URBAN GreenUP

D5.7: Data Collection Procedures (Interim I)

WP 5 , T 5.4

01.05.2021

May, September* 2021 *(M47)

Authors: DEM, CAR, GMV, VAL, LIV, IZM, BIT

URBAN GreenUP

SCC-02-2016-2017

Innovation Action – GRANT AGREEMENT No. 730426

Technical References

Project Acronym	**URBAN GreenUP**
Project Title	New Strategy for Re-Naturing Cities through Nature-Based Solutions – URBAN GreenUP
Project Coordinator	Raùl Sànchez Fundación Cartif rausan@cartif.es
Project Duration	1 June 2017 – 31 May 2022 (60 Months)

Deliverable No.	D5.7
Dissemination Level	CO[1]
Work Package	WP 5 –
Task	T 5.4 – Data collection and ICT platforms implementation supervision
Lead beneficiary	11 (DEM)
Contributing beneficiary(ies)	1(CAR), 2(VAL), 3(ACC), 6(CHD), 7(LIV), 8(CFT), 10(IZM), 11(DEM), 12(EGE), 13(IZT), 21(MAN), 22(LUD), 23(MED), 24(BIN)
Due date of deliverable	30 September 2020
Actual submission date	18 May 21

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

Version	Person	Partner	Date
V0.1	Kaan Emir	DEM	August 2020
V0.2	Clare Olver	CFT	September 2020
V0.2	Sarah Clement	UOL	September 2020
V0.3	Kaan Emir	DEMIR	September 2020
V1	Jesús Ortuño	GMV	16 Feb. 2021
V2	Kaan Emir	DEMIR	17 Feb. 2021
V3	Jesús Ortuño	GMV	18 Feb. 2021
V3.1	Clare Olver	CFT	21 Feb 2021
V3.2	Sarah Clement	UOL	28 Feb 2021
V3.3	Stella Shackel	CFT	01 March 2021
V3.4	Şerif Hepcan, Çiğdem Coşkun Hepcan, Merve Ozeren Alkan	EGE Landscape	01 March 2021
V3.5	Yusuf Kurucu, Tolga Esetlili, Hüsnü Kayıkçıoğlu	EGE Soil	01 March 2021
V3.6	Gülden Gökçen Akkurt, Gülşah Kaçmaz, Koray Velibeyoğlu	IZT, EGE	01 March 2021
V3.7	Ali Serdar Atalay	BIT	01 March 2021
V4	Kaan Emir	DEM	02 March 2021
V4.1	Jesús Ortuño	GMV	09 March 2021
V5	Kaan Emir	DEM	10 March 2021
V5.1	Juliet Staples,	LCC	11 March 2021
V5.2	Stella Shackel	CFT	12 March 2021
V5.3	Sarah Clement	UOL	13 March 2021
V5.4	Kaan Emir	DEM	16 March 2021
V6	Jesús Ortuño	GMV	5 May 2021
V7	Kaan Emir	DEM	18 May 2021

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Scope of the deliverable

In Task 5.4 Data collection protocols, this is the main task where the monitoring results are to be collected. This deliverable was scheduled once the project started. This task had attached just one deliverable to be submitted at the end of the project. This new document will serve to provide information, which describes the procedures and protocols that will be used for data collection.

Under this task the partner in charge (with the required help from the rest of the participants on the task) shall remotely supervise the raw data collection and ICT platforms, when applicable, as each city as different tools to be used. For example in the case of Valladolid Demo, the GMV-APP or the Izmir data portal. Implementation for each city to ensure compliance with the given high level guidelines and established schedule on previous documents, as D5.2.

The focus of data collection will be on collecting the right data at agreed time frequencies. The main challenge for this task is to establish procedures that could be incorporated to systems and to raise an alarm in both city demo, WP Managers and the Project Coordinator so that immediate recovery actions must be implemented and supported through monthly discussions and updates if required.

2 Data Collection Protocol

2.1 Data Collection structure

The idea envisioned and decided during the 5th Valladolid's Progress Meeting, by all partners' participants and demo cities, was to follow a Data collection Structure as outlined in Figure 2.1. and Figure 2.2.

Under this structure, each city must take responsibility for their local data storage and data collection. The aim with this is to be able to continue if not all, most of the procedures after the lifespan of the project. That's why it was envisioned this way. In order to have a common place for the project storage, each city is in charge to upload to the global repository the data. This has been very carefully though through. Appling the Ockham's razor principles the approach is simple: Through a manual drag and drop procedure, each city-partner will upload the data to a shared global repository, NextCloud. NextCloud will be linked to the Project Public Website and the already calculated data will be open, accessible for further exploitation.

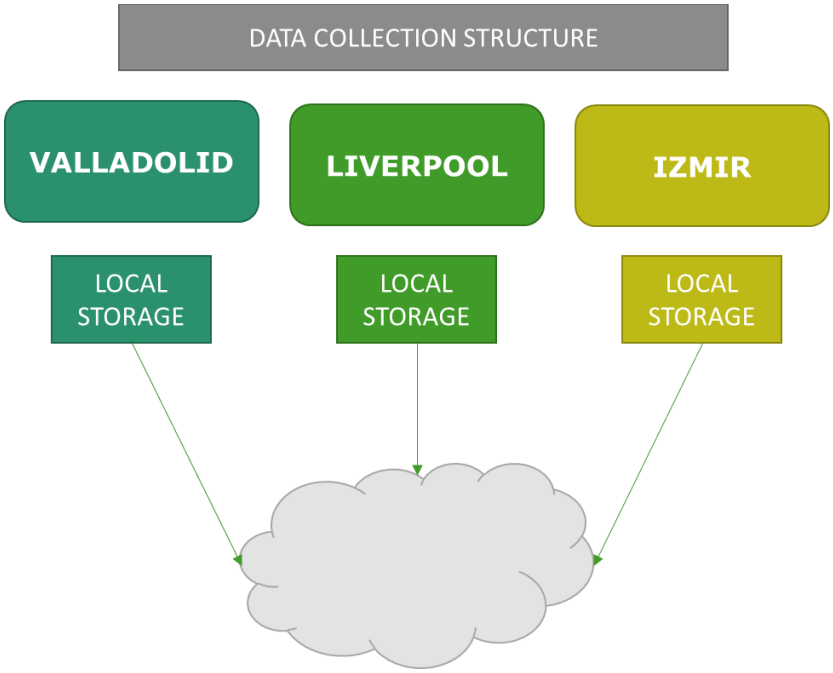


Figure 2.1: Data collection structure visual

There is a higher goal where make this data accessible through EU Data Portal was consider, but it will need further research and resource estimation, due to certain specification of the portal. In order to perform the final connection to the EU Data Portal there will be a need for an API that serves the data to the EU-DataPortal. This will be similar to systems being implemented by other sister projects. .

After discussion and involvement on NBS Task Forces, the use of the tool CKAN was firstly envisioned to solve the technical challenges spotted by the consortium. The first tool selected to comply with UrbanGreenUP requirements on openness and scalability was Ckan.org because

this is open, easily scalable and fits the main purpose. CKAN provides a streamlined way to make the data discoverable and presentable. It provides data store extension and has advanced geospatial features covering data preview, as well as search and discovery. Where structured data with location information is loaded into CKAN's DataStore, CKAN can plot the data on an interactive map. With the spatial extension[2] enabled, CKAN can understand a location associated with a dataset, and use this to offer geospatial search capabilities via the web interface and API. A user searching for datasets can filter the results by geographical location, specifying a bounding box to limit the area they are interested in. CKAN understands different co-ordinate geometries and parses location information accordingly. CKAN includes tools to import geo-coded metadata in a number of formats and make it by queries (making it 'discoverable') according to the INSPIRE standard.

It can import major metadata schemas such as ISO19139, GEMINI 2.1 and FGDC can handle records hosted in a variety of ways, including the geospatial CSW standard, WAFs, ArcGIS portals, Geoportal Servers and Z39.50 databases. CKAN can also serve geospatial packages via its own CSW interface. The architecture is extensible, making it easy to support other standards and distribution services. CKAN's data previewing tool has a host of powerful features for previewing data stored in the Data Store.

Table view: If structured data is uploaded or linked to CKAN as a .csv or Excel table, the DataStore loads it into a database, allowing CKAN to give a range of ways to view and process the data. Initially it is displayed as a table. The user can sort the data on particular columns, filter or facet by values, or hide columns entirely.
Graphing data: You can also display the data on a graph, choosing the variables on the axes and comparing a number of variables by graphing them together on the same y-axis.
Mapping data: If the table has columns that CKAN recognises as latitude and longitude, it can plot the data points on a map, which can be panned (dragged) and zoomed. Selecting a data point displays all the field values in the corresponding row.
Image data: CKAN's previewing is not restricted to tabular data. Common image formats will be displayed, and if a resource is a web page, it will also be previewed directly in the CKAN dataset

CKAN supports the [DCAT standard][3] for data catalogue metadata, so data can also be federated from other non-CKAN catalogues.

This plan was agreed following ambiguity on the proposal and taking into account the risk of otherwise missing the key parts on the Data Management Plan where there wasn't clear responsibility on data storage. But, it had complications during the application of the procedures. The technology proposed needed special resources, especially in the cities, where the technology wasn't known nor were envisioned to spend extra HR on this part, even though there was willingness to cooperate and find the most effective solution. Also Ckan.org can't be added from the Cloud to the EU-DataPortal because the portal only allows API's coming from public entities per se. Therefore if we aim to use Ckan.org to point to the EU-DataPortal must

[2] https://github.com/ckan/ckanext-spatial

[3] https://github.com/ckan/ckanext-dcat

come from each of the cities, and that is not feasible. That's why we needed an additional solution because the graph shown in the figure below (Figure 2.2) missed the last connection.

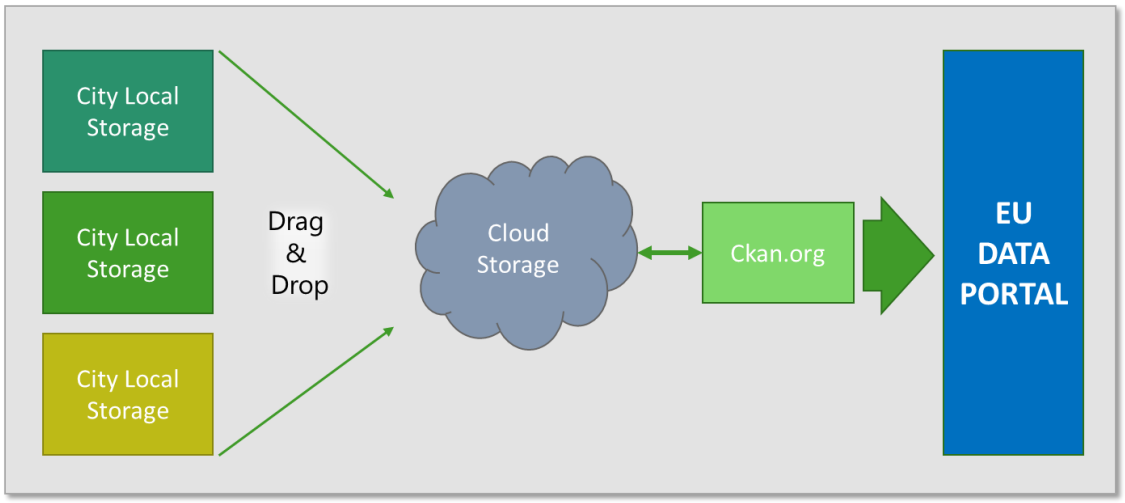


Figure 2.2: Data collection structure visual

To comply with the milestone regarding both openness and scalability of the data produced during the monitoring of each city, it was proposed in the working package on monitoring (WP5), as our aim to coordinate monitoring in each city in order to have the most accurately and homogenous procedures for the URBANGreenUP project, to use existing tools already in use within the project. In that sense, we will take the must benefits from each of the technologies already known and enhance the capabilities on sustainability and replicability, after the project ended.

This led to the idea on using use NextCloud, which is a Cloud Service that UrbanGreenUP is currently using and perfectly matches with the approach sought here. NextCloud will allow the partners to use a friendly interface (Drag&Drop based) that they are already aware of. It allows formats (Section 2.1.2) as .CSV, .PDF, .SHP and potentially others as .Tiff and much more.

NextCloud will provide for the monitoring data a total sum of 200GB for the whole repository. So far our figures in terms of GBs are below that amount and the 200GB must be enough for the calculated data and results from the monitoring, estimated in half that number.

With the NextCloud repository we will comply with the openness and accessibility by creating a public folder that will be linked to the UrbanGreenUP website. The writing rights for this folder will be limited. Only a limited number of persons will be able to upload data. By the use of the NextCloud client on a computer and synchronising the folder with the global repository from there.

Leaving room for enhancing and further developments. A WebDAV API could be develop if requested. The repository offers and API (namely WebDAV). This could include other APIs but at this stage is not consider.

The repository will be keep online and serving the results and monitoring data as long as the website of the project is or as long it is needed to be.

2.2 Data Storage structure

2.2.1 Detailed explanation of supervision data sheet

The leader and responsible of Task 5.4, DEMIR produced a Data Sheet for supervision, in order to follow closely and obtain information on the data collection frequency, responsibilities, formats and key information in order to being able to control the process. It was distributed among partners and is being use periodically to acquire information on each indicator calculation method performance.

2.2.2 Data Format

The rationale followed on the choice for all data formats has been about both versatility and compatibility. Having in mind the variety of indicators calculated by different partners and the opportunity to use a variety of recording formats the main challenge was to identify the most common indicators that matched our final goal, of being both scalable and open to a broad public.

In that sense the preference for .csv type files has been strong, due to the versatility and indicators' requirements. Nevertheless, there will be some indicators that could be storede and saved into a spatial format that can be shapefile (.shp) for spatial vector data or TIFF for raster imagery. As well as that GeoJSON format could also be used if needed, it was consider due to its compatibility. Also, reports will continue to be delivered in a .PDF format for some of the KPIs that need further explanation as for example social indicators.

2.2.3 Data Folder Structure

There will be a folder named:

URBANGreenUP

Inside the folder must be one per city:

URBANGreenUP/VAL

URBANGreenUP/LIV

URBANGreenUP/IZM

Inside each city folder should be an .xlsm document (spreadsheet file) showing information on owner or responsible for the KPI, overall status of the indicator, details on the indicator, and start and last collection frecuency or measurement data.

URBANGreenUP/City/City_Template_Final.xlsm

Inside each city folder must be a folder per KPI. Named after the code of the KPI. *URBANGreenUP /City/KPI-<Number>/*

For example:

URBANGreenUP/VAL/CH0402

In each KPI folder should be a Metadata file in .XML format. *URBANGreenUP /City/KPI-<Number>/Readme.Metadata*

For example:

URBANGreenUP/VAL/CH0402/ CH0402-Metadata.XML

If there is different time frequencies a folder on the time could be added:

URBANGreenUP /City/KPI-<Number>/YYYY-MM-DD/

Same with different formats deliveries

URBANGreenUP /City/KPI-<Number>/PNG

URBANGreenUP /City/KPI-<Number>/PDF

If the is only one file containing the already calculated indicator, the path should be the root of the KPI-<Number> for example:

URBANGreenUP /VAL/CH0402

2.2.4 Metadata file information

Title
Name of the dataset

Creator (Owner/responsible partner of KPI)
Name of the organization or people who created the data

Identifier
Number used to identify the data, even if it is just an internal project reference number

Dates
Key dates associated with the data, including KPI measurement start, end date, data modification data release date, and time period covered by the data

Subject
Keywords or phrases describing the subject or content of the data

Rights
Any known intellectual property rights held for the data, if applicable.

Language
Language(s) of the intellectual content of the resource, when applicable

Location
Where the data relates to a physical location, record information about its spatial coverage, Sensor number etc.

File Types, Data Formats used in the data sets

This will include descriptions of all file types and data formats contents of csv files, if any. For example, simple folders may include, QGIS project files in XML format (.qgz), data files (.csv), KMZ files (.kmz), shp files ESRI shape file format and. json based Questionnaire files. It is also important to show the location of the KPI results. This can be in one of the existing input files (such as .csv) or may be within new output files. The first row in the csv headers is expected to include columns representing the data format of the measurements

Instruments used

Standards/calibrations used

Environmental conditions

Units of measure

Precision/accuracy

Software, data processing

Date last modified.

2.2.5 Metadata format checker

It was distributed by GMV a Metadata format checker in order to be sure that the metadata is being well written and as a procedure to double check (automatically) the information generated in a high level approach.

The metadata checker, shown in Figure 2.3. was created in order to see if all the fields were in place for each KPI. Some indicators may not require completion of all the fields and some additional metadata fields may be required in the following months to accommodate feedback from the partners involved.

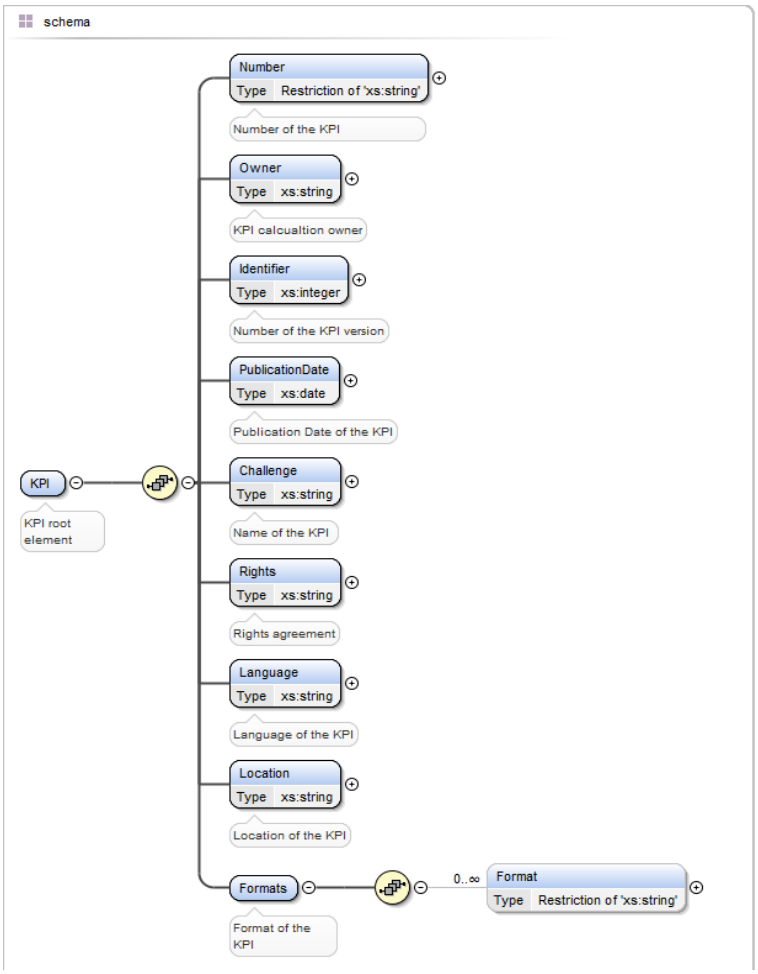


Figure 2.3: Metadata template structure

2.2.6 Data format checker

For further quality check control BITNET will develop a simple Data Format Checker python based code that could be supplied and run periodically with or without Jenkins to check that the format of the data supplied is consistent with metadata and is also of good quality. This can be used locally by the cities admins and the global data management admin team.

Cities global data will be validated against the metadata rules and if there are some errors or the fields are empty or corrupted, the City data admin owner will be notified for revision.

2.3 Roles and Responsibilities

1. Izmir Local Data Admin (BitNet)

BitNet for Izmir will handle the responsibility of periodically collecting and administrating the data. Data will be pulled in via a web portal interface and all the process will be managed by devops processes. All data will be managed at a dual server with redundant raid operations. All data will be backed up incrementally. The current capacity of Local storage will be 1TB allowing enough redundancy. Also there will be 4 TB Net space for backup in NAS devices. There will be secure authenticated access pull in and push data interface.

BitNet will also be responsible for delivering data periodically to the global cloud. This will be handled by an additional server and network out of business hours to avoid additional loading to user access by local teams.

There will be .py script that will check the provided data against metadata requirements. This will be checked automatically and will validate the provided data if/when the processed data fulfils the set requirements.

2. Valladolid Local Data Admin

The responsibility and the role of Valladolid Local Data admin shall be to securely store the data and 'drag and drop' the data to the global repository in the established timeframe.

Valladolid city council uses a suite of client-server software that serves the purpose of using file hosting services and functions as other widely known cloud applications services. In the case of Valladolid city the suite is ownCloud. It is an open-source server with editing capabilities that allows anyone installing and operating it to use it without making changes on their own private server. In that sense it matches the main challenges that city local data must face which is to first store and protect the data, as well as being able to, eventually, have the capability to upscale and perform further uses with the data.

The capacity of the Local Storage is set by default on 10GB, with the possibility of expansion if needed. So far, that need hasn't been required. Less than 10GB of data was being used for storage by February 2021. It is estimated that more storage will be needed, and the request has already been made to ensure there will be sufficient to continue the established roadmap of data production.

3. Liverpool Local Data Admin

The responsibility for local data admin in Liverpool will be split between the partners. Mersey Forest will provide digital data storage space (unlimited) on a shared site (ShareFile) to which all partners have controlled access and can upload and store collected data in agreed formats.

In Liverpool the role of the Local Data admin is to ensure that the data is securely stored and periodically at an agreed time uploaded to the global repository.

The data across Liverpool is stored locally in the. Mersey Forest ShareFile. This is a secure cloud-based storage system with unlimited storage. It is also backed up to the Research Data Store at the University of Liverpool, with a capacity of 1 TB. These data stores are password protected, comply with the GDPR, and can only be accessed by those directly associated with the project. There is more than enough capacity for all project data to be stored to these sites.

In line with ethical approval conditions, only aggregated social and economic data is backed up to shared files during the project to protect the anonymity of respondents. Once data collection is complete, all socio-economic data will be anonymised, aggregated and uploaded to shared drives for sharing with project partners. This data will be reviewed by all partners (UOL, LCC, and CFT) to ensure it does not compromise confidentiality requirements.

Data will be uploaded by identified project partners at agreed intervals for each KPI. Checks on uploaded data will be made by the LCC Project Officer (or another identified project partner) who will have responsibility to drag and drop the data in the global repository in the established time frame.

4. City Data Format Checker code (City Admins)

Each city is responsible for the indicator therefore the quality of them. Nevertheless as the tool to be developed and distributed by BitNet (Exposed in Section 2.2.6) is not mandatory but recommended each partner and city with responsibilities on indicators should at least know the tool and include in their quality control procedures. Same applies for the metadata checker (Exposed in Section 2.2.5).

5. Temp. Global Data Structure Owner

In Valladolid demo city there are nine different partners providing data to calculate the KPI, during the time that Valladolid city council was preparing its own data storage, it was proposed to test the established procedure on a temporal data storage, and at the same time, monitor the performance of the indicators in order to being able to detect any deviations,.

As leader of the WP and partner involved on the coordination of the monitoring for Valladolid demo, GMV provided a cloud storage service, GMVDrive, to test the procedures.

GMV provided access to a project folder in GMVDrive where each of the partners could upload, edit and download data. A specification sheet was provided as well as a KPI metadata template (see next section).

As the functions are widely and commonly spread (drag & drop) partners should quickly get used to the service. As the same time as monitoring the production of data, the test will also provide a good approach to estimating all the project data storage needs for the demo city.

Following the test, the Valladolid Data Storage will be migrated, u following the same folder structure, and same procedures to lessen the impact of the change of platform.

For the metadata, partners started checking data examples provided, and actual data. Partners started filling information on each KPI accordingly to their responsibilities. It happened that for

the Indicators partners don't have to complete a certain field, because is not applicable for them. Following this test we were able to spot current mistakes and FAQs that will help polishing the procedures exposed above.

Now, the migration to the Valladolid City OwnCloud is being performed and GMVDrive will be abandoned. The structure will match the described before but it was worth to include this procedure followed.

6. Global Repository (NextCloud)

For the Global Repository the Key Partner will be ICONs they provide the repository for the project and have the communication channel with the IT service. But, each city partner must have a designated person to drag and drop and update the indicators in the folder, as explained before.

In the following sections we will explore the responsibilities per partner and indicator.

2.3.1 Valladolid

2.3.1.1 Roles & resp.

The calculation of the KPIs is assumed by the entity with the best expertise among the partners of the Valladolid Demo. The following table contains the KPIs of Valladolid associated with the entity that calculates, where the reason for that expertise is included. Note that we have differentiated the entity responsible for the calculation (*Leader calculation*) from the entity providing the data (*Data provider/measure*).

Expertise	Challenge	Type	Code	KPI (D5.5)	Leader calculation	Data provider / measure
[CAR] CARTIF Technology Center						
[CAR] Technology center with expertise on Climate change	CHALLENGE 1: Climate mitigation & adaptation	Carbon savings Carbon storage	CH0101	Ton C02 CARBON REMOVED per Ha	CAR	VAL
			CH0102	Ton C02 CARBON REMOVED per year	CAR	VAL
		Temperature reduction	CH0105	TEMPERATURE DECREASE	CAR	CAR
			CH0108	HEATWAVE RISK	CAR	CAR
	CHALLENGE 2	Physical	CH0207	TEMPERATURE REDUCTION	CAR	VAL
[CAR] Technology center with expertise on Spatial planning and GIS	CHALLENGE 4: Green Space Management	Social indicators (benefits)	CH0401	GREEN SPACE DISTRIBUTION (m2/capita)	CAR	VAL
			CH0402	GREEN SPACE DISTRIBUTION (km cycle lane/capi	CAR	VAL
			CH0403	GREEN SPACE ACCESSIBILITY	CAR	VAL
			CH0408	GREEN INFRASTRUCTURE CONNECTIVITY	CAR	VAL
	CH9: Public Health and	Health indicators	CH0902	WALKING AREA INCREASE	CAR	VAL/GMV
			CH0903	CYCLING AREA INCREASE	CAR	VAL/GMV
[CAR] Expertise on Biodiversity	CHALLENGE 4	Biological	CH0412	POLLINATOR SPECIES INCREASE	CAR	CAR
[CAR] Expert on Air pollution	CHALLENGE 5: Air Quality	Social (physiological)	CH0509	AIR QUALITY PARAMETERS NO2	CAR	CAR
			CH0510	AIR QUALITY PARAMETERS O3	CAR	CAR
			CH0511	AIR QUALITY PARAMETERS PM	CAR	CAR
[CAR] Expert on Sustainability and NBS	CHALLENGE 8	Social justice	CH0801	CRIME REDUCTION	CAR	VAL
	CHALLENGE 9	Psychological	CH0901	NOISE REDUCTION	CAR/SGR	VAL
[LEI] LEITAT Technology Center						
[LEI] Technology center with expertise on Energy efficiency	CH7: Participatory Planning and	Economic	CH0109	ENERGY SAVINGS FROM REDUCED BUILDING ENE	LEI	VAL
			CH0110	CARBON SAVINGS FROM REDUCED BUILDING ENE	LEI	VAL
	CH6: Urban Regeneration	Economic	CH0603	ENERGY SAVINGS RELATED TO GREEN INFRASTRUCTURE	LEI	VAL/LEI
[LEI] Expertise on Waste water treatment systems	CHALLENGE 2: Water Management	Chemical indicators (water quality)	CH0211	NUTRIENT ABATEMENT (COD)	LEI	VAL
			CH0212	NUTRIENT ABATEMENT (BOD)	LEI	VAL
			CH0213	NUTRIENT ABATEMENT (Total Solids, SST)	LEI	VAL
[CEN] CENTA, Technology Center						
[CEN] Technology center with expertise on Sustainable Water Management.	CHALLENGE 2: Water Management	Physical indicators	CH0201	RUN-OFF COEFFICIENT	CEN	VAL
			CH0204	ABSORPTION CAPACITY (m3/m2)	CEN	VAL
			CH0205	ABSORPTION CAPACITY (m3/tree)	CEN	VAL
		Economic	CH0216	IRRIGATION WATER PROVISION	CEN	VAL
			CH0217	WATER REMOVED FROM THE WATER TREATMENT	CEN	VAL
			CH0218	SAVINGS IN TREATMENT OF STORMWATER	CEN	VAL
		Spatial	CH0208	INTERCEPTED RAINFALL	CEN	VAL

[VAL] Valladolid City Council						
[VAL] Local Entity that analyses the citizen's response.	CHALLENGE 6: Urban Regeneration	Socio-cultural	CH0602	BENEFITS FROM INTERVENTIONS	VAL	VAL
	CHALLENGE 7: Participatory Planning and	Social	CH0701	OPENNESS	VAL	VAL
			CH0704	CITIZEN PERCEPTION	VAL	GMV
	CHALLENGE 4: Green Space Management	Social indicators (benefits)	CH0406	RECREATIONAL VALUE	VAL	GMV
			CH0410	GREEN AREAS SUSTAINABILITY	VAL	GMV
[VAL] Manage municipal orchards			CH0411	FOOD PRODUCTION	VAL	VAL
[VAL] Local Entity in charge of local communication	CHALLENGE 8: Social Justice and Social Cohesion	Social cohesion	CH0802	GREEN INTELLIGENCE AWARENESS (Educational actions)	VAL	VAL
			CH0803	GREEN INTELLIGENCE AWARENESS (Communication activities)	VAL	VAL/GMV

[GMV-S] GMV, SA (company)						
[GMV-S] IT private company that programes the Mobile App	CH4: Green Space Management	Social indicators (benefits)	CH0407	ELDERLY PEOPLE LIFE QUALITY	GMV	GMV
			CH0409	CONNECTIVITY PERCEPTION	GMV	GMV

[ACC] Acciona Ingeniería, SA (company)						
[ACC] Private company with expertise on economic analysis.	CHALLENGE 5	Economic	CH0508	AIR QUALITY MONETARY VALUES	ACC	VAL
	CH10: Potential of economic opportunities and green jobs	Economic	CH1001	TAX REDUCTION	ACC	VAL
			CH1002	SUBSIDIES	ACC	VAL
			CH1003	JOB CREATION	ACC	VAL
			CH1005	NEW BUSINESSES	ACC	VAL
			CH1006	CONSUMPTION BENEFITS	ACC	VAL

Table 2.1: Leaders and expertise of the calculation of Valladolid Demo KPIs

2.3.1.2 Future plans

As mention above. In Valladolid a first version of the data storage is stored in GMV's cloud, as responsible for the monitoring of WP2 and WP5. Once it is up and running, and the technical requirements have been determined, the information will be migrated to Valladolid City Council's cloud (Valladolid's OwnCloud portal). This migration process as already started and will be done before September 2021.

During the duration of the European project, the partners responsible for the calculation of each KPI will upload the result to the cloud (GMV's or City Council). Once the project finishes, it is difficult for the partners to continue this manual work, due to lack of personnel attached to the EU project. However, the storage system will continue to operate with the automatic capture data. We are proposing and preparing the ground to ease every possible procedure to be continued after the project, focusing mainly in the usedness of it.

2.3.2 Liverpool

2.3.2.1 Roles & resp.

The data collection and analysis of the KPIs within Liverpool has been undertaken by the organisation with the appropriate expertise among the partners. It should be noted that the majority of the environmental monitoring outlined in the research proposal was planned to be undertaken by a PhD candidate at the University of Liverpool, however following their departure, the biophysical KPIs as well as a few others were picked up by Community Forest Trust. The University of Liverpool, in collaboration with the University of Manchester, have

focused on the socio-economic KPIs and have financially supported the biophysical monitoring and analysis in a number of ways as well as developing postgraduate research projects to support the project and explore these KPIs in new ways.

The following tables show the lead partners for the different KPIs within Liverpool.

CHALLENGES	TYPE OF INDICATORS	CODE	KPI NAME	Lead
CHALLENGE 1: Climate mitigation & adaptation	**Carbon savings per unit area**	**CH0103**	CARBON STORED	CFT with LJMU
		CH0104	CARBON SEQUESTRATION	CFT with LJMU
	Temperature reduction (environmental, physical)	**CH0105**	TEMPERATURE DECREASE	CFT
		CH0106	TEMPERATURE REDUCTION (PROJECTION)	CFT with LJMU
		CH0108	HEATWAVE RISK	CFT with LJMU
	Other	**CH0111**	SPECIES MOVEMENT	CFT with LJMU
CHALLENGE 2: Water Management	**Physical indicators**	**CH0201**	RUN-OFF COEFFICIENT	CFT
		CH0206	WATER SLOWED DOWN FROM SEWER SYSTEM	CFT
	Chemical indicators (water quality)	**CH0211**	NUTRIENT ABATEMENT (COD)	CFT
		CH0212	NUTRIENT ABATEMENT (BOD)	not monitored
		CH0213	NUTRIENT ABATEMENT (SST)	CFT
	Chemical indicators (water quality)	**CH0217**	WATER REMOVED FROM THE WATER TREATMENT	CFT with LJMU
		CH0218	SAVINGS IN TREATMENT OF STORMWATER	CFT with LJMU
CHALLENGE 4: Green Space Management	**Social indicators (benefits)**	**CH0403**	GREEN SPACE ACCESSIBILITY	UOL/UOM
		CH0408	GREEN INFRASTRUCTURE CONNECTIVITY	UOL/UOM with CFT
	Environmental (biological)	**CH0412**	POLLINATOR SPECIES INCREASE	CFT
		CH0413	FLORAL RESOURCES INCREASE	CFT
		CH0414	PLANT SPECIES INCREASE	CFT
		CH0415	INSECTIVORE INCREASE	CFT
CHALLENGE 5: Air Quality	**Social (physiological)**	**CH0501**	DEATHS RELATED TO POLLUTION AND CONTAMINATION	CFT
		CH0502	ANNUAL MEAN LEVELS OF FINE PM2.5 PARTICULES	CFT and LCC

CHALLENGES	TYPE OF INDICATORS	CODE	KPI NAME	Lead
		CH0503	ANNUAL MEAN LEVELS OF FINE PM10 PARTICULES	CFT and LCC
		CH0504	NOx TRENDS	CFT and LCC
		CH0505	Sox TRENDS	Stopped
		CH0506	VOC TRENDS	not monitored
	Economic	**CH0513**	Run-off mitigation	CFT with LJMU
		CH0514	Energy savings	CFT with LJMU
		CH0515	Increase in property value	UOL/UOM
		CH0516	GI val to calculate the value of air quality improvements	CFT with LJMU
		CH0517	Value of air pollution reduction	CFT with LJMU
		CH0518	Total monetary value of urban forests including air quality	CFT with LJMU
CHALLENGE 6:	**Socio-cultural indicators**	**CH0602**	Green Space Diversity (includes functionality)	UOL/UOM
CHALLENGE 7: Participatory Planning and Governance	**Social**	**CH0703**	Social learning	UOL/UOM
		CH0704	Citizen perception	UOL/UOM
		CH0707	Engagement with NBS	UOL/UOM
CHALLENGE 8: Social Justice and Social Cohesion	**Social justice**	**CH0801**	Crime reduction	UOL with LCC
CHALLENGE 9: Public Health and Well-being	Health indicators related to ecosystem service provision (Buffering of noise and air pollution, reduced heat, exposure to microflora).	**CH0902**	Walking area increase	UOL/UOM with LCC
		CH0903	Cycling area increase	UOL/UOM with LCC
		CH0904	Health quality perception	UOL/UOM
Potential of economic opportunities and green jobs	**Economic**	**CH1003**	Job creation	UOL/UOM
		CH1004	Land and property price change	UOL/UOM
		CH1005	New businesses	UOL/UOM
		CH1007	Job creation	UOL/UOM

2.3.2.2 Future plans

Monitoring for the biophysical indicators will be terminated shortly before the end of the project to allow time for data analyses and reporting.

Most of the monitoring for the social and economic indicators will be complete by the end of May 2021, at which point funding for staff who are undertaking the monitoring ceases. Additional research will be undertaken by dissertation students; however, most of this time will be needed to complete the analysis of data and drafting of publications.

Options exist to supplement data beyond the end of the project via potential future dissertation and research projects associated with ongoing monitoring of URBAN Green UP legacies and demonstrator initiatives. At the time of this report, 6 additional research students are developing projects that will contribute to monitoring, on top of the 14 other dissertations and 1 other thesis that has monitored these aspects. Most of this monitoring is focused on the socio-economic, policy, and planning aspects, although a few of these dissertations work with biophysical data.

2.3.3 Izmir

2.3.3.1 Roles & resp.

DB_Code	KPI	Owner
CH0101	Ton C02 CARBON REMOVED per Ha	EGE Landscape
CH0102	Ton C02 CARBON REMOVED per year	EGE Landscape
CH0103	CARBON STORED by soil	EGE Soil
CH0103	CARBON STORED by vegetation	EGE Landscape
CH0104	CARBON SEQUESTRATION by vegatation	EGE Landscape
CH0105	TEMPERATURE DECREASE	IZT+EGE Landscape
CH0106	TEMPERATURE REDUCTION (PROJECTION)	IZT+EGE Landscape
CH107	HUMAN COMFORT	IZT+EGE Landscape
CH0108	HEATWAVE RISK	IZT+EGE Landscape
CH0109	kWh savings per year	IZT+EGE Landscape
CH0110	t C/y savings per year	IZT+EGE Landscape
CH0113	Global Warming Potential (GWP; 100-year horizon)	EGE Soil
CH0219	RUNOFF ESTIMATION OF BIOSWALES IN BIOBOULEVARD	EGE Landscape
CH0403	GREEN SPACE ACCESSIBILITY	IZT
CH0406	RECREATIONAL VALUE	IZT
CH0408	GREEN INFRASTRUCTURE CONNECTIVITY	EGE Landscape
CH0411	FOOD PRODUCTION	EGE Soil
CH0412	POLLINATOR SPECIES INCREASE	EGE Landscape
CH0502	ANNUAL MEAN LEVELS OF FINE PM2.5 PARTICULES	IZT+EGE Landscape
CH0503	ANNUAL MEAN LEVELS OF FINE PM10 PARTICULES	IZT+EGE Landscape
CH0504	NOx TRENDS	IZT+EGE Landscape
CH0505	Sox TRENDS	IZT+EGE Landscape
CH0508	POLLUTANT REMOVED BY VEGETATION	EGE Landscape
CH0601	GREEN SPACE QUANTITY	IZT
CH0705	URBAN FARMING ACTIVITIES - Energy saving kWh	EGE Soil
CH0705	URBAN FARMING ACTIVITIES - water saving(m3/ha/year)	EGE Soil
CH0802	GREEN INTELLIGENCE AWARENESS (EDUCATIONAL ACTIONS)	IZT
CH0803	GREEN INTELLIGENCE AWARENESS (INHAB. ATTENDED)	IZT
CH0902	WALKING AREA INCREASE	IZT
CH0903	CYCLING AREA INCREASE	IZT
CH1003	JOB CREATION	IZT

2.3.3.2 Future plans

EGE University Landscape Team is responsible for monitoring of a couple of KPIs related to removal of air pollutants and carbon storage by trees (CH0101/CH0102, CH0103 CH0508 - Ton C02 CARBON REMOVED per Ha/Ton C02 CARBON REMOVED per year and CARBON STORED by vegetation and POLLUTANT REMOVED BY VEGETATION.

In the process of calculating the amount of removal of air pollutants and carbon stored by vegetation, the monitoring has already started in Peynircioğlu stream. We have been collecting data. In other words, we have been measuring and documenting the trees one by one in the

area to be able to quantify the amount of carbon stored and sequestered as well as pollutants removed at the end of the process using I-Tree Eco software. Measuring trees one by one is an intensive work and takes quite sometime.

The following data is collected and recorded; name of the tree species, DBH (diameter breast height), total tree height, height to crown base, crown width and percent tree missing. When we are done with the area, we will be calculating the parklets for the same purpose. More than 1200 trees are supposed to be measured and documented. This is the first period or year of monitoring. These measurements will be repeated for the second year. Thus, there will be a two-year monitoring data by the end of the project. No barrier or challenge has been foreseen for above mentioned KPIs in the process of collecting data and measuring trees in the future as long as vegetation in demo sites is not dead or destroyed.

Once URBAN GreenUP is finished, it is not easy to keep monitoring or collecting data. However, EGE Landscape Team is committed to make a final measurement in order to have the data of trees when they reach their maximum crown size and height because trees will have maximum capacity of pollutants removal and carbon storage as long as plants are healthy (not dead or destroyed) and keep growing overtime.

Another KPI (CH0412- POLLINATOR SPECIES INCREASE) that EGE Landscape Team is responsible for is to observe and count pollinating species in two different locations; Peynircioğlu stream and Sasali Bio-boulevard (If the general construction and planting end by May 2021 in Sasali). The monitoring process has not started yet and is beginning in mid-spring of 2021 because most of the pollinators will be more active and most of the pollinator friendly plants will be fully blossomed in springtime. This process will be repeated in the spring of 2022. Finally there will be a two-year of monitoring data by the end of the project so as evaluate if there is an increase in number of pollinator species.

EGE Landscape Team is dealing with CH0408- GREEN INFRASTRUCTURE CONNECTIVITY. The baseline values were calculated using some landscape metrics (Connect etc.) between Peynircioğlu stream and Sasalı wild life park. However, the proposed 10 km green corridor has not been implemented in this route to establish a connectivity. Therefore, the KPI “green infrastructure connectivity” seems not possible to quantify at the moment in the case of İzmir. There are still thousands of trees to be planted by the end of the project. Thus, if there is a chance to create a green corridor with these plants, measuring green infrastructure connectivity might be possible.

RUNOFF ESTIMATION OF BIOSWALES IN BIOBOULEVARD is one another KPI that that Ege Landscape Team is responsible. In this KPI, it is aimed to calculate the runoff holding capacity of bioswales in the Sasali Bio-boulevard. The baseline calculation has been completed within the scope of this KPI, and the runoff holding capacity will be calculated for the post-development situation after the construction in the area is completed It should be noted that the measurements are made at the desk by means of software, not on the field.

In Izmir, CH0105-Temperature Reduction and CH0107- Human Comfort KPIs have been studied under the main title of climate adaptation and mitigation. Air temperature, relative humidity and wind velocity measurements are planned to be performed at various radius-sampling points

from NBS locations before and after the intervention in the monitoring process. Measurements are made as planned in the Vilayetler Evi parking lot, one of the demo sites. For instance, air temperature and relative humidity values were measured and recorded for baseline in 2019 by using mobile devices. After that, first measurements of the monitoring have been executed in 2020 for the same site with mobile device. Moreover, a fixed meteorological station was established in the parking lot of provinces house and started measuring and recording to support the mobile measurements. Measurements will be repeated 2 times over the next two years to be having a two-year database to compare baseline values. Also, based on the measurements, simulations of the current situation and when the plants were fully grown after about 10 years were made using the Envi-met program.

Furthermore, thermal-imaging cameras has been used in application areas (demo sites) to capture surface temperatures before and after intervention. In this context, the work is carried out as planned and will be doing so in the monitoring process. For instance, first measurements were made in summer of 2019 for the baseline values. After that, first recordings of monitoring were executed in 2020. The monitoring will be repeated in 2021.

In Girne Street around the parklets, thermal imaging cameras and mobile devices have been employed to capture surface temperatures hoping that parklet can influence thermal comfort and create cool spots. That would be a test to see if the parklets are effecting surface temperatures and creating cool spots.

Thermal comfort calculations in demo sites are carried out as planned.

Air quality measurements have not started yet. It is planned to give start in summer 2021 by portable devise.

For the actions;

a) Smart soil production in climate-smart urban farming precinct
b) Development of Smart soil from mud plant

The field experiments started on the date of 19.12.2020 for the subtask b in the Menemen Research, Application and Production Farm of Agriculture Faculty of EGE University and on the date of 11.01.2021 for the subtask a in the Sasalı region. No monitoring activity is envisaged in these tasks since there were conducted control plots in the field experiment, which will give us the baseline information of the experimental soils.

In the sewage sludge experiment (subtask b), the soil samples were taken 15 days after the organic materials were incorporated into the experimental soil in order to determine changes in soil microbial diversity in response to the treatments. The soil samples will be taken at harvest for the second term.

In both experiment (subtasks a and b), The greenhouse gases (GHGs; CO_2, CH_4, N_2O) emission measurements started 30 days after the organic wastes were incorporated into the soils and will be continued monthly until the end of the experiment. GASERA ONE PULSE (Photoacoustic Analyzer for measurement of CH_4, N_2O and CO_2) is used for the GHGs measurement.

3 City Specific Data Collection Procedures

3.1 Valladolid

KPIs List Valladolid

								DATA COLLECTION		REPORTING PERIOD		MONITORING RESULTS			
CHALLENGES	TYPE OF INDICATORS	Code	KPI	Unit	SCALE R=Regional M=Metropolitan U=Urban S=Street B=Building	ECOSYSTEM SERVICES P. provisioning; R. regulating; S. supporting; C. cultural.	Metering specifications	FRECUENCY	OUTPUT DATA	START/END	FRECUENCY OF REPORTING	BASELINE	Target to Start	Start	Frequency
CHALLENGE 1: Climate mitigation & adaptation	Chemical	CH0101	Ton C02 CARBON REMOVED per Ha	(t CO2 / Ha)	>R	Regulation	Estimated (model, software)	Quarterly/Annual	Table values (csv, xlsx)	M36/M60	Quarterly/Annual	On going	M36	M41	Annual
		CH0102	Ton C02 CARBON REMOVED per year	(t CO2/year)	>R	Regulation		Quarterly/Annual	Table values (csv, xlsx)	M36/M60	Quarterly/Annual	On going	M36	M41	Annual
	Physical	CH0105	TEMPERATURE DECREASE	(°C)	R M U	Regulation	Sensor UGU	Hourly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M33	M41	Annual
		CH0108	HEATWAVE RISK	(nº days)	R M U	Regulation	Sensor UGU	Hourly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M33	M41	Annual
	Economic	CH0110	ENERGY SAVINGS FROM REDUCED BUILDING ENERGY CONSUMPTION	(kWh/year)	R M U S B	Regulation	Statistical data measured UGU	Daily	Table values (xlsx)	M36/M60	Quarterly	0	M36	M39	Quarterly
		CH0111	CARBON SAVINGS FROM REDUCED BUILDING ENERGY CONSUMPTION	(t C/year)	R M U S B	Regulation	Estimated (model, software)	Daily	Table values (xlsx)	M36/M60	Quarterly	0	M36	M39	Quarterly
CHALLENGE 2: Water Management	Physical indicators	CH0201	RUN-OFF COEFFICIENT	(mm/%)	R M U S B	Regulation	Estimated (model, software)	Calculated just one time	Table values (csv, excel)	M36/M60	Quarterly/annual	On going	M36	M47	Annual
		CH0204	ABSORPTION CAPACITY (m3/m2)	(m3/m2)	U S B	Supporting	Statistical data existing	Calculated just one time	Table values (csv, excel)	M36/M60	Quarterly/annual	On going	M36	M47	Annual
		CH0205	ABSORPTION CAPACITY (m3/tree)	(m3/tree)	U S B	Supporting	Statistical data existing	Calculated just one time	Table values (csv, excel)	M36/M60	Quarterly/annual	On going	M36	M47	Annual
		CH0206	TEMPERATURE REDUCTION	(°C)	R M U S	Regulation	Sensor UGU	Hourly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M33	M41	Annual
		CH0207	INTERCEPTED RAINFALL	(m3 /year)	U S B	Regulation	Sensor UGU	Monthly	Table values (csv, excel)	M36/M60	Quarterly/annual	On going	M36	M47	Annual
	Chemical	CH0211	NUTRIENT ABATEMENT (Chemical Oxygen Demand, COD)	(mg O2/l) (kg O2/year)	R	Regulation	Statistical data measured UGU	Every 2 weeks	Table values (xlsx)	M36/M60	Quarterly	0	M36	M44	Quarterly
		CH0212	NUTRIENT ABATEMENT (Biochemical Oxygen Demand, BOD)	(mg O2/l) (kg O2/year)	R	Regulation		Every 2 weeks	Table values (xlsx)	M36/M60	Quarterly	0	M36	M44	Quarterly
		CH0213	NUTRIENT ABATEMENT (Total Solids, TSS)	(mg TSS/l) (kg TSS/year)	R	Regulation		Every 2 weeks	Table values (xlsx)	M36/M60	Quarterly	0	M36	M44	Quarterly
	Socioeconomic indicators	CH0215	IRRIGATION WATER PROVISION	(m3)	M U	Provisioning	Sensor UGU	Monthly	Table values (csv, excel)	M36/M60	Quarterly/annual	On going	M36		Annual
		CH0216	WATER REMOVED FROM THE WATER TREATMENT	(m3/s)	U S B	Regulation	Estimated (model, software)	Monthly	Table values (csv, excel)	M36/M60	Quarterly/annual	On going	M36	M47	Annual
	Economic	CH0218	SAVINGS IN TREATMENT OF STORMWATER	(€/m3)	R M U S B	Supporting	Statistical data existing	Monthly	Table values (csv, excel)	M36/M60	Quarterly/annual	On going	M36	M47	Annual

CHALLENGES	TYPE OF INDICATORS	Code	KPI	Unit	SCALE R=Regional M=Metropolitan U=Urban S=Street B=Building	ECOSYSTEM SERVICES P. provisioning; R. regulating; S. supporting; C. cultural.	Metering specifications	FRECUENCY	OUTPUT DATA	START/END	FRECUENCY OF REPORTING	BASELINE	Target to Start	Start	Frequency
CHALLENGE 4: Green Space Management	Spatial	CH0401	GREEN SPACE DISTRIBUTION (m2/capita)	(m2/capita) (%)	R M U	Cultural	GIS analysis	Yearly	GIS data (vectorial)	M36/M60	Quarterly/Annual	On going	M36	M41	Annual
		CH0402	GREEN SPACE DISTRIBUTION (km cycle lane/capita)	(km cycle lane/capita)	R M U	Cultural		Yearly	GIS data (vectorial)	M36/M60	Quarterly/Annual	On going	M36	M41	Annual
		CH0405	GREEN SPACE ACCESSIBILITY	(m) ~~(min)~~	R M U S	Cultural	GIS analysis	Yearly	GIS data (vectorial)	M36/M60	Quarterly/Annual	On going	M36	M41	Annual
		CH0406	GREEN INFRASTRUCTURE CONNECTIVITY	(%)	U	Supporting	GIS analysis	Yearly	GIS data (vectorial)	M36/M60	Quarterly/Annual	On going	M36	M41	Annual
	Social	CH0408	RECREATIONAL VALUE	(people/year)	R M U S	Cultural	Mobile App / Statistical data measured UGU	Monthly	Table values (.xlsx)	M1/M60	Annual	502 people	M6	M6	Month
		CH0410	ELDERLY PEOPLE LIFE QUALITY	Survey (%)	U	Cultural	Mobile App	Monthly	Table values (csv)	M36/M60	Annual	n/a	October 2020 (M41)	2020	Annual
		CH0411	CONNECTIVITY PERCEPTION	Survey (%)	U	Cultural	Mobile App	Monthly	Table values (csv)	M36/M60	Annual	n/a	October 2020 (M41)	2020	Annual
		CH0412	FOOD PRODUCTION	(ton/year) Other: (kg/m2) (t/plot)	U S B	Provisioning	Statistical data measured UGU	Yearly	Table values (.xlsx)	M1/M60	Annual	54.21 t	Ex-ante scenario (2017-2018-2019)	2017	Annual
	Biological	CH0413	POLLINATOR SPECIES INCREASE	(%) (nº)	U S	Supporting	Statistical data measured UGU	Monthly/ depending on weather	Table values (.xlsx)	M36/M60	Annual	On going	M33	M36	Annual
		CH0417	GREEN AREAS SUSTAINABILITY	Score (0%-100%)	U	Cultural	Mobile App / Statistical data measured UGU	Yearly	Table values (.xlsx)	M36/M60	Annual	n/a	M41	2020	Annual
CHALLENGE 5: Air Quality	Physical indicators	CH0509	AIR QUALITY PARAMETERS NO2	(µg/m3) NOx	M U	Regulation	Sensor UGU	Hourly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M36	M41	Annual
		CH0510	AIR QUALITY PARAMETERS O3	(µg/m3) O3	M U	Regulation	Sensor UGU	Hourly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M36	M41	Annual
		CH0511	AIR QUALITY PARAMETERS PM	(µg/m3) PM	M U	Regulation	Sensor UGU	Hourly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M36	M41	Annual
	Economic	CH0507	AIR QUALITY MONETARY VALUES	(€)	M U	Supporting	Statistical data measured UGU	Yearly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M36	M41	Quarterly/Annual

CHALLENGES	TYPE OF INDICATORS	Code	KPI	Unit	SCALE R=Regional M=Metropolitan U=Urban S=Street B=Building	ECOSYSTEM SERVICES P. provisioning; R. regulating; S. supporting; C. cultural.	Metering specifications	FRECUENCY	OUTPUT DATA	START/END	FRECUENCY OF REPORTING	BASELINE	Target to Start	Start	Frequency
CHALLENGE 6: Urban Regeneration	Socio-cultural indicators	CH0602	BENEFITS FROM INTERVENTIONS	(%)	U	Cultural	Statistical data existing	Yearly	Table values (.xlsx)	M1/M60	Annual	On going	M1	On going	Annual
	Economic	CH0112	SAVINGS IN ENERGY USE DUE TO IMPROVED GI	(kWh/year)	R M U S	Regulation	Estimated (model, software)	Daily	Table values (xlsx)	M36/M60	Quarterly	0	M36	M44	Quarterly
CHALLENGE 7: Participatory Planning and Governance	Social	CH0701	OPENNESS	(average score) Other: (#Participatory actions/year) (# attendees)	M U	Cultural	Statistical data measured UGU	Monthly	Table values (.xlsx)	M1/M60	Annual	**3.40 score**	June 2017 (M1)	July 2018 (M14)	Annual
		CH0703	CITIZEN PERCEPTION	Likert scale (1-5) Other: (% satisfaction) (nº users)	M U S B	Cultural	Mobile App	Monthly	Table values (.xlsx)	M1/M60	Annual	On going	June 2017 (M1)	November 2020 (M42)	Annual
CHALLENGE 8: Social Justice and Social Cohesion	Social justice	CH0801	CRIME REDUCTION	(nº crimes) (%)	U S B	Cultural	GIS analysis	awaiting data and formatting available	awaiting data and formatting available	awaiting data and formatting available	awaiting data and formatting available	awaiting data and formatting available	awaiting data and formatting available	awaiting data and formatting available	awaiting data and formatting available
	Social cohesion	CH0802	GREEN INTELLIGENCE AWARENESS (Educational actions)	(nº people) Other: (nº educ. actions)	M U	Cultural	Mobile App	Monthly	Table values (.xlsx)	M1/M60	Annual	**2,234 people**	June 2017 (M1)	January 2018 (M8)	Annual
		CH0803	GREEN INTELLIGENCE AWARENESS (Communication activities)	(nº publications)	R M U	Cultural		Monthly	Table values (.xlsx)	M1/M60	Annual	16 publications	June 2017 (M1)	June 2017 (M1)	Annual
CHALLENGE 9: Public Health and Well-being	Psychological	CH0901	NOISE REDUCTION	(dB(A)/m2 green unit)	S B	Regulation	Sensor UGU / Estimated (model, software)	Yearly	Table values (.xlsx)	M36/M60	Quarterly/Annual	On going	M36	M41	Annual
	Health	CH0902	WALKING AREA INCREASE	(users)	M U	Cultural	Mobile App	Monthly	?	M36/M60	Quarterly	On going	?	?	?
		CH0903	CYCLING AREA INCREASE	(bicycles)	M U	Cultural		Monthly	?	M36/M60	Quarterly	On going	?	?	?
CHALLENGE 10: Potential of economic opportunities	Economic	CH1001	TAX REDUCTION	(nº tax reductions)	R M U S B	Supporting	Statistical data measured UGU	Yearly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M36	M41	Quarterly/Annual
		CH1002	JOB CREATION	(jobs) (GDP)	R M U	Supporting		Yearly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M36	M41	Quarterly/Annual
		CH1003	BUSINESS REVENUE	(business)	R M U	Supporting		Yearly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M36	M41	Quarterly/Annual
		CH1005	CONSUMPTION BENEFITS	(€)	R M U	Supporting		Yearly	Table values and Graphs	M36/M60	Quarterly/Annual	On going	M36	M41	Quarterly/Annual

3.2 Liverpool (LIV, UOL, CFT)

			SCALE							DATA COLLECTION		REPORTING PERIOD		MONITORING RESULTS			
DB_Code	KPI	KPI Unit	P	M	U	S	P	ECOSYSTEM SERVICES	METERING SPECIFICATIONS	FREQUENCY	OUTPUT DATA	START/END	FRECUENCY OF REPORTING	BASELINE	Target to Start	Start	Frequency
CH0103	CARBON STORED	tC			Y			R	GIS model - GIVal/Ecosev	The measurement results will be given once a year.	xls/csv	2018/2020	Annually	Completed	2021		Once
CH0104	CARBON SEQUESTRATION	tC			Y			R	GIS model - GIVal/Ecosev	The measurement results will be given once a year.	xls/csv	2018/2020	Annually	Completed	2021		Once
CH0105	TEMPERATURE DECREASE	(°C)	Y	Y	Y			R	Thermal Imaging camera	Monthy	Numerical Trend Graph overtime	2019/2022	Monthly	Completed	2019	05/2019 (M24)	Monthly
CH0106	TEMPERATURE REDUCTION (PROJECTION)	(°C)			Y			R	GIS model: Star tools	The measurement results will be given once a year.	xls/csv	2018/2022	Annually	Completed	2021		Once
CH0108	HEATWAVE RISK	(°C)	Y	Y	Y			R	GIS model: Star tools	The measurement results will be given once a year.	xls/csv	2018/2022	Annually	Completed	2021		Once
CH0111	SPECIES MOVEMENT	population			Y			R	GIS model: Condatis	The measurement results will be given once a year.	xls/csv	2018/2022	Annually	Completed	2021		Once
CH0201	RUN-OFF COEFFICIENT	(mm/%)	Y	Y	Y	Y	Y	R	GIS model: Star tools	The measurement results will be given once a year.	xls/csv	2018/2022	Annually	Completed	2021		Once
CH0206	WATER SLOWED DOWN FROM SEWER SYSTEM	m^3			Y	Y		R	GIS model: Star tools	The measurement results will be given once a year.	xls/csv	2018/2022	Annually	Completed	2021		Once
CH0211	NUTRIENT ABATEMENT (COD)	COD (mg/l)	Y		Y	Y		R	Water collection & Sampling	monthly	xls/csv	2018/2022	Monthly	Completed	2019	11/2018 (M18)	Monthly
CH0212	NUTRIENT ABATEMENT (BOD)	BOD (mg/l)	Y		Y	Y		R						not monitored			
CH0213	NUTRIENT ABATEMENT (SST)	SST (mg/l)	Y		Y	Y		R	Water collection & Sampling	Six monthly	xls/csv	2018/2022	Six monthly	Completed	2019	08/2019 (M27)	Six monthly
CH0217	WATER REMOVED FROM THE WATER TREATMENT	(€/m3)			Y	Y	Y	R	flow meter/model	The measurement results will be given once a year.	xls/csv	2018/2022	Annually	Completed	2021		Once
CH0218	SAVINGS IN TREATMENT OF STORMWATER	(€/m3)			Y	Y		R	flow meter/model	The measurement results will be given once a year.	xls/csv	2018/2022	Annually	Completed	2021		Once
CH0403	GREEN SPACE ACCESSIBILITY	(m) (min)	Y	Y	Y	Y		C	GIS model - GIVal/Ecosev	The measurement results will be given once a year.	xls/csv	2018/2022	Annually	Completed	2021		Once
CH0408	GREEN INFRASTRUCTURE CONNECTIVITY	(m) (%)	Y		Y			S	GIS model - GIVal/Ecosev	The measurement results will be given once a year.	xls/csv	2018/2022	Annually	Completed	2021		Once
CH0412	POLLINATOR SPECIES INCREASE	(nº) (%)	Y		Y			R	Physical observation	monthly (May- Sep)	xls/csv	2018/2022	Monthly	Completed	2018	09/2018 (M16)	Monthly
CH0413	FLORAL RESOURCES INCREASE	(nº) (%)	Y		Y			R	Physical observation	monthly (May- Sep)	xls/csv	2018/2022	Monthly	Completed	2018	09/2018 (M16)	Monthly
CH0414	PLANT SPECIES INCREASE	(nº) (%)	Y		Y			R	Physical observation	monthly (May- Sep)	xls/csv	2018/2022	Monthly	Completed	2018	09/2018 (M16)	Monthly
CH0415	INSECTIVORE INCREASE	(nº) (%)	Y		Y			R	Physical observation	monthly (May- Sep)	xls/csv	2018/2022	Monthly	Completed	2018	06/2018 (M13)	Monthly

			SCALE							DATA COLLECTION		REPORTING PERIOD		MONITORING RESULTS			
DB_Code	KPI	KPI Unit						ECOSYSTEM SERVICES	METERING SPECIFICATIONS	FREQUENCY	OUTPUT DATA	START/END	FRECUENCY OF REPORTING	BASELINE	Target to Start	Start	Frequency
CH0501	DEATHS RELATED TO POLLUTION AND CONTAMINATION	(nº deaths)						R	model	The measurement results will be given once a year.	xls/csv	2018/2022	Annually	Completed	2021		Once
CH0502	ANNUAL MEAN LEVELS OF FINE PM2.5 PARTICULES	(μg/m3) PM2.5		Y	Y			R	Mobile sensor	monthly	xls/csv	2018/2022	Monthly	Completed	2019	02/2019 (M21)	Monthly
CH0503	ANNUAL MEAN LEVELS OF FINE PM10 PARTICULES	(μg/m3) PM10		Y	Y			R	Mobile sensor	monthly	xls/csv	2018/2022	Monthly	Completed	2019	02/2019 (M21)	Monthly
CH0504	NOx TRENDS	(μg/m3) NO2		Y	Y			R	Diffusion tubes	monthly	xls/csv	2018/2022	Monthly	Completed	2018	10/2018 (M17)	Monthly
CH0505	Sox TRENDS	(μg/m3) SO2		Y	Y			R	Diffusion tubes	monthly	xls/csv	2018/2022	Monthly	Stopped in March 2019			Once
CH0506	VOC TRENDS										xls/csv	2018/2022		not monitored			
CH0513	Run-off mitigation	(€)		Y	Y			S			xls/csv	2018/2022	Once in 2022		2021		Once
CH0514	Energy savings	(€)		Y	Y			S			xls/csv	2018/2022	Once in 2022		2021		Once
CH0515	Increase in property value	(€)		Y	Y			S			xls/csv	2018/2022	Once in 2022		2021		Once
CH0516	GI val to calculate the value of air quality improvements	(€)		Y	Y			S			xls/csv	2018/2022	Once in 2022		2021		Once
CH0517	Value of air pollution reduction	(€/m3)		Y	Y			S			xls/csv	2018/2022	Once in 2022		2021		Once
CH0518	Total monetary value of urban forests including air quality	(€/m2)		Y	Y			S			xls/csv	2018/2022	Once in 2022		2021		Once
CH0602	DIVERSITY (Diversity of NBS - land use and functionality)	area, numeric			Y	Y	Y	S		Before and after	xls/csv, rtf, shapefiles	2018/2022	Once in 2022	Completed	01/06/2021		Once
CH0703	SOCIAL LEARNING	N/A		Y	Y			S		Before and after	rtf	2018/2022	Once in 2022	Completed	01/10/2020	01/01/2021	Once
CH0704	CITIZEN PERCEPTION	N/A			Y	Y		S		Before and after	xls/csv, rtf	2019/2022	Once in 2022	Completed	01/10/2020	01/01/2021	Once
CH0707	ENGAGEMENT WITH NBS	N/A			Y	Y		S		Before and after	xls/csv, rtf	2019/2022	Once in 2022	Completed	01/10/2020		Once
CH0801	CRIME REDUCTION	(nº crimes) + type				Y		S		monthly	xls/csv, rtf	2018/2022	Once in 2022	Completed	01/10/2020	01/10/2020	monthly
CH0902	WALKING AREA INCREASE	(users)				Y		S		daily	xls/csv	2020/2022	Once in 2022	Completed (partial due to delays)	Ongoing		Daily
CH0903	CYCLING AREA INCREASE	(bicycles)				Y		S		daily	xls/csv	2020/2022	Once in 2022	Completed (partial due to delays)	Ongoing		Daily
CH0904	HEALTH QUALITY PERCEPTION	N/A			Y	Y		S		Before and after	xls/csv, rtf	2019/2022	Once in 2022	Completed	01/10/2020		1-2 times
CH1003	JOB CREATION	(jobs)			Y			S		Before and after	xls/csv	2019/2022	Once in 2022	Completed	01/01/2021	01/01/2021	Once
CH1004	LAND AND PROPERTY PRICE CHANGE	£ (median)				Y		S		Before and after	xls/csv	2018/2022	Once in 2022	Completed	01/01/2021	01/01/2021	Once
CH1005	NEW BUSINESSES	(business)				Y		S		Before and after	xls/csv	2018/2022	Once in 2022	Completed	01/01/2021	01/01/2021	Once
CH1007	JOB CREATION	N/A				Y		S		Before and after	xls/csv	2018/2022	Once in 2022	Completed	01/01/2021	01/01/2021	Once

3.3 Izmir (BIT, DEM, IZM, IZT, EGE) (To be updated)

			SCALE							DATA COLLECTION		REPORTING PERIOD		MONITORING RESULTS			
DB_Code	KPI	KPI Unit	F	N	U	S	E	ECOSYSTEM SERVICES	METERING SPECIFICATIONS	FRECUENCY	OUTPUT DATA	START/END	FRECUENCY OF REPORTING	BASELINE	Target to Start	Start	Frequency
CH0101	Ton C02 CARBON REMOVED per Ha	ton CO2/Ha					X	D	The land use-land cover map will be derived from WorldView2 satellite images using screen digitalizing in ArcGIS 10. The percentage of tree cover is calculated for each Demo Site separately in ArcGIS 10. Izmir Municipality currently uses ARCGIS. On the other hand, the maps and models can easily be converted to an open platform such as QGIS	The GHGs will be sampled once a day during the first week of experimental period, every two days for the following three weeks and then every ten days until the end of the experiment.	Numerical Trend Graph overtime	Fixed and mobile sensors will be started in June-July 2019 and run for 3 years	every month	On-going calculations	2020	2020	once
CH0102	/Ton C02 CARBON REMOVED per year	ton CO2/yr					X	D		The GHGs will be sampled once a day during the first week of experimental period, every two days for the following three weeks and then every ten days until the end of the experiment.	Numerical Trend Graph overtime	Fixed and mobile sensors will be started in June-July 2019 and run for 3 years	every month	On-going calculations	2020	2020	once
CH0103	CARBON STORED by soil	ton CO2/Ha tonCO2/yr					X	D		The GHGs will be sampled once a day during the first week of experimental period, every two days for the following three weeks and then every ten days until the end of the experiment.	Numerical Trend Graph overtime	Fixed and mobile sensors will be started in June-July 2019 and run for 3 years	every month	16.15	2020	2020	once
CH0103	CARBON STORED by vegetation	tC				X	X	R	I-Tree Eco software	The measurement results will be given once a year.	xls/pdf	2020/2021	Annually	357	2020	2020	once
CH0104	CARBON SEQUESTRATION by vegetation	tC/y				X	X	R	I-Tree Eco software	The measurement results will be given once a year.	xls/pdf	2020/2021	Annually	5.59	2020	2020	once
CH0105	TEMPERATURE DECREASE	°C				X	X	R	Fixed and mobil sensors + thermal camera	Android fixed Sensors: every half hour measurement. Mobil sensors: hottest days every summer Thermal sensors: hottest days every summer	Numerical Trend Graph overtime	Thermal Measurement: August 2020- repeats, hottest days every summer for 2 years. Mobile and fixed sensors have started in August 2020 and will be run for 2 years. But, fixed sensor hasn't yet been installed on the one of the demo sites.	every month	On-going calculations	2020	started in 2020 in one of the locations. Will start in 2021 for the other location	once
CH0106	TEMPERATURE REDUCTION (PROJECTION)	°C				X	X	R	Fixed and mobil sensors + thermal camera	Android fixed Sensors: every half hour measurement. Mobil sensors: hottest days every summer Thermal sensors: hottest days every summer	Numerical Trend Graph overtime	Thermal Measurement: August 2020- repeats, hottest days every summer for 2 years. Mobile and fixed sensors have started in August 2020 and will be run for 2 years. But, fixed sensor hasn't yet been installed on the one of the demo sites.	every month	On-going calculations	2020	2021	once
CH107	HUMAN COMFORT	°C				X	X	R	Fixed and mobil sensors	Android fixed Sensors: every half hour measurement. Mobil sensors: hottest days every summer	Numerical Trend Graph overtime	Mobile and fixed sensors have started in August 2020 and will be run for 2 years. But, fixed sensor hasn't yet been installed on the one of the demo sites.	Annually	Completed	2020	2020	once

			SCALE							DATA COLLECTION		REPORTING PERIOD		MONITORING RESULTS			
DB_Code	KPI	KPI Unit	F	N	U	S	E	ECOSYSTEM SERVICES	METERING SPECIFICATIONS	FRECUENCY	OUTPUT DATA	START/END	FRECUENCY OF REPORTING	BASELINE	Target to Start	Start	Frequency
CH0108	HEATWAVE RISK	num. of nights >20°C days >35°C	X	X	X			R	Sensors	Android Sensors: every half hour measurement. Thermal sensors: hottest days every summer	Numerical Trend Graph overtime	Mobile and fixed sensors have started in August 2020 and will be run for 2 years. But, fixed sensor hasn't yet been installed on the one of the demo sites.	July-August-September	On-going calculations	2020	2021 summer	once
CH0109	kWh savings per year	kWh/year	X	X	X	X	X	R	Software	Modelling using collected data of CH0105	Numerical	2021/2022	Once	On-going calculations	2020	End of 2021	twice
CH0110	t C/y savings per year	°C/year	X	X	X	X	X	R	Software	Modelling using collected data of CH0105	Numerical	2021/2022	Once	On-going calculations	2020	End of 2021	twice
CH0113	Global Warming Potential (GWP; 100-year horizon)	ton CO2-eq ha-1 yr-1	X					R	GASERA ONE PULSE (Photoacoustic Analyzer for measurement of CH4, N2O and CO2)	The GHGs will be measured once a month during the experimental period.	Table values (csv, xlsx)	The measurements started in December 2020, with the beginning of the field experiment. It will end in June 2021 with the wheat harvest	Quarterly/annual	Not necessarry	May 2020	December 2020	Monthly
CH0219	RUNOFF ESTIMATION OF BIOSWALES IN BIOBOULEVARD	m3				x		?	KPI data is required using SCS Runoff Estimation Method by Autodesk Civil 3D Hydraflow Express Extensionx software.	Data collection frequency is twice through the project. The first one is for baseline calculations to assess the predevelopment data. The second one will be made after the construction is completed to measure the post-development effect.	xls, jpg, doc	2019/2021	Twice (before and after the implementation)	Completed (563.9 m3)	2021	2021	once
CH0403	GREEN SPACE ACCESSIBILITY	%	X	X	X	X		C	Field calculator tool / spatial analysis software like QGIS tool includes Basic statistics for numeric fields	The measurement results will be given once a year.	%	Fixed and mobile sensors will be started in June-July 2019 and run for 3 years	every year	On-going calculations			
CH0406	RECREATIONAL VALUE	%			X			U	KPI data collected from user surveys and expert focus study groups can be processed by using spreadsheet software by Excel or SPSS and spatial analysis software like ARCGIS or QGIS.	The measurement results will be given once a year.	%	Fixed and mobile sensors will be started in June-July 2019 and run for 3 years	every year	0			Once
CH0408	GREEN INFRASTRUCTURE CONNECTIVITY	NA			X	X	X	S	Two major landscape metrics are highlighted here; a) GYRATE_AM and b) CONNECT to better interpret the connectivity results / The land use-land cover map will be derived from WorldView2 updated satellite images using screen digitalizing in ArcGIS 10. Based on land use-land cover map, the components of GI will be defined and classified in ArcGIS 10 as well	The measurement results will be given once a year.	xls/csv	?	Annually	2.16	?	?	

			SCALE							DATA COLLECTION		REPORTING PERIOD		MONITORING RESULTS			
DB_Code	KPI	KPI Unit	P	N	U	S	B	ECOSYSTEM SERVICES	METERING SPECIFICATIONS	FRECUENCY	OUTPUT DATA	START/END	FRECUENCY OF REPORTING	BASELINE	Target to Start	Start	Frequency
CH0411	FOOD PRODUCTION	ton/Ha/yr					X		The KPI can be calculated by using a methodology defined by URBAN GreenUP Project: BACI (Before, After, Control, Impact)	The measurement results will be given once a year.	Numerical	two years	every 3 months	On-going calculations			Once
CH0412	POLLINATOR SPECIES INCREASE	number				X	X	S	observing and recording pollinating insects visiting the plants in demo sites	The measurement results will be given once a year in springtime.	xls/csv	2021/2022	Annually	10 taxons in Sasali/6 taxons in Peynircioglu	2020 May	2020 May	Once
CH0502	ANNUAL MEAN LEVELS OF FINE PM2.5 PARTICULES	µg/m3			X			R	Sensors	during winter, every 30 min during peak pollution days (measured and reported by municipality), or else every hour every day	Numerical Trend Graph overtime	2021/22	every month	On-going calculations	2020	2021	Once
CH0503	ANNUAL MEAN LEVELS OF FINE PM10 PARTICULES	µg/m3			X			R	Sensors	during winter, every 30 min during peak pollution days (measured and reported by municipality), or else every hour every day	Numerical Trend Graph overtime	2021/22	every month	On-going calculations	2020	2021	Once
CH0504	NOx TRENDS	µg/m3			X			R	Sensors	during winter, every 30 min during peak pollution days (measured and reported by municipality), or else every hour every day	Numerical Trend Graph overtime	2021/22	every month	On-going calculations	2020	2021	Once
CH0505	Sox TRENDS	µg/m3			X			R	Sensors	during winter, every 30 min during peak pollution days (measured and reported by municipality), or else every hour every day	Numerical Trend Graph overtime	2021/22	every month	On-going calculations	2020	2021	Once
CH0508	POLLUTANT REMOVED BY VEGETATION	kg/year				X	X	R	I-Tree Eco software	The measurement results will be given once a year.	xls/csv	2020/2021	Annually	28.98	2020	2020	Once
CH0601	GREEN SPACE QUANTITY	%			X	X	X	U, N, D	Field calculator tool / spatial analysis software like QGIS tool includes Basic statistics for numeric fields	The measurement results will be given once a year.	%	two years	every year	On-going calculations			

			SCALE							DATA COLLECTION		REPORTING PERIOD		MONITORING RESULTS			
DB_Code	KPI	KPI Unit	F	N	U	S	E	ECOSYSTEM SERVICES	METERING SPECIFICATIONS	FRECUENCY	OUTPUT DATA	START/END	FRECUENCY OF REPORTING	BASELINE	Target to Start	Start	Frequency
CH0705	URBAN FARMING ACTIVITIES	Energy saving kWh					X		The KPI can be calculated by using a methodology defined by URBAN GreenUP Project: BACI (Before, After, Control, Impact)	The measurement results will be given once a year.	Numerical	two years	every month	On-going calculations			
		water saving(m3/ha/year)					X		The KPI can be calculated by using a methodology defined by URBAN GreenUP Project: BACI (Before, After, Control, Impact)	The measurement results will be given once a year.	Numerical	two years	every 3 months	On-going calculations			
CH0802	GREEN INTELLIGENCE AWARENESS (EDUCATIONAL ACTIONS)	nº educ. actions		X				C	Degree of awareness level can be processed by using spreadsheet software by Excel or SPSS.	The measurement results will be given at the end of project	Numerical			0			
CH0803	GREEN INTELLIGENCE AWARENESS (INHAB. ATTENDED)	inhab. attended		X				C	Degree of awareness level can be processed by using spreadsheet software by Excel or SPSS.	The measurement results will be given at the end of project	Numerical			0			
CH0902	WALKING AREA INCREASE	nº users and trips			X	X	X	C	KPI data are acquired by basic statistics in standard software by Excel or SPSS and GIS processing. Data collected via pedestrian and bicycle counter units has been sent to İzmir Transportation Centre called 'İZUM'.	The measurement results will be given once a year.	%	two years	every month	0			
CH0903	CYCLING AREA INCREASE	nº users and trips			X	X	X	C	KPI data are acquired by basic statistics in standard software by Excel or SPSS and GIS processing. Data collected via pedestrian and bicycle counter units has been sent to İzmir Transportation Centre called 'İZUM'.	The measurement results will be given once a year.	%	two years	every month	0			
CH1003	JOB CREATION	nº jobs €/m2	X	X				S	The KPI can be calculated by using a methodology defined by URBAN GreenUP Project: BACI (Before, After, Control, Impact)	The measurement results will be given at the end of project	Numerical			0			

4 Success Stories – Failures - Barriers and Boundaries on data collection - COVID Effect?

4.1 Valladolid

Challenges

Decision-making process. The identification of monitoring indicators in Valladolid has evolved from the first selection of indicators to the present. In an initial phase in 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 that affect the collection and calculation of reliable data for these KPIs. This has meant that some KPIs have been changed to others that are more appropriate to real needs.

A specific case occurred with the intervention of the Floodable Park (VAc11). This intervention will not be carried out in Valladolid, so the KPIs associated with flood risks will not be monitored by CENTA, from Challenge 2-Water management (*CH0202-Flood peak reduction*, *CH0203-Drought risk reduction*, *CH0208-Green areas in flood risk*, *CH0209-Area (ha) exposed to flood risk*, *CH0210-Population exposed to flood risk*).

Lack of information of the pre-NBS period. This situation occurs with several KPIS, and the following example is provided. Energy efficiency KPIs, such as "*Energy and carbon savings from reduced building energy consumption*" will be calculated for the Green Roof and the Green Wall. They are expected to be calculated through several methodologies, some of them including direct measurement and others using estimation from building energy consumption. 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 either not available or sufficiently detailed enough to be of any use.

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.

- The data is relative; it is highly complex to define the surface/ scale of the measurement.
- They are not defined with the level of complexity needed.
- There are additional factors that influence the economic KPIs, which makes it difficult to focus on or extract just the influence attributable to NBS. Factors such as natural city growth scenarios will need to also be considered

Non-technical. COVID-19 has directly affected non-technical interventions in Valladolid. At the beginning of the pandemic in Spain, which was declared in March 2020, the population was confined to their homes and only those considered essential workers (health care, police, etc.) attended their jobs. Face-to-face meetings were prohibited at that time. They are now minimised, to avoid contact and community transmission of the virus.

Success stories

Air quality monitoring. In the ex-ante phase of intervention implementation, CARTIF technology centre has installed a network of equipment for air quality monitoring in the NBS environment. This network is composed of air quality equipment installed in the NBS environment and equipment installed in the vicinity to establish a baseline for comparison.

Figure 4.1: Mobile Air quality sensors installed close to the Green façade in Valladolid (CARTIF)

The data captured by these systems will provide input information for the calculation of the Air Quality Challenge KPIs. Valladolid City Council also has an extensive network of air quality monitoring stations in the municipal Air Pollution Control Network (RCCAVA). The data provided by this network will complete the sensors installed specifically for the URBAN GreenUP project.

Mobile App. The partner GMV-S is programming an Android mobile application to take data of interest for monitoring URBAN GreenUP interventions. This mobile application has the following objectives:

- Gather KPI information leveraging smartphone sensor and user interaction.
- Raise awareness and increase Nature-Based Solutions engagement: The application will show information about the NBS associated with their location, which will allow the dissemination of information about the characteristics and benefits, contributing to the engagement.
- Monitor Green Corridor usage: Through a positioning API, the application will detect when the user is near an NBS. This contributes to statistics of users or visits to the NBS. The App will also detect the modern of transport e.g.by bike, on foot and others.
- Promote Green Corridor usage: The App has a generation of points per use, which allows establishing a ranking of users. This is an example of applied gamification (Serious games).

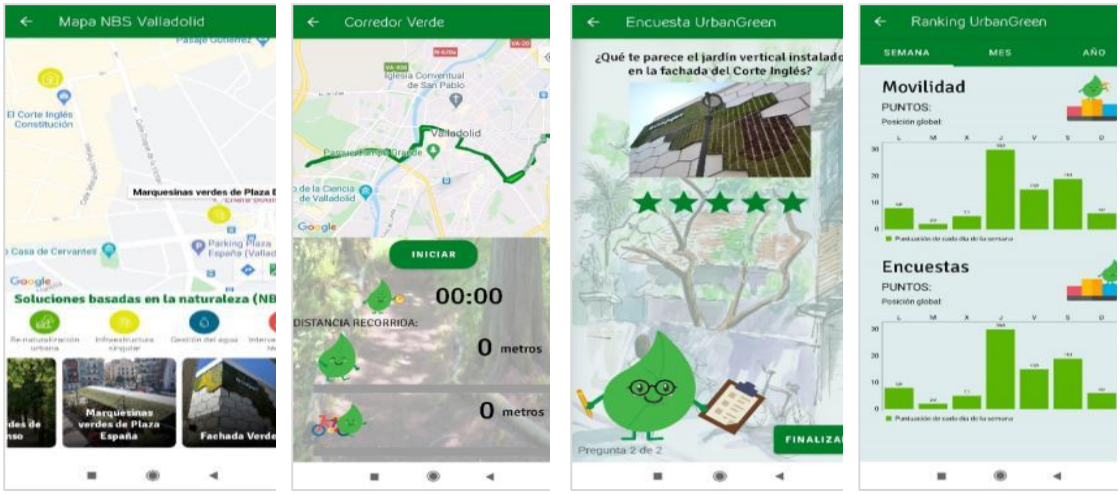


Figure 4.2: Screenshots of the Valladolid Demo mobile application (GMV-S)

Coordination between stakeholders for the water quality monitoring. Water quality parameters are measured from the laboratory analysis of water samples taken in-situ in the NBS during the treatment process. A successful collaboration between stakeholders has been necessary to acquire these data. Accordingly, AQUAVAL, the municipal company in charge of water and wastewater treatment in Valladolid, will be responsible for sampling and analysing at their laboratories. LEITAT, the project partner, will collect the given results and process them for publication.

4.2 Liverpool

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 we maintained the principles of identifying KPIs that could be monitored effectively, and were repeatable and at reasonable cost.

In reality we 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. Socio-economic KPIs were designed with the complex nature of socio-economic data and its relationship to broader contextual factors in mind, in order to understand how NBS is addressing societal challenges beyond numerical improvements to the environment. For this reason, Liverpool adopted a range of KPIs that enabled the team to capture rich, detailed qualitative data alongside quantitative data.

Liverpool partners also worked with local experts to support data analysis and data collection.

- Colleagues at Liverpool John Moores University have supported some of the water quality heavy metal and nutrient analysis by permitting access to their labs and facilities;
- A local sensor company (Sensor City) has provided 4 continuous sensors to help us understand the detail behind some of our air quality monitoring;
- Contractors for the Ecosystem island (i.e. Biomatrix) have provided underwater footage of the colonisation of the underwater reef structures;
- Local community groups and Parks groups (e.g. Friends of Sefton Park) have additionally supported citizen science projects and biodiversity monitoring and
- Linking with the Lancashire Wildlife Trust to promote the use of the bioapp (iNaturalist) in the demo areas and across the city will also involve many local people and help to promote biodiversity recordings in the demo areas whilst adding to the city's biodiversity records and data sets.

4.2.1 Changes in timeline – Covid 19

The timing of the Coronavirus and the subsequent lockdown affected project delivery and thus challenges around the monitoring. All interventions were halted in the run up to lockdown as it became uncertain if staff would be in work to progress works/accept deliveries etc. Some works already on site were left semi completed as contractors closed down operational work, and all co-creation activities with communities were suspended which affected delivery of a number of initiatives. Where installation was delayed, this delayed the start of the post intervention monitoring.

The most significant delays relate to the socio-economic monitoring, as collection of social data in person has been forbidden for most of 2020 and all of 2021 (as at March 2021) by the Human Ethics Research Committee at the University of Liverpool. All monitoring has been shifted to an online format and much of it was undertaken slightly later than anticipated. All interviews were successfully conducted over the summer of 2020, which has provided a rich source of qualitative data. Further online and postal surveys have also been conducted in winter/spring 2021 and are due to be completed in spring 2021. All monitoring in person to evaluate public perceptions of the intervention was delayed and replaced with online alternatives. The funding was used judiciously to focus only on funding staff to undertake activities directly related to the KPIs as and when needed, in line with national, city-wide, and university-level restrictions.

UOL consulted its ethics committee to receive formal approval to modify the methodology. Following confirmation that all face-to-face data collection was prohibited for the foreseeable future, monitoring was moved online and targeted survey work via business, community and LCC supported networks. This was complemented by a dual approach to surveying including postal and online surveys, which allows the project team to target specific communities as well as reach a broader population. The situation has been monitored continually but return to face-to-face data collection has not been possible as yet. Limited permission for face-to-face data collection was granted in November 2020, but soon after the UK went back into 'lockdown' and

data collection was once again forbidden due to national orders to stay at home and not interact with others outside of their household. These rules have not yet been lifted at the time of this report. Specific changes to monitoring for both biophysical and socio-economic monitoring are summarised below.

At this stage, it is anticipated that these restrictions will not be lifted until June 2021 at the earliest, which is after funding has finished for Liverpool's socio-economic monitoring programme, so any planned in person monitoring of social perceptions will need to be cancelled unless further funding is provided for this activity. Further data may be collected in person in summer 2021 by masters' students at UOL, but this will only be allowed if permission is once again granted, which is not guaranteed. It is also notable that use of green spaces have change significantly over the course of the pandemic, as national and local restrictions often only allowed time spent outdoors and, at times, restricted both time and reasons for access to public spaces (e.g. permitting only 1 hour of exercise per day and forbidding recreational and social interactions in public spaces). This will have an impact on the quality and reliability of the data and will be difficult to tease out from general data on perceptions, use, and access. To help address this, nationally representative datasets on use of green space will be used to help contextualise this data. Economic data will also be impacted by both the pandemic and Brexit, and will need to be contextualised with national-level datasets as well.

For the biophysical monitoring:

Air Quality - NO2: diffusion tube monitoring was on hold during lockdown due to the closure of the labs, but restarted in June 2020, with just the loss of a few months' data.

Temperature: Due to time for resetting camera and some distancing difficulties: data were not collected until June when guidelines relaxed, with the loss of data for a few months.

Water: March –July 2020: During this period there was no access to University laboratories for preservation and storage of water samples, nor was there opportunity to calibrate and clean equipment. Water sampling was limited to only abiotic measures with the water probe, but calibration checks of the probe were limited. No water samples were taken during April-July 2020 but sampling restarted in August 2020 and all the existing samples that had been collected had been filtered, frozen, or acidified to preserve them for future analyses. In total there was about a 4 month data gap when samples could not be collected, stored and analysed. In the recent lockdown, access was again restricted, so no water sampling could take place in January and February 2021, but has restarted in March 2021.

Pollinator & Floral (May – September 2020): No pollinator or floral data were obtained for May 2020, but monitoring restarted in June 2020. Monitoring had to accommodate a number of access restrictions from March 2020 (both temporary and permanent) to Parks and gardens, e.g. St Luke's Church garden, Bluecoat garden. In addition it was not possible initially to access either the Royal Court Green Pollinator Roof, or St Johns Green Wall; although this has since been resolved. Similar access issues affected some Dragonfly Transects from May 2020 particularly at Otterspool SUDS as installation was in progress and taking longer due to COVID restrictions. Bat

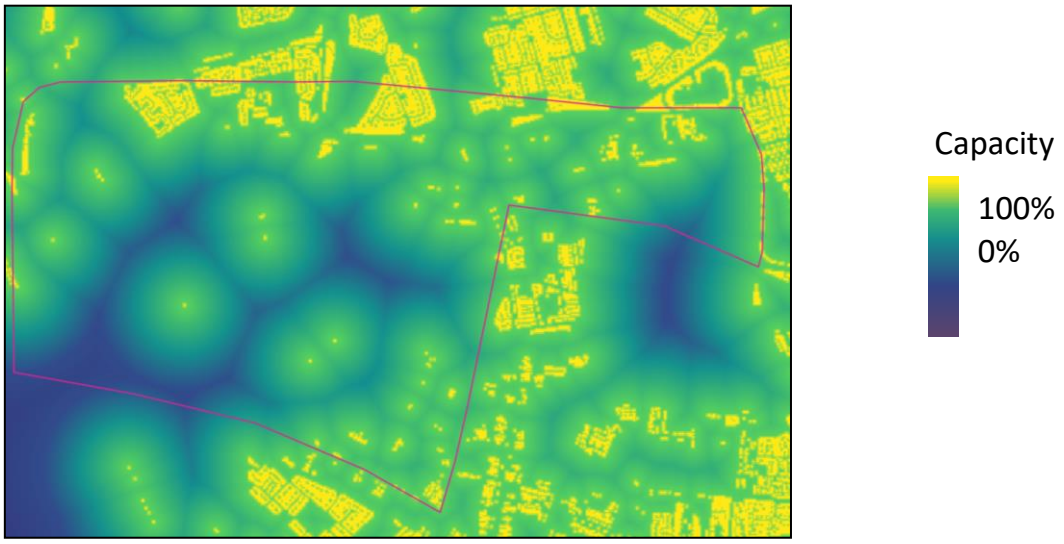
transects restarted in July 2020 when distance guidelines relaxed and parks were less full and monitoring transects were shortened due to time restrictions on monitoring in the dark.

4.2.2 Success stories

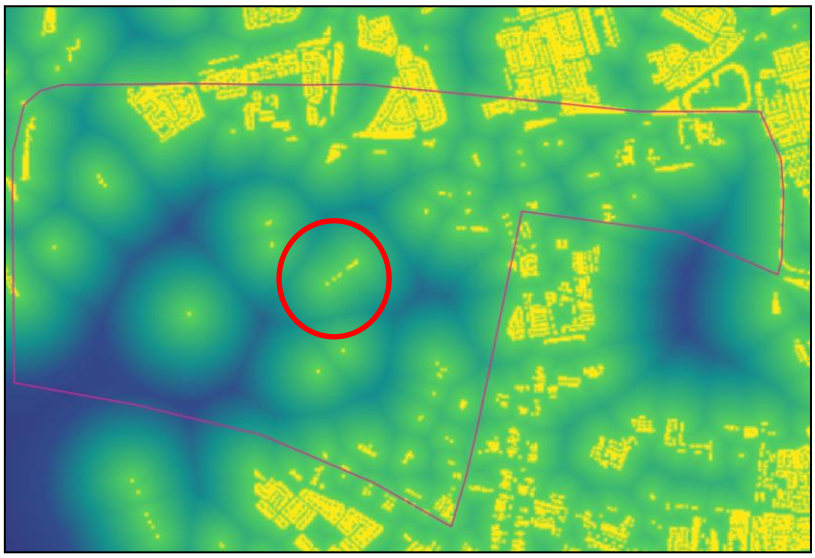
A recent success story has been working with partners to further develop the models to demonstrate the impacts of the pollination capacity of NBS in a way that is accessible. The EcoserV model helps to tease out some of the benefits associated with the introduction of NBS. Using the example of pollination capacity, data can be input from pre NBS baseline data and compared with post intervention data to assess the pollinator capacity increase that is solely attributable to the additional NBS.

The first image below shows baseline data for demo B in an area that includes the site of the green wall at St Johns and the adjacent site of the Royal Court Pollinator roof. The second image shows the data post intervention once the NBS are in place. Comparison shows that a new bubble has been formed with a line of 100% capacity reflecting the location of the new wall. This very visual tool is also accompanied by a table which provides % capacity changes in a numerical format.

This model is still under development but early results are promising.



Pollination capacity increase baseline Sub Demo B



Pollination capacity increase baseline Sub Demo B following installation of green wall and pollinator roof (Royal Court)

It is also notable that all socio-economic KPIs have been monitored in some way, even if it was not in the same way as planned. In light of the covid crisis and its impact on conducting face-to-face interviews, engagement was shifted online. Interviews were conducted with individuals engaged with the urban greening agenda in Liverpool, many of whom were connected to the work of URBAN GreenUP. Interviewees ranged from business owners, SME and charity employees, members of 'Friends of' groups and local councillors. From this, we identified strong themes that contributed to monitoring of all socio-economic KPIs. Research by 6 masters students from the University of Liverpool in the summer of 2020 has also provided data on these KPIs, with researchers adapting methods to online alternatives to ensure alignment with government rules and ethical approval conditions. This is in addition to 8 prior masters research projects focused on Urban GreenUP and one MPhil research project, all of which provide data for the social and/or economic KPIs.

4.3 Izmir

Ege Landscape Team had studied the Eklipse documents for developing relevant KPIs. But they evolved in the process. In other words, the identification of monitoring indicators has evolved from the first selection to the present phase based on some limitations and changes of the implementation sites (demo sites) in the process. Moreover, some of the initial calculation methods of KPIs that Ege Landscape Team is dealing with have been changed to new ways as well, such as getting involved I-Tree Eco software. That was not the initial plan. It did not happen because of a barrier or challenge. It was just included to have better and faster results for calculation of following KPIs: CH0101/CH0102, CH0103 and CH0508- Ton C02 CARBON REMOVED per Ha/Ton C02 CARBON REMOVED per year and CARBON STORED by vegetation and

POLLUTANT REMOVED BY VEGETATION. In the cases of above-mentioned KPIs, no substantial barrier or challenge has been observed by Ege Landscape Team in the monitoring process except delays of constructions or implementations. Monitoring has already begun and been progressing properly as planned if the vegetation is kept healthy and growing in the process.

Another KPIs Ege Landscape Team is responsible for are CH0412- POLLINATOR SPECIES INCREASE and RUNOFF ESTIMATION OF BIOSWALES IN BIOBOULEVARD. Baseline observations had undertaken as planned. Monitoring process will start and progress as planned and will be done by the project team unless there is a delay because of constructions or implementation of plants in Sasali because of covid19 or some other reasons.

Ege Landscape Team is dealing with CH0408- GREEN INFRASTRUCTURE CONNECTIVITY. The team has experienced some challenges in the case of this KPI. The initial plan was to establish a green corridor between demo sites in different locations and assess the new green corridor's contribution to the connectivity. The planned initial 10 km green corridor or connectivity in the early stages of the project between Sasali and Peynircioğlu stream where baseline measurements had executed using some landscape metrics has not been implemented. Therefore, the KPI "green infrastructure connectivity" seems not possible to quantify at the moment in the case of İzmir. There are still thousands of trees to be planted by the end of the project. Thus, if there is a chance to create a green corridor with these plants, measuring green infrastructure connectivity in the monitoring process might be possible.

There is another change in monitoring. The initial locations of parklets have changed. Thus, baseline values will need to be recalculated in the new locations of parklets to make a comparison with the monitored values. But monitoring has not started yet, so the process will continue as planned.

In terms of CH0105-Temperature Reduction and CH0107- Human Comfort KPIs, air temperature, relative humidity and wind velocity measurements were planned to be performed for both baseline values and the monitoring process accordingly. Measurements have been made as planned in the Vilayetler Evi parking lot, one of the demo sites without any challenges by using a mobile device. However, in the Sasalı Wildlife Park car park, the installation of the measuring device (fixed one) has still not taken place due to the Covid-19 pandemic and recordings has been delayed. That was not the plan in the first place. The plan was to establish two fixed meteorological stations in two locations at the same time and start recoding accordingly. However, only one fixed station was able to be set up just before the COVID-19 pandemic (March 2020) and then the isolation period is started. Therefore, we could not collect data from this station yet. In Sasali, only measurements taken by mobile device is available at the moment. Hoping to set up second fixed station in Sasali and start recording as soon as possible.

CHO106, CHO108, CH0109, CH0110 are all related with the data planned to be collected at CHO105 and CHO107. Therefore, these KPIs are delayed as well.

Air quality monitoring for CH0502/CH0503/CH0504/CH0505 are also delayed because of the pandemic since a portable device was going to be used for measurements.

For the actions;

a) Smart soil production in climate-smart urban farming precinct

b) Development of Smart soil from mud plant

The purchase of the two devices and laboratory equipment required for the planned measurements in the project was delayed due to the production processes that slowed down due to the pandemic period, as well as some bureaucratic problems. For this reason, maize field experiment that we planned to start in April 2020 for both subtasks of SubdemoB could not performed. Although the field experiment, which was revised as winter wheat planting, was planned to start in the early November 2020, it was established on December 19, 2020 due to the delay in precipitation in relation with global climate change. However, as of December 2020, our experiments on both subtask a and b have started and are continuing clearly.