URBAN GreenUP

KPI Results Catalogue

(D5.4: NBS implementation conclusions and recommendations. Annex)

WP 5 , T 5.5

Date of document

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URBAN GreenUP

SCC-02-2016-2017

Innovation Action – GRANT AGREEMENT No. 730426

1 Valladolid

1.1 CH0101 Ton CO2 Carbon removed per year

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0101	Ton Co2 Carbon removed per year	CAR
CITY	*RELATED NBS*	
VAL	VAC07 and Tree-planting actions: VAC2, VAC3, VAC4, VAC5	

1.1.1 Results and Discussion

Table of results (summary, from Task 5.4)

Total CO2 absorption (ton) 20 years	VALUE	UNITS
Ex-ante	10,02	Ton CO2/ha
Ex-post	31,20	Ton CO2/ha
CH0101	**211%**	**%**

Data provided for the KPI calculation is only referred to the Urban Carbon Sink action (VaC07). The data given in the table correspond to the cumulative uptake of the trees planted in the UCS after 20 years of planting.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

VaC07

The baseline (ex-ante) corresponds to the agricultural harvest: Alfalfa crop (Medicago sativa) 4-5 years rotation. The CO2 absorption for the baseline has been calculated for the value of 20 years, by using data from Source 1[1].

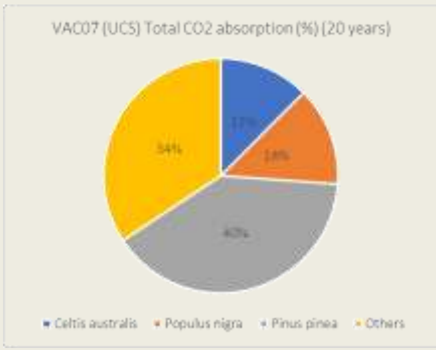
- The ex-post has been calculated using data from Valladolid City Council (tree planting list) and the absorption rates from Source 2[2].

[1] Ref. Mortenson, Matthew & Schuman, Gerald & Ingram, Lachlan. (2004). Carbon Sequestration in Rangelands Interseeded with Yellow-Flowering Alfalfa (Medicago sativa ssp. falcata). Environmental Management. 33. S475-S481. 10.1007/s00267-003-9155-9.

[2] CALCULADORA DE ABSORCIONES EX ANTE DE DIÓXIDO DE CARBONO DE LAS ESPECIES FORESTALES ARBÓREAS ESPAÑOLAS. Ministerio para la transición ecológica y el reto demográfico

The graph shown below (left), shows the global trend in CO2 absorption up to 40 years after planting. As can be seen, CO2 absorption will be particularly significant after 35 years (mature trees).

The graph on the right shows which species contribute most to carbon sequestration in the UCS, either by their sequestration power or by the number of trees planted. *Pinus pinea* contributes with the 40% of the CO2 fixation potential of the UCS. It is follows by *Populus nigra* and *Celtis australis*.



1.1.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
It has not been possible to calculate the value for tree planting actions. There is no data on the situation before the tree planting actions carried out within the framework of the URBAN GreenUP project.	This KPI has been only calculated for VaC07 action (Urban Carbon Sink).
Economical barriers	How they have been addressed
No economical barriers detected.	
Social barriers	How they have been addressed
No barriers detected.	
Environmental (including COVID)	How they have been addressed

https://www.miteco.gob.es/es/cambio-climatico/temas/mitigacion-politicas-y-medidas/calculadoras.aspx

No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

The CO2 fixation has been increased in a 211% within the area of the Urban Carbon Sink (VAC07). The action implemented has led to a change in land use. Although the existing agricultural cover was already fixing atmospheric carbon prior to the URBAN GreenUP action, has increased significantly. Moreover, this impact increases over time.

What was the impact? (positive/negative, significant/non-significant)?

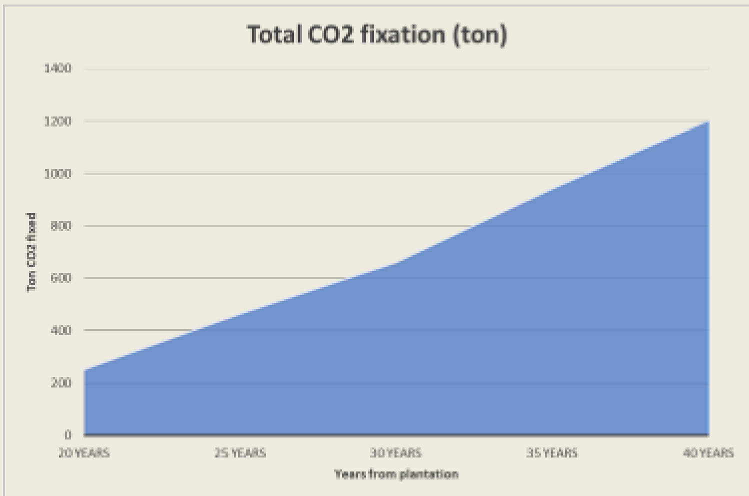
There is a significant impact on C sequestration in the area of the Urban Carbon Sink. The contribution to the "Challenge 1: Climate mitigation & adaptation" is a positive impact in the values.

Regarding the Tree planting actions, although no value can be set for this KPI, the planting of 2391 trees in the city will contribute positively to carbon sequestration (see "other comments").

1.1.3 Other comments

Optional: Any other relevant comments that you would like to include.

Regarding the tree planting actions, the cumulative absorption for the trees planted under the URBAN GreenUP project framework are shown in the next table and graphs.



1.2 CH0102 Ton Co2 Carbon removed per year

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0102	Ton Co2 Carbon removed per year	CAR
CITY	*RELATED NBS*	
VAL	VAC07 and Tree-planting actions: VAC2, VAC3, VAC4, VAC5	

1.2.1 Results and Discussion

Table of results (summary, from Task 5.4)

Total CO2 absorption (ton) 20 years	VALUE	UNITS
Ex-ante	2,83	Ton CO2/year
Ex-post	8,8215	Ton CO2/year
CH0101	**211%**	**%**

Data provided for the KPI calculation is only referred to the Urban Carbon Sink action (VaC07). The data given in the table correspond to the cumulative uptake of the trees planted in the UCS after 20 years of planting.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

VaC07

The baseline (ex-ante) corresponds to the agricultural harvest: Alfalfa crop (Medicago sativa) 4-5 years rotation.

- The CO2 absorption for the baseline has been calculated for the value of 20 years, by using data from Source 1[3].
- The ex-post has been calculated using data from Valladolid City Council (tree planting list) and the absorption rates from Source 2[4].

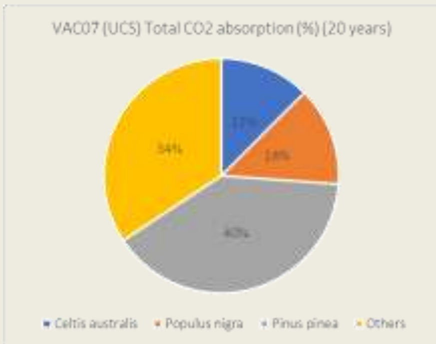
[3] Ref. Mortenson, Matthew & Schuman, Gerald & Ingram, Lachlan. (2004). Carbon Sequestration in Rangelands Interseeded with Yellow-Flowering Alfalfa (Medicago sativa ssp. falcata). Environmental Management. 33. S475-S481. 10.1007/s00267-003-9155-9.

[4] CALCULADORA DE ABSORCIONES EX ANTE DE DIÓXIDO DE CARBONO DE LAS ESPECIES FORESTALES ARBÓREAS ESPAÑOLAS. Ministerio para la transición ecológica y el reto demográfico

https://www.miteco.gob.es/es/cambio-climatico/temas/mitigacion-politicas-y-medidas/calculadoras.aspx

The graph shown below (left), shows the global trend in CO_2 absorption up to 40 years after planting. As can be seen, CO_2 absorption will be particularly significant after 35 years (mature trees).

The graph on the right shows which species contribute most to carbon sequestration in the UCS, either by their sequestration power or by the number of trees planted. *Pinus pinea* contributes with the 40% of the CO_2 fixation potential of the UCS. It is follows by *Populus nigra* and *Celtis australis*.



1.2.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
It has not been possible to calculate the value for tree planting actions. There is no data on the situation before the tree planting actions carried out within the framework of the URBAN GreenUP project.	This KPI has been only calculated for VaC07 action (Urban Carbon Sink).
Economical barriers	How they have been addressed
No economical barriers detected.	
Social barriers	How they have been addressed
No barriers detected.	
Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

The CO2 fixation has been increased in a 211% within the area of the Urban Carbon Sink (VAC07). The action implemented has led to a change in land use. Although the existing agricultural cover was already fixing atmospheric carbon prior to the URBAN GreenUP action, has increased significantly. Moreover, this impact increases over time.

What was the impact? (positive/negative, significant/non-significant)?

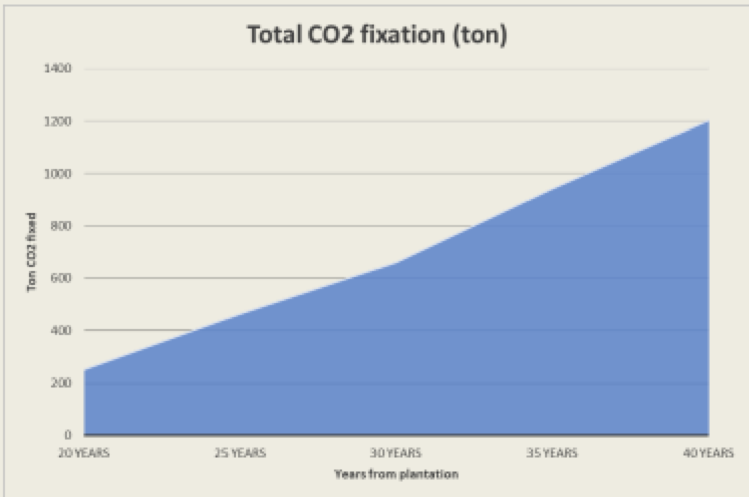
There is a significant impact on C sequestration in the area of the Urban Carbon Sink. The contribution to the “Challenge 1: Climate mitigation & adaptation" is a positive impact in the values.

Regarding the Tree planting actions, although no value can be set for this KPI, the planting of 2391 trees in the city will contribute positively to carbon sequestration (see “other comments”.

1.2.3 Other comments

Optional: Any other relevant comments that you would like to include.

Regarding the tree planting actions, the cumulative absorption for the trees planted under the URBAN GreenUP project framework are shown in the next table and graphs.



1.3 CH0105 Decrease in mean or peak daytime local temperatures (ºC)

RELATED KPI CODE *NBS NAME* *PARTNER(S)*

CH0105	Decrease in mean or peak daytime local temperatures (ºC)	CAR
CITY	*RELATED NBS*	
VAL	VAc24, VAc25, VAc27 & Vac29,	

1.3.1 Results and Discussion

Table of results of this KPIs for the relevant NBS interventions in the city of Valladolid. In this case, as introduction for each NBS is indicated the reference site selected to calculate the CH0105 KPI. The selection of the reference site has been done according the NBS implementations site characteristics among the available reference data.

The calculation of this KPI has been done individually for each NBS because, as these NBS have building or street scale, the evaluation of all of them at district or city scale joining all the date, has no interest itself. However, the individual evaluation of each NBS will support the selection of the proper NBS when a temperature reduction is aiming in the hot season.

VAc25 Green Façade (Ending implementation date 30/06/2020)

NBS intervention site (El Corte Inglés Building in Constitución St.). Reference site (Rinconada Sq. in Valladolid).

Temperture reduction (ºC)	VALUE	UNITS	Year
Ex-ante (2019)	-1,45	ºC	
Ex-post (2020)	-1,44	ºC	
Ex-post (2021)	-1,29	ºC	
CH0105	**11**	**%**	**2021**

VAc 27 Green Covering Shelter (Ending implementation date 24/02/2020)

NBS intervention site in España Sq. Reference site in Montero Calvo St. in Valladolid. The reference site is not a square such as the España Sq. but Montero Calvo St. is very close to it and on the other side España Sq is not a conventional open square. Anyway, the use of Rinconada Sq. data to calculate this KPI produces similar results in terms of impact.

Temperture reduction (ºC)	VALUE	UNITS	Year
Ex-ante (2019)	0,66	ºC	
Ex-post (2020)	2,46	ºC	
Ex-post (2021)	0,57	ºC	
CH0101	**14%**	**%**	**2021**

VAc29 Green shady structures (Ending implementation date 26/02/2021)

NBS intervention site in Santa María St. Reference site in Montero Calvo St. in Valladolid. Both streets are parallel and very close and have a similar configuration.

Temperture reduction (ºC)	VALUE	UNITS	Year
Ex-ante (2019)	0,16	ºC	
Ex-ante (2020)	1,33	ºC	
Ex-post (2021)	-0,72	ºC	
CH0101	**-2,02ºC / -154%**	**%**	**2020 as reference**

Discussion of results: In the results and discussion section, all the related KPIs will be put in common and contextualized in terms of the challenges addressed. This section should be supported with photos, tables, charts, maps, etc.

The discussion of the results of this KPI has been also done individually for each NBS because, as these NBS have building or street scale, the evaluation of all of them at district or city scale joining all the date, has no interest itself. However, the individual evaluation of each NBS will support the selection of the proper NBS when a temperature reduction is aiming in the hot season.

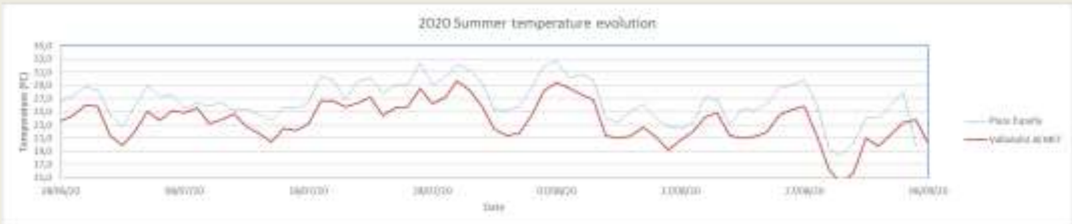
VAc25 Green Façade (Ending implementation date 30/06/2020)

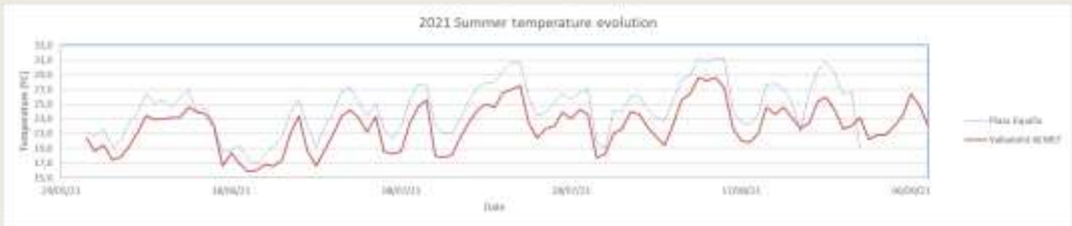
This result in 2021 indicates that the Green Façade (VAc25) has not significant impact on the temperature reduction in the area. It could be due to the fact the vertical garden is installed quite high (around 7 m high of the lower part) from the floor where people are (and thermometers too).

VAc 27 Green Covering Shelter (Ending implementation date 24/02/2020)

This result in 2021 indicates even a slightly increase in the temperature in comparison with the reference site in the Green covering shelter (VAc27). So, it has not significant impact on the temperature reduction in the area. It could be due to the fact the green covering layer has been installed on an existing shadow structure and the implementation of the vegetation on it has not significant impact over the area temperature in the hot season.

Additionally, if it is compared temperature profiles before and after the interventions, it can be seen that no differences are appreciated.





VAc29 Green shady structures (Ending implementation date 26/02/2021)

This result in 2021 seems to indicate that the implementation of the green shady structures in the Santa María St. provokes the reduction of the average temperature of around 2 ºC. It is a relevant impact considering that are average temperatures. In order to complete the analysis, an alternative study was carried out. CH0105 KPI was calculated again but considering only maximum daily temperatures.

Temperture reduction In maximum daily temperatures(ºC)	VALUE	UNITS	Year
Ex-ante (2019)	-0,23	ºC	
Ex-ante (2020)	5,14	ºC	
Ex-post (2021)	-2,02	ºC	
CH0101	-7,16ºC / -139%	%	2020 as reference

7ºC of reduction in daily maximum temperature is a very relevant impact of this intervention. Additionally, if maximum daily temperatures are compared between reference site and NBS site during the hot season, a change in the pattern clearly appears. Temperatures in Santa

María St. go under temperatures in Montero Calvo St. due to the Green shadow structures implementation.

1.3.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No available wifi connections in the streets. Individual gprs or other systems for each sensor is to expensive.	Install Bluetooth connection system for the sensors. However, it requires on site data collection.
Economic barriers	How they have been addressed
No barriers detected.	
Social barriers	How they have been addressed
Temperature and humidity sensors. Some of them suffered vandalism or directly disappear. Some of the sensors could not be installed due to lack of available anchors in public domains. Some of private owners in the street refused to let us to install the sensons in their elements.	Some of the sensors were substituted. Some streets are not fully monitored with the planned sensors and were only partially monitored.

Environmental (including COVID)	How they have been addressed
During the lockdown some of the sensors required maintenance operations but we could not carry out them. Some data sets were lost because of it.	Hopefully, no more pandemics affect the world.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

As it has been previously introduced, impacts depend on the type of NBS and its location. Some of the interventions did not show a detectable impact on the temperature reduction during the hot season comparing with a no modified reference location.

However, the Green Canopies NBS intervention area (Santa María St.) showed a relevant temperature reduction during the hot season (June-August) in comparison with the reference area selected (a parallel street close to the intervention area, Montero Calvo St.). 2 ºC of the average temperature reduction and more then 7 ºC of the reduction in the daily peak temperatures.

What was the impact? (positive/negative, significant/non-significant)?

Regarding temperature reduction, the impact was positive, as it has been mentioned previously for the case of the Green canopies installed in the Santa María St.

1.3.3 Other comments

Optional: Any other relevant comments that you would like to include.

Other NBS in Valladolid have been partially monitored but data collected do not allow an adequate analysis and so these results have not been included in this document.

1.4 CH0108 Heatwave risks reduction (days, %)

RELATED KPI CODE	*NBS NAME*	*PARTNER(S)*
CH0108	Heatwave risks reduction (days, %)	CAR
CITY	*RELATED NBS*	
VAL	VAc24, VAc25, VAc27 & Vac29,	

1.4.1 Results and Discussion

Table of results of this KPIs for the relevant NBS interventions in the city of Valladolid. In this case, as introduction for each NBS is indicated the reference site selected to calculate the

CH0108 KPI. The selection of the reference site has been done according the NBS implementations site characteristics among the available reference data.

The calculation of this KPI has been done individually for each NBS because, as these NBS have building or street scale, the evaluation of all of them at district or city scale joining all the date, has no interest itself. However, the individual evaluation of each NBS will support the selection of the proper NBS when a temperature reduction is aiming in the hot season.

Of course, it is anyway a relevant KPI to be considered at city or district scale, but the scale of intervention of the proposed NBS and this KPI do not allow to assess the impact at these bigger scales. Anyway, results can be extrapolated and can be used to propose solutions regarding the heatwave risk reduction and the climate change impact in big cities. This KPI indicates the number of days with maximum temperatures over 35ºC and compares it with data before the intervention keeping in mind data from reference sites.

VAc25 Green Façade (Ending implementation date 30/06/2020)

NBS intervention site (El Corte Inglés Building in Constitución St.). Reference site (Rinconada Sq. in Valladolid).

Heatwave risk reduction (%)	VALUE	UNITS	Year
Ex-ante (2019)	45 / 79%	Days /%	
Ex-post (2020)	50 / 100%	Days /%	
Ex-post (2021)	50 / 94%	Days /%	
CH0108	**+15**	**%**	**2021**

VAc 27 Green Covering Shelter (Ending implementation date 24/02/2020)

NBS intervention site in España Sq. Reference site in Montero Calvo St. in Valladolid. The reference site is not a square such as the España Sq. but Montero Calvo St. is very close to it and on the other side España Sq is not a conventional open square. Anyway, the use of Rinconada Sq. data to calculate this KPI produces similar results in terms of impact.

Heatwave risk reduction (%)	VALUE	UNITS	Year
Ex-ante (2019)	67 / 248%	Days /%	
Ex-post (2020)	50/ 1000%	Days /%	
Ex-post (2021)	44 / 191%	Days /%	
CH0108	**- 57**	**%**	**2021**

VAc29 Green shady structures (Ending implementation date 26/02/2021)

NBS intervention site in Santa María St. Reference site in Montero Calvo St. in Valladolid. Both streets are parallel and very close and have a similar configuration.

Temperture reduction (ºC)	VALUE	UNITS	Year
Ex-ante (2019)	35 / 130%	Days /%	
Ex-ante (2020)	38 / 760%	Days /%	
Ex-post (2021)	16/ 70%	Days /%	
CH0108	**- 60**	**%**	**2021**

Discussion of results: In the results and discussion section, all the related KPIs will be put in common and contextualized in terms of the challenges addressed. This section should be supported with photos, tables, charts, maps, etc.

The discussion of the results of this KPI has been also done individually for each NBS because, as these NBS have building or street scale, the evaluation of all of them at district or city scale joining all the date, has no interest itself. However, the individual evaluation of each NBS will support the selection of the proper NBS when a temperature reduction is aiming in the hot season.

VAc25 Green Façade (Ending implementation date 30/06/2020)

This result in 2021 indicates that the Green Façade (VAc25) has not significant impact on the temperature reduction in the area. Anyway, it is difficult to assess the impact because data in different year differs quite a lot. Anyway, it is recommended to wait for an extra year to assess the impact.

VAc 27 Green Covering Shelter (Ending implementation date 24/02/2020)

This result in 2021 indicates a slightly reduction in risk of heatwaves in comparison with the reference site in the Green covering shelter (VAc27). However, data are quite variable and it is recommended to assess the impact during 2022 summer time in order to know if this intervention could affect maximum temperatures in the area.

VAc29 Green shady structures (Ending implementation date 26/02/2021)

This result in 2021 seems to indicate (in comparison with 2019 because data in 2020 are unexpectable) that the implementation of the green shady structures in the Santa María St. provokes a relevant reduction of the heatwave risk in the street. Anyway, it is recommended to assess this KPI also in 2022 in order to check this tendency.

Temperture reduction			Year
In maximum daily temperatures(ºC)	VALUE	UNITS	
Ex-ante (2019)	-0,23	ºC	
Ex-ante (2020)	5,14	ºC	
Ex-post (2021)	-2,02	ºC	
CH0108	**-7,16ºC / -139%**	**%**	**2020 as reference**

1.4.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No available wifi connections in the streets. Individual gprs or other systems for each sensor is to expensive.	Install Bluetooth connection system for the sensors. However, it requires on site data collection.
Economic barriers	How they have been addressed
No barriers detected.	
Social barriers	How they have been addressed
Temperature and humidity sensors. Some of them suffered vandalism or directly disappear. Some of the sensors could not be installed due to lack of available anchors in public domains. Some of private owners in the street refused to let us to install the sensons in their elements.	Some of the sensors were substituted. Some streets are not fully monitored with the planned sensors and were only partially monitored.
Environmental (including COVID)	How they have been addressed

During the lockdown some of the sensors required maintenance operations but we could not carry out them. Some data sets were lost because of it.	Hopefully, no more pandemics affect the world.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

As it has been previously introduced, impacts depend on the type of NBS and its location. Some of the interventions did not show a detectable impact on the temperature reduction during the hot season comparing with a no modified reference location.

However, the Green Canopies NBS intervention area (Santa María St.) showed a relevant temperature reduction during the hot season (June-August) in comparison with the reference area selected (a parallel street close to the intervention area, Montero Calvo St.).

What was the impact? (positive/negative, significant/non-significant)?

Regarding temperature reduction, the impact was positive, as it has been mentioned previously for the case of the Green canopies installed in the Santa María St.

1.4.3 Other comments

Optional: Any other relevant comments that you would like to include.

Other NBS in Valladolid have been partially monitored but data collected do not allow an adequate analysis and so these results have not been included in this document.

Additionally, it is recommended to assess this KPI during 2022 in order to value the real impact of the interventions thinking that the vegetation is fully developed this year.

1.5 CH0109 Energy saving from reduced building consumption

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0109	Energy saving from reduced building consumption	LEITAT

CITY	*RELATED NBS*
VALLADOLID	Green roof (“Campillo”market). Vertical façade (El Corte Inglés)

1.5.1 Results and Discussion

Table of results (summary, from Task 5.4)

NBS Surface

Vac28	Mercado "El Campillo"	524,09	*m2*
Vac25	Corte Inglés	351,05	*m2*

Envelope characterization - AFTER RENOVATION (NBS)

Vac28 Mercado		Layer 1	Layer 2	Layer 3	Layer 4
Material	-	Rock wool	Integrated Sedum system	lightweight concrete	slab with beams
di	*m*	0,05		0,1	0,3
Li	*W/mK*	0,04		0,19	0,846
R-value i	*m2K/W*	1,25	0,4158	0,52631578	0,35460992

Vac25 Corte Inglés		Layer 1	Layer 2	Layer 3	Layer 4
Material	-	air chamber	PVC panel	Rock wool	vegetation layer
di	*m*	0,05	0,035	0,04	0,07
Li	*W/mK*	0,0256	0,021	0,032	0,12
R-value i	*m2K/W*	1,953125	1,6666667	1,25	0,5833333

Thermal resistance of the building envelope **- BEFORE RENOVATION**

Vac28	Mercado "El Campillo"	1,18	*m2K/W*
Vac25	Corte Inglés	1,18	*m2K/W*

Thermal resistance of the building envelope **- AFTER RENOVATION (NBS)**

Vac28	Mercado "El Campillo"	2,55	*m2K/W*
Vac25	Corte Inglés	3,65	*m2K/W*

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Methodology 2: Estimation from thermal transmittance

Assuming an average temperature reduction of a 2% due to passive NBS system (Chafer et al, 2021), we have calculated the following energy saving:

Vac28 Mercado	**Mercado "El Campillo"**

		YEAR 1 (19-20)	YEAR 2 (20-21)	YEAR 3 (21-22)
E. savings	*KWh/year*	622,27	584,00	568,84

Vac25 Corte Inglés	**El Corte inglés**

		YEAR 1 (20-21)	YEAR 2 (21-22)	YEAR 3 (22-23)
E. savings	*KWh/year*	469,65	450,72	564,70

UGUP	**Urban GreenUP**

		YEAR 1	YEAR 2	YEAR 3
E. savings	*KWh/year*	1091,92	1034,72	1133,54

Methodology 3: Estimation from electrical building consumption

Energy savings will be calculated taking into account electrical building consumption pre and post intervention and the corresponding climatical conditions.

Vac28 Mercado	**Mercado "El Campillo"**

		Mean (17-19)	2020	2021	2022
E. savings	*KWh/year*	145404	25380	14474	42170
	SD	7670			

Vac25 Corte Inglés	**El Corte inglés**				
		Mean (17-19)	**2020**	**2021**	**2022**
E. savings	*KWh/year*	4165468	807740	399348	#¡VALOR!
	SD	88270			
UGUP	**Urban GreenUP**				
		Mean (17-19)	**2020**	**2021**	**2022**
E. savings	*KWh/year*	95940	833120	413822	42170

1.5.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
Installation of temperature sensor inside the market to calculate KPIi. Installed climate-controlled system in El Corte Inglés.	Cartif (responsible of this installation) is in process to install this sensor in campillo market. El Corte Inglés in/out temperature difference should be calculated from literature and/or use an energy consumption approach.
Economical barriers	How they have been addressed
Not identified.	Not identified.
Social barriers	How they have been addressed
Not identified.	Not identified.
Environmental (including COVID)	How they have been addressed
Covid situation caused several delays in the calculation of energy saving KPI.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

There is a significative aesthetic impact, but we don't have enough data to assure a significant energy reduction due to the NBS implementation. In one hand, the relative size of the NBS compared to the total building envelope, building complexity may have influenced thermal methodology approach. On the other hand, energy consumption approach may have been affected by many factors like: COVID lockdown, energy saving measures in lightning, changes in electricity provider, etc.

What was the impact? (positive/negative, significant/non-significant)?

not measurable

1.6 CH0110 Carbon savings from reduced building energy consumption

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0110	Carbon savings from reduced building energy consumption	LEITAT

CITY	*RELATED NBS*
VALLADOLID	Green Roof ("El Campillo" market) Vertical façade (El Corte Inglés)

1.6.1 Results and Discussion

Table of results (summary, from Task 5.4)

Energy savings		**2020**	**2021**	
Vac25	El corte Inglés Constitución	807740	399348	*KWh*
Vac28	Mercado del Campillo	25380	14474	*KWh*

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Carbon savings		2020	2021	
Vac25	El corte Inglés Constitución	24240277.4	11984433	*Kg CO2*
Vac28	Mercado del Campillo	761653.8	434365	*Kg CO2*

UGUP	Urban GreenUP		
		2020	**2021**
CO2 savings	*Kg CO2*	25001931	12418798

1.6.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
Historical data collection of energy consumption.	Ayto Valladolid has been addressing these issues with the demonstrator administrators.
Economical barriers	How they have been addressed
Not identified.	Not identified.
Social barriers	How they have been addressed
Not identified.	Not identified.
Environmental (including COVID)	How they have been addressed
Covid situation caused several delays in the calculation of energy saving KPI and lockdown affected energy consumption records.	We have compared 2020 results with an average of the past 5 years.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

There is a significative aesthetic impact, but we don't have enough data to assure a significant energy reduction due to the NBS implementation. Energy consumption approach may have been affected by many factors like: COVID lockdown, energy saving measures in lightning, changes in electricity provider, etc.

What was the impact? (positive/negative, significant/non-significant)?

not measurable

1.7 CH0201 Run-off coefficient

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0201	RUN-OFF COEFFICIENT	CEN
CITY	*RELATED NBS*	

1.7.1 VAL

SUB-DEMO C

1.7.2 Results and Discussion

Table of results (summary, from Task 5.4)

Estimated:

Actuación: Jardín de lluvia Av. Mundial 82
Tipo: Rain Garden
Superficie ocupada (m2): 964
ΔV (m3): 25.70
Cr (%): 0.81

Actuación: Balsa de retención
Tipo: SuDS
Superficie ocupada (m2): 290
ΔV (m3): 7.73
Cr (%): 0.81

Actuación: Pavimento permeable
Tipo: Green Parking pavements
Superficie ocupada (m2): 611
ΔV (m3): 16.29
Cr (%): 0.81

No data recorded (see conclusions section)

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The calculated values of ΔV and Cr has been assessed before the installation of the NBS for each intervention.

A higher DV value means greater potential hydrologic benefits provided by the NBS studied, whereas a higher Cr indicates less need to improve future urban rainwater management in a specific area.

This is an estimated KPI using a cost-effective hydrologic model based on the Soil Conservation Service Curve Number (SCS-CN) method (NRCS, 1986).

No data recorded (see conclusions section).

1.7.3 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Lack of qualified technical personnel in the entity.	Not addressed within the project.
Economical barriers	How they have been addressed
Social barriers	How they have been addressed
Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

What was the impact? (positive/negative, significant/non-significant)?

1.8 CH0202 Absorption capacity (m3/m2)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0202	ABSORPTION CAPACITY (m3/m2)	CEN
CITY	*RELATED NBS*	
VAL	SUB-DEMO C	

1.8.1 Results and Discussion

Table of results (summary, from Task 5.4)
No data recorded (see conclusions section)
Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.
No data recorded (see conclusions section)

1.8.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Lack of qualified technical personnel in the entity	Not addressed within the project.
Economical barriers	How they have been addressed
Social barriers	How they have been addressed
Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
What was the impact? (positive/negative, significant/non-significant)?

1.9 CH0203 Absorption capacity (m3/tree)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0203	ABSORPTION CAPACITY (m3/tree)	CEN
CITY	*RELATED NBS*	
VAL	SUB-DEMO C	

1.9.1 Results and Discussion

Table of results (summary, from Task 5.4)
No data recorded (see conclusions section)

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.
No data recorded (see conclusions section)

1.9.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Lack of qualified technical personnel in the entity	Not addressed within the project.
Economical barriers	How they have been addressed
Social barriers	How they have been addressed
Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
What was the impact? (positive/negative, significant/non-significant)?

1.10 CH0206 Intercepted rainfall

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0206	INTERCEPTED RAINFALL	CEN
CITY	*RELATED NBS*	
VAL	SUB-DEMO C	

1.10.1 Results and Discussion

Table of results (summary, from Task 5.4)
No data recorded (see conclusions section)
Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.
No data recorded (see conclusions section)

1.10.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Lack of qualified technical personnel in the entity	Not addressed within the project.
Economical barriers	How they have been addressed
Social barriers	How they have been addressed
Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
What was the impact? (positive/negative, significant/non-significant)?

1.11 CH0210 Irrigation water provision

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0210	IRRIGATION WATER PROVISION	CEN
CITY	*RELATED NBS*	
VAL	SUB-DEMO C	

1.11.1 Results and Discussion

Table of results (summary, from Task 5.4)
No data recorded (see conclusions section)
Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.
No data recorded (see conclusions section)

1.11.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Lack of qualified technical personnel in the entity	Not addressed within the project.
Economical barriers	How they have been addressed
Social barriers	How they have been addressed
Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

What was the impact? (positive/negative, significant/non-significant)?

1.12 CH0211 Nutrient abatement (Chemical Oxygen Demand, COD)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0211(old) **CH0206**	NUTRIENT ABATEMENT (Chemical Oxygen Demand, COD)	LEITAT
CITY	*RELATED NBS*	
VALLADOLID	Electrowetland	

1.12.1 Results and Discussion

Table of results (summary, from Task 5.4)

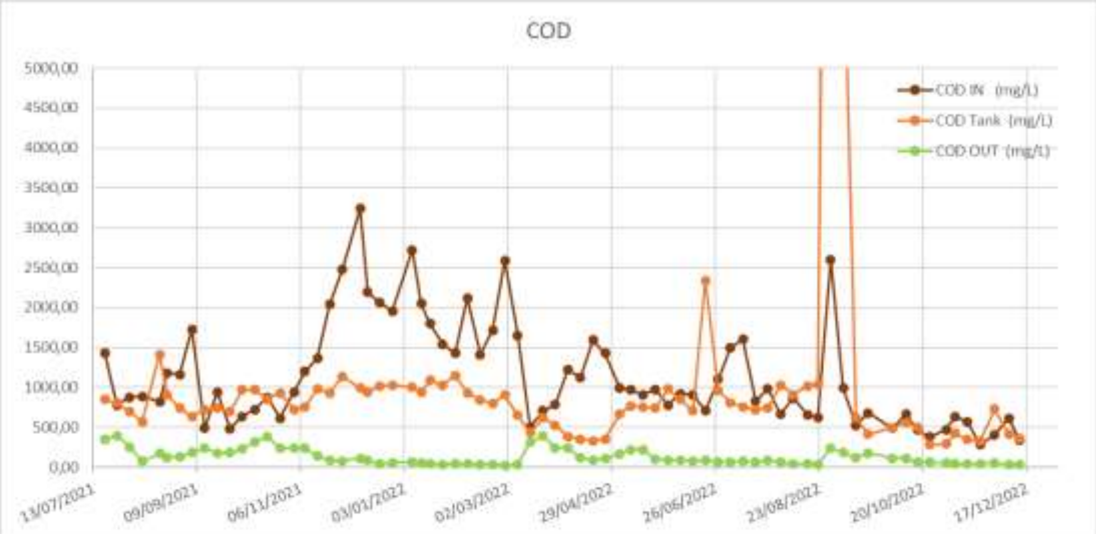
This KPI is complementary with CH0212 and CH0213 related to nutrient abatement (biochemical oxygen demand and total solids). Results are expressed in *kg COD/year*

EX ANTE		**EX POST**					
2020 (Jan-May) M36	**Baseline tot**	**2021**	**2022 (Jan-May) M60**	**2022 (Jun-Dec)**	**2022 tot**	**2023 (Jan-May) M72**	**Post Total**
73.60	73.60	6.94	4.52	2.95	3.56	1.13	3.88

Discussion of results: comment all relevant information to put in context the results from the *table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.*

Evolution of COD degradation is being shown below, from the beginning of the implementation of electrowetland until now. We can see that COD was reduced by an average of 87% (87,06±11,90).

There was a peak value inside the tank (17000 mg/L) in 29/08/2022 but the electrowetland outlet kept values under 250 mg/L. This peak is due to the flush effect of a storm event of 25L/m^2 in less than 10 min after a period of drought.



1.12.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
Sampling frequency and maintenance of the electrowetland.	We had to modify the subcontract with the company in charge of maintenance of the electrowetland.
Economical barriers	How they have been addressed
Not identified.	Not identified.
Social barriers	How they have been addressed
Not identified.	Not identified.
Environmental (including COVID)	How they have been addressed

Not identified.	Not identified.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Yes, Electrowetland is obtaining chemical oxygen demand removals around 87%.

What was the impact? (positive/negative, significant/non-significant)?

It's having a positive and significant impact in COD reduction from wastewater.

1.13 CH0212 Nutrient abatement (Biochemical Oxygen Demand, BOD)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0212 (old) **CH0207**	NUTRIENT ABATEMENT (Biochemical Oxygen Demand, BOD)	LEITAT
CITY	*RELATED NBS*	
VALLADOLID	Electrowetland	

1.13.1 Results and Discussion

Table of results (summary, from Task 5.4)

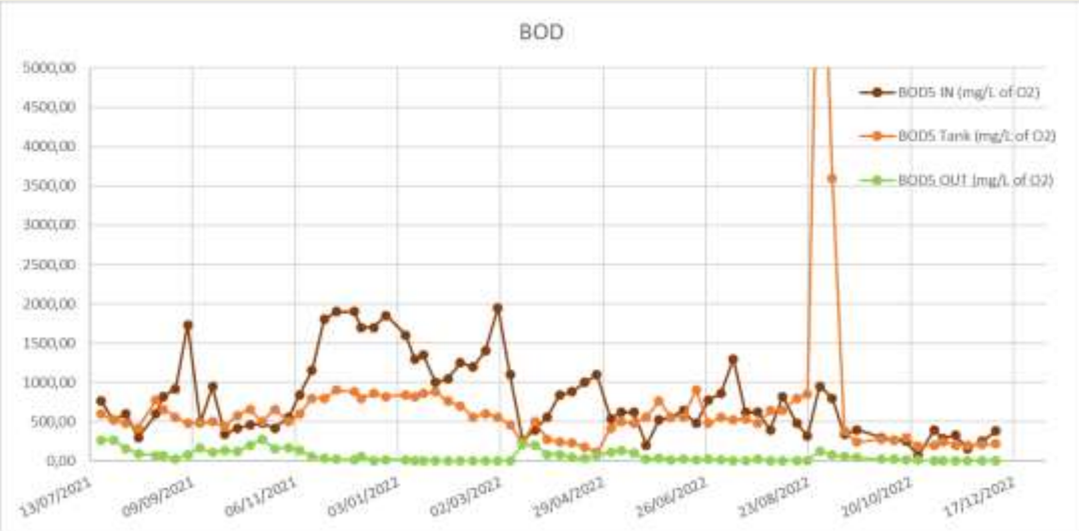
This KPI is complementary with CH0211 and CH0213 related to nutrient abatement (chemical oxygen demand and total solids). Results are expressed in *kg BOD/year*

EX ANTE		**EX POST**					
2020 (Jan-May) M36	**Baseline tot**	**2021**	**2022 (Jan-May) M60**	**2022 (Jun-Dec)**	**2022 tot**	**2023 (Jan-May) M72**	**Post Total**
25.71	25.71	4.16	2.01	0.78	1.29	0.15	1.87

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Evolution of BOD degradation is being shown below, from the beginning of the installation of electrowetland until now. BOD was reduced by 88% (87,92±16,42).

There was a peak value inside the tank (8000 mg/L O_2) in 29/08/2022 but the electrowetland outlet kept values under 125 mg/L. This peak is due to the flush effect of a storm event of 25L/m^2 in less than 10 min after a period of drought.



1.13.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
Climatology Sampling frequency	We readjust the sampling for water analytics
Economical barriers	How they have been addressed
Not identified.	Not identified.
Social barriers	How they have been addressed
Not identified.	Not identified.
Environmental (including COVID)	How they have been addressed
Not identified.	Not identified.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Yes, Electrowetland is obtaining biochemical oxygen demand removal around 88%.

What was the impact? (positive/negative, significant/non-significant)?

It's having a positive and significant impact in BOD reduction from wastewater.

1.14 CH0213 Nutrient abatement (Total Solids, TSS)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0213 (old) **CH0208**	NUTRIENT ABATEMENT (Total Solids, TSS)	LEITAT
CITY	*RELATED NBS*	
VALLADOLID	Electrowetland	

1.14.1 Results and Discussion

Table of results (summary, from Task 5.4)

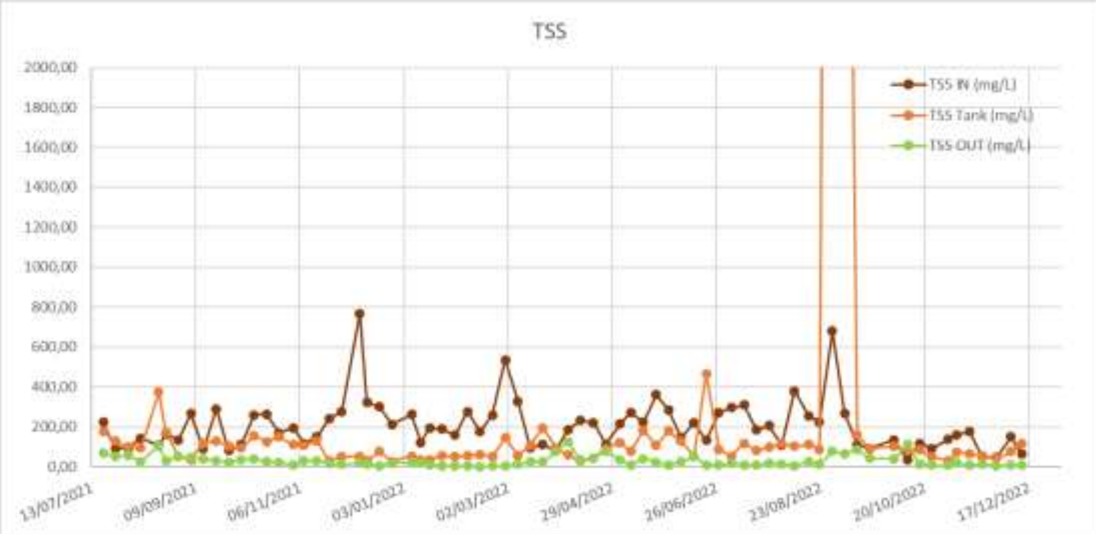
This KPI is complementary with CH0211 and CH0212 related to nutrient abatement (chemical oxygen demand and biochemical oxygen demand). Results are expressed in *kg TSS/year*

EX ANTE		**EX POST**					
2020 (Jan-May) M36	**Baseline tot**	**2021**	**2022 (Jan-May) M60**	**2022 (Jun-Dec)**	**2022 tot**	**2023 (Jan-May) M72**	**Post Total**
7.36	7.36	1.24	1.01	0.98	0.97	0.19	0.80

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Evolution of TSS reduction is being shown below, from the beginning of the installation of electrowetland until now. TSS was reduced by 76% (76,50±43,01).

There was a peak value inside the tank (10500 mg/L) in 29/08/2022 but the electrowetland outlet kept values under 77 mg/L. This peak is due to the flush effect of a storm event of 25L/m^2 in less than 10 min after a period of drought.



1.14.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
Climatology Sampling frequency Data for baseline	We readjust the sampling for water analytics
Economical barriers	How they have been addressed
Not identified.	Not identified.
Social barriers	How they have been addressed
Not identified.	Not identified.
Environmental (including COVID)	How they have been addressed

Not identified.	Not identified.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Yes, Electrowetland is obtaining total solids removal around 76%.

What was the impact? (positive/negative, significant/non-significant)?

It's having a positive and probably significant impact in TSS reduction from wastewater.

1.15 CH0218 Savings in treatment of stormwater

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0218	SAVINGS IN TREATMENT OF STORMWATER	CEN
CITY	*RELATED NBS*	
VAL	SUB-DEMO C	

1.15.1 Results and Discussion

Table of results (summary, from Task 5.4)
No data recorded (see conclusions section)
Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.
No data recorded (see conclusions section)

1.15.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Lack of qualified technical personnel in the entity	Not addressed within the project.
Economical barriers	How they have been addressed
Social barriers	How they have been addressed
Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

What was the impact? (positive/negative, significant/non-significant)?

1.16 CH0401 Green space distribution (m2/capita)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0401	GREEN SPACE DISTRIBUTION (m2/capita)	CAR
CITY	*RELATED NBS*	
VAL	VAc07 VAc09 VAc10 VAc14 VAc14 vac23 Vac25 VAc27 VAc28 vac29 VAc30 VAc31 VAc33	

1.16.1 Results and Discussion

Table of results (summary, from Task 5.4)

DISTRICTS	CH0401 BASELINE	CH0401 POST	% CH0401
Universidad	3,746	3,749	0,092
Girón	124,964	125,382	0,334
Centro	19,748	19,860	0,571
Las Villas-Cañada Puente Duero-Covaresa-Parque Alam	17,509	17,823	1,792
Campo Grande	2,081	2,201	5,761
Pilarica	13,079	21,555	64,813
Average	**30,188**	**31,762**	**12,227**

CH0401 Baseline (M2/CAPITA): GI_SURFACE (M2)/DI_inhab

CH0401 POST (M2/CAPITA): (GI_SURFACE (M2) + UGU_AREA)/DI_inhab

% CH0401: (CH0401 POST - CH0401 Baseline)*100/ CH0401 POST

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The following map shows the **baseline** for this KPI. Districts with the highest ratio of green spaces (m2) per inhabitant in green, and in red those with the lowest.

After the URBAN GreenUP interventions, there are 6 districts which has increased the green areas surfaces per inhabitant. The increase has been especially relevant in the District located at the East of Valladolid, due mainly to the VaC07 action (Urban Carbon Sink). This area has increased in a 65% green areas surface.

1.16.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
-	

Economical barriers	How they have been addressed
-	

Social barriers	How they have been addressed
-	

Environmental (including COVID)	How they have been addressed
-	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

The overall impact of the project on this KPI in the city of Valladolid has not been very significant. The NBS with the greatest impact was the Urban Carbon Sink (VaC7), which with approximately 50,000 m2 is the largest project in the city.

What was the impact? (positive/negative, significant/non-significant)?

The impact is positive in the identified districts, although not significant in many of them. The average impact has been 12.27%, considering only the districts where the impact has occurred. In total there are 6 districts of the city where the project has had an impact with respect to this KPI.

1.17 CH0402 Green space distribution (km cycle lane/capita)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0402	GREEN SPACE DISTRIBUTION (km cycle lane/capita)	CAR
CITY	*RELATED NBS*	
VAL	VAc01	

1.17.1 Results and Discussion

Table of results (summary, from Task 5.4)

TIPO	LENGTH (M)	INHABITANTS	CH0402 (KM/1000 INHAB)	% CH0402
BASELINE	82910,375	298866	0,277	
POST	90858,570	298866	0,304	9,586

CH0402 BASELINE (M/CAPITA): GI_SURFACE (M)/DI_inhab

CH0402 POST (M/CAPITA): (GI_SURFACE (M2) + UGU_AREA)/DI_inhab

% CH0402: (CH0402 POST - CH0402 Baseline)*100/ CH0402 POST

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Vac01 action involves the creation of a new interconnected network of almost 8 km in length. Over the total of the city, it has meant an increase of 9.6% of linear metres of new cycle lanes with respect to the existing one.

The following image shows in red the new sections corresponding to the Vac01 action. In yellow, the pre-existing route is shown.

1.17.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
-	
Economical barriers	How they have been addressed
-	
Social barriers	How they have been addressed
-	

Environmental (including COVID)	How they have been addressed
-	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This KPI has contribute with the challenge in a positive way, as the Vac01 has increased the accessibility to Green Space to population by cycling.

What was the impact? (positive/negative, significant/non-significant)?

The impact has been positive and significant, as the connection between different areas of the city has increased.

1.18 CH0403 Green space accessibility (m/min)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0403	GREEN SPACE ACCESSIBILITY (m/min)	CAR
CITY	*RELATED NBS*	
VAL	all	

1.18.1 Results and Discussion

Table of results (summary, from Task 5.4)

	KPI_CH0405
EXANTE (m)	83,73
EXPOST (m)	80,92
KPI INCREASE (%)	-2,33%

Average distance from houses to the nearest Green Infrastructure (m).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The following map shows the average distance between each house in the city and the nearest green infrastructure (baseline). As can be seen, there are areas of concentration of yellow and red dots. These are areas where green infrastructure is scarcer.

One such area is the central district, where several project actions have been implemented. In this particular district, the average distance to green infrastructure has changed from 102 to 51 metres.

DISTRICTS	KPI INCREASE (%)	EXANTE	EXPOST
Centro	-38,7%	102,88	51,22
Caño Argales	-24,3%	125,46	94,64
San Juan	-12,6%	60,51	47,21
Pajarillos Bajos	-8,0%	62,75	55,23
Circular	-7,8%	86,39	79,89
Pajarillos Altos	-6,5%	81,98	74,09
Universidad	-4,9%	62,42	57,22
San Miguel	-2,9%	64,70	61,35
Total general	-2,3%	83,69	80,89
Campo Grande	-2,2%	74,79	72,83
Delicias	-2,2%	69,01	66,62

Huerta del Rey (Baja)	-1,5%	15,83	15,68
Pilarica	-1,4%	75,99	75,03
Las Villas-Cañada Puente Duero-Covaresa-Parque Alam	-0,3%	47,49	47,31
Girón	-0,1%	48,06	48,06

1.18.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No technical barriers have been detected, although it can be said that this KPI depends on the availability of census data and that these are up to date.	
Economical barriers	How they have been addressed
-	
Social barriers	How they have been addressed
-	
Environmental (including COVID)	How they have been addressed
-	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This KPI has contribute with the challenge in a positive way, especially in areas with a low rate of GI and high rate of population.

What was the impact? (positive/negative, significant/non-significant)?

The impact has been positive and significant, as the accessibility has increased in the areas affected by the Urban GreenUP project.

1.19 CH0404 Green infrastructure connectivity (%)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0404	GREEN INFRASTRUCTURE CONNECTIVITY (%)	CAR
CITY	*RELATED NBS*	
VAL	All (VAC2, VAC3, VAC4, VAC5 excluded)	

1.19.1 Results and Discussion

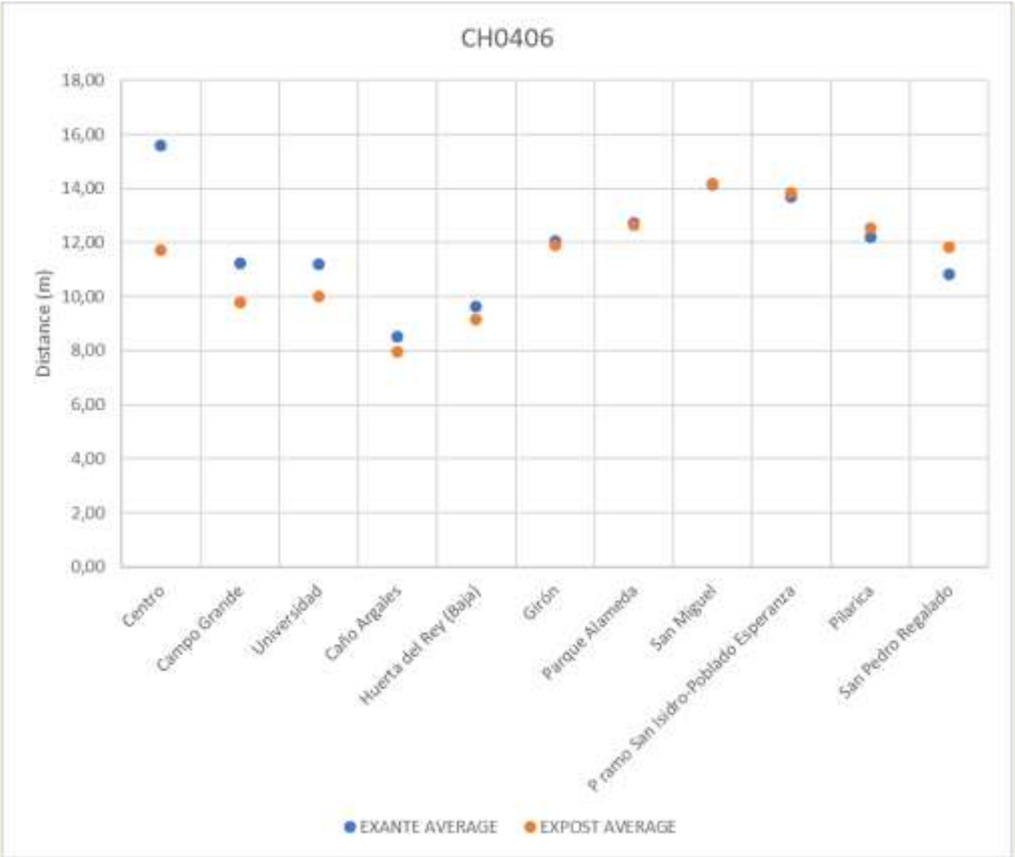
Table of results (summary, from Task 5.4)

	KPI_CH0406
EXANTE (m)	11,99
EXPOST (m)	11,41
KPI INCREASE (%)	-4,45%

Average distance from one Green Infrastructure to the nearest (m) considering neighborhoods with URBAN GreenUP actions.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

In the districts where interventions have taken place, the distance between green infrastructure has decreased by 4.45%. This was particularly significant in the Centro district, where the distance between a green infrastructure and its nearest neighbour decreased by 25%, from 16m to 12m.



1.19.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Tree-planting actions has not been evaluated since location of the plantations has not been provided	VAC2, VAC3, VAC4, VAC5 not included in the analysis.
Economical barriers	How they have been addressed
-	
Social barriers	How they have been addressed
-	

Environmental (including COVID)	How they have been addressed
-	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This KPI has contribute with the challenge in a positive way, especially in areas with a low rate of GI. That is the case of the Central district.

What was the impact? (positive/negative, significant/non-significant)?

The impact has been positive and significant, as the connectivity between green infrastructure has increased in the areas affected by the Urban GreenUP project.

1.20 CH0406 Recreational value

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0406	RECREATIONAL VALUE	VAL

CITY	*RELATED NBS*
VALLADOLID	Non-technical (VAc39 Ecological reasoning, Vac41 Support NBS)

1.20.1 Results and Discussion

Table of results

Quantify the number of people participating in the recreational activities per year, related to any NBS, both recreational (number of visitors, number of recreational activities) or cultural value (number of cultural events, people involved, children in educational activities), expressed in (nº people/year).

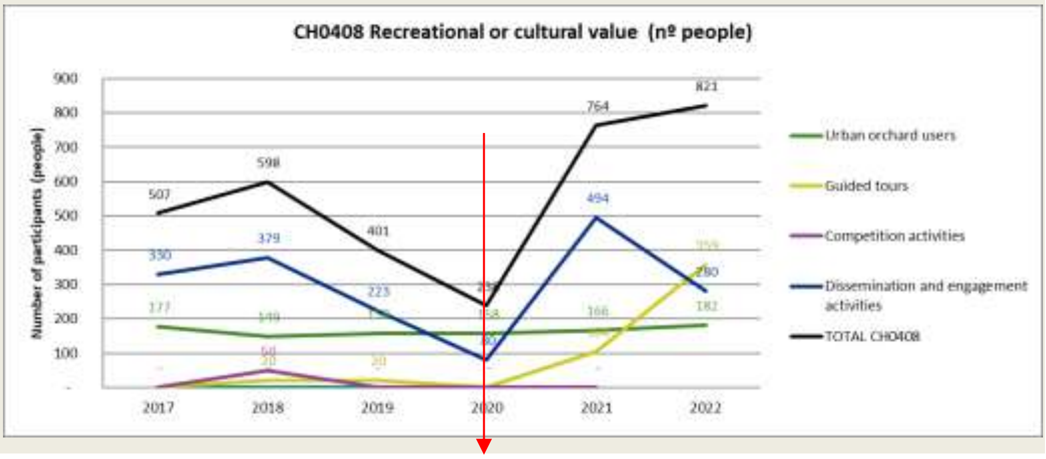
EX ANTE (BASELINE)				
2017	2018	2019	2020 (Jan-May)	Σ Baseline
507 people	598 people	401 people	238 people	502 people

EX POST			
2020	2021	2022	Σ Post
238 people	764 people	821 people	608

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Trends: Clear recovery of the number of citizens who have been reached with non-technical activities (dissemination, engagement), after the fall due to the Covid-19 pandemic (march 2020). In 2021 most of the activities were online.

Name	Unit	2017	2018	2019	2020	2021	2022	Total
Urban orchard users	nº gardener	177	149	158	158	166	182	**808**
Guided tours	nº participants	-	20	20	-	104	359	**144**
Competition activities	nº competitors	-	50	-	-	-		**50**
Dissemination and engagement activities	nº participants	330	379	223	80	494	280	**1.506**
TOTAL CH0408		**507**	**598**	**401**	**238**	**764**	**821**	**2.508**



1.20.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
The quantification of the number of people who attend a non-technical activity is sometimes estimated.	Estimated number of participants, for those events in which there is no list.

Economical barriers	How they have been addressed
Not identified.	

Social barriers	How they have been addressed
In some non-technical activities there is low citizen participation.	▪Reinforcement of the dissemination of the event. ▪Invitation campaigns to specific groups of stakeholders.

Environmental (including COVID)	How they have been addressed
▪The Covid-19 pandemic forced the cancellation of several non-technical events for 2020.	▪Non-technical actions recovered early but virtual, starting in fall 2020. The activities of 2020 and 2021 have been mostly virtual.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Yes. The KPI CH0408 is part of the CHALLENGE 4: Green Space Management. This KPI clearly shows the number of citizens who have been reached with non-technical actions, both cultural and recreational. The results show that the scope of the actions has been increasing, despite the pandemic.

What was the impact? (positive/negative, significant/non-significant)?

Positive and Significant.

1.20.3 Other comments

Optional: Any other relevant comments that you would like to include.

This indicator is easy to monitor, and to feed mostly real data. An updated inventory can be made of all the non-technical activities carried out in the city on the occasion of URBAN GreenUP, and the number of people participating can be recorded. This KPI includes the farmers that use the municipal urban orchards, as well as the nº participants in guided tours, dissemination & engagement activities, as well as nº competitors that participate in the specific competitions organized for URBAN GreenUP.

1.21 CH0408 Green areas sustainability

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0408	GREEN AREAS SUSTAINABILITY	VAL
CITY	*RELATED NBS*	

VALLADOLID	VAc24 Green Vertical mobile garden VAc27 Green Covering Shelter VAc25 Green Façade VAc28 Green Roof VAc29 Green Shady Structures VAc22-VAc23 Green noise barriers VAc30 Urban Garden Bio-Filter VAc26 Electro-wetland VAc2 Planting 1,000 trees VAc3 Tree shady places (500 trees) VAc4 Shade and cooling trees (600 trees) VAc5 Re-naturing parking trees (250) VAc31 Urban orchard VAc32 Community composting VAc1 New green cycle lane and re-naturing existing bike lanes VAc15 Cycle-pedestrian green paths VAc6 Installation of 3 Green Resting areas (C1, B, C3) VAc7 Urban Carbon Sink VAc20 Compacted Pollinator's modules VAc19-VAc21 Natural pollinator's modules VAc9 SUDs for re-naturing parking VAc10 Rain gardens VAc14 Green Parking Pavements

1.21.1 Results and Discussion

Table of results

The methodology evaluates different aspects (requisites) for every NbS implemented in Valladolid, organized in three different topics: 1) Impact on ecosystem, 2) Construction and operation, 3) Impact on society.

The score table is completed only in the Expost scenario. Basline is 0 (before implementation).

EX ANTE	EX POST				
⍰ Baseline	2020	2021	2022	2023	⍰ Expost
Score = 0	54	51	49	49	51

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The KPI is calculated individually for each of the NbS implemented in Valladolid. Each NbS gets a numerical (score) and qualitative rating (Very good: 65-100, Good: 40-65, Bad: 20-40, Very bad: 0-20)

		Ex-post						
Name	NBS	Ecosystem	Construction/ operation	Society	Score	Category	Implementation date	
Vertical and horizontal interventions								
Green infraestructure	VAc24 Green Vertical mobile garden	13,3	3,3	16,7	33	Bad	08/05/2020	M36
	VAc27 Green Covering Shelter	13,3	13,3	23,3	50	Good	24/02/2020	M33
	VAc25 Green Façade	16,7	20,0	23,3	60	Good	30/06/2020	M37
	VAc28 Green Roof	20,0	20,0	20,0	60	Good	15/08/2020	M39
	VAc29 Green Shady Structures	16,7	13,3	16,7	47	Good	26/02/2021	M45
	VAc22-VAc23 Green noise barriers	16,7	10,0	20,0	47	Good	04/03/2022	M58
Singular infraestructure								
BioFilter	VAc30 Urban Garden	10,0	16,7	16,7	43	Good	25/11/2021	M54

	Bio-Filter							
EW	VAc26 Electro wetland	23,3	16,7	23,3	63	Good	02/07/2021	M50
Tree related actions								
Trees	VAc2 1,000 trees	26,7	10,0	20,0	57	Good	octubre-20	M41
	VAc3 Tree shady	26,7	13,3	20,0	60	Good	January-20	M32
	VAc4 Shade &cooling trees	23,3	16,7	23,3	63	Good	octubre-20	M41
	VAc5 Re-naturing parking trees	26,7	13,3	20,0	60	Good	enero-20	M32
Urban orchards								
Urban orchards	VAc31 Urban orchard	13,3	6,7	20,0	40	Good	sept-20	M40
	VAc32 Community composting	6,7	26,7	20,0	53	Good	Sept 2020	M40
Green corridor								
Cycle lane	VAc1 New green cycle lane	6,7	13,3	26,7	47	Good	abril-22	M59
	VAc15 Cycle-pedestr green paths	13,3	6,7	23,3	43	Good	abril-22	M59
Resting areas	VAc6 Installation of 3 Green Resting areas	13,3	16,7	26,7	57	Good	abril-22	M59
Urban carbon sink	VAc7 Urban Carbon Sink	26,7	16,7	23,3	67	Very good	abril-22	M59
Pollinator's modules								
Compacted	VAc20 Compacted Pollinator's modules	10,0	6,7	23,3	40	Good	abril-22	M59
Natural	VAc19-VAc21 Natural pollinator's modules	16,7	13,3	13,3	43	Good	abril-22	M59
Stormwater management systems								
SUDs	VAc9 SUDs for re-naturing parking	26,7	16,7	6,7	50	Good	mayo-23	M72
	VAc10 Rain gardens	26,7	16,7	6,7	50	Good	mayo-23	M72
	VAc14 Green Parking Pavements	20,0	16,7	10,0	47	Good	mayo-23	M72

CH0417 Green areas sustainability	Ecosystem	Construction/ operation	Society	
AVERAGE TOTAL SCORE NBS	18,0	13,7	21,0	51

1.21.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed

The assessment of the questions that make up each of the three criteria has a certain degree of subjectivity.	Questions can be answered with yes/No, so this minimize the subjectivity.
Economical barriers	How they have been addressed
Not identified.	
Social barriers	How they have been addressed
Not identified. The opinion of citizens is evaluated through a Citizen Participation Survey (launched in September 2021). This KPI CH0417 is calculated by technicians from the City Hall of Valladolid.	The opinion, perception and knowledge of the citizens is addressed with KPI CH0703 Citizen Perception.
Environmental (including COVID)	How they have been addressed
Not identified. The calculation of this KPI has not been directly influenced by the Covid pandemic. It has only delayed the execution of some NbS.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
Yes. This KPI CH0412 belongs to CHALLENGE 4: Green Space Management. This KPI is defined by a methodology of 30 questions for three criteria (10 questions each). It is a robust method of identifying the degree of sustainability of the NbS. To make the analysis more robust, it could be completed by other technicians and stakeholders directly involved in Valladolid Demo, and calculate an average of results.
What was the impact? (positive/negative, significant/non-significant)?
Positive and Significant. The impact of this KPI is positive since it assigns a score to each NbS of Valladolid Demonstration, which allows determining the degree of sustainability as Very high, high, medium, low or very low (Likert scale of 5). It is considered Significant since it is calculated individually for each of the NbS. And the methodology is easily replicable to other cities with any NbS.

1.22 CH0409 Food production

KPI CODE	*KPI NAME*	*PARTNER(S)*

CH0409	FOOD PRODUCTION	VAL
CITY	*RELATED NBS*	
VALLADOLID	Vac31-Urban orchard; Vac32-Community composting	

1.22.1 Results and Discussion

Table of results (summary, from Task 5.4)

EX ANTE (BASELINE)				
2017	2018	2019	2020 (Jan-May)	Σ Baseline
58,61 t	50,76 t	53,28 t	53,28 t	53,98 t

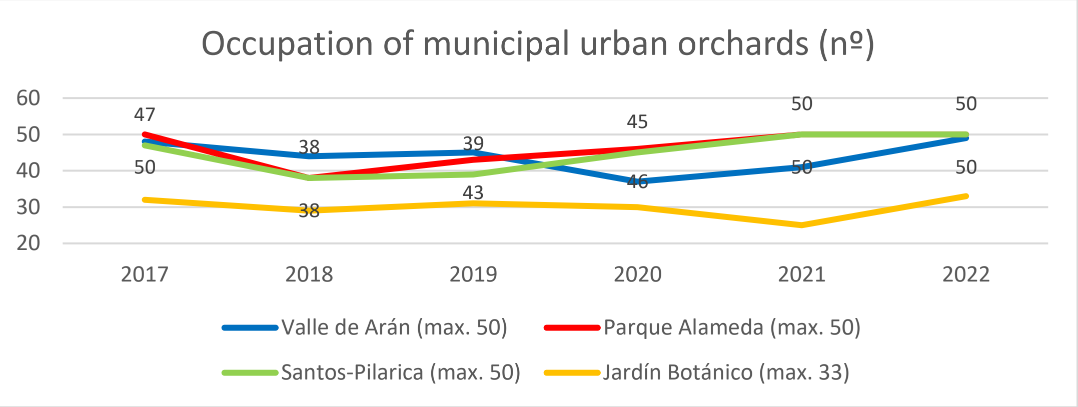
EX POST			
2020 (Jun-Dec)	2021	2022	Σ Expost
53,28 t	55,45	55,45 t	60,01 t

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

For the calculation of the production of food in the municipal orchards, we calculated an average factor (kg food/m^2) with measured data taken in the municipal plot of the *Communitary orchard 'Valle de Arán'*. The food production rate is 5,61 kg/m^2. This factor is applied to the area occupied in each municipal garden, annually.

Orchard	Individual plot (nº) [50m2/plot]	Surface (m2)	2017	2018	2019	2020	2021	2022	Total
Valle de Arán	50	3.300	17,95 t	16,83 t	17,11 t	14,86 t	15,98 t	18,23 t	100,95 t
Parque Alameda	50	2.800	14,02 t	10,66 t	12,06 t	12,90 t	14,02 t	14,02 t	77,68 t
Santos-Pilarica	50	3.300	17,67 t	15,14 t	15,42 t	17,11 t	18,51 t	18,51 t	102,35 t
Jardín Botánico	33	1.650	8,97 t	8,13 t	8,69 t	8,41 t	6,94 t	9,25 t	50,40 t
	183	11.050 m2	**58,61 t**	**50,76 t**	**53,28 t**	**53,28 t**	**55,45 t**	**60,01 t**	**331,38 t**

Average occupation of urban orchards is around 90% yearly. No significant variations in the orchards' occupancy are observed after the application of improvements in urban gardens (VAc31, VAc32).



1.22.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
The amount of food produced in each plot of each garden is not measured. On average there are 50 plots of 50m2 each in each of the 4 municipal gardens.	The KPI is calculated on an estimated basis with a production factor measured in a pilot experience.

Economical barriers	How they have been addressed
There is no economic relationship with the market gardeners. All food production from each plot is for personal use.	

The food from the community gardens is transferred to the Food Bank, social kitchens or others.	
Social barriers	How they have been addressed
They do not exist. The reception of the urban orchards and the improvements on the part of the gardeners is good. The occupancy rate is always high.	
Environmental (including COVID)	How they have been addressed
The exploitation of urban orchards was affected during the closure of the pandemic (March-June 2020).	The orchards reopened again in 2021.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This KPI CH0412 belongs to CHALLENGE 4: Green Space Management. Impact can be identified as Medium. The municipal gardens work before the arrival of URBAN GreenUP. The improvements implemented and community composting have been well received, but have not been reflected in improved results for this KPI. But the results continue to be positive in the 4 municipal gardens.

What was the impact? (positive/negative, significant/non-significant)?

Positive and Partially significant.

1.23 CH0410 Elderly People Life Quality

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH...0410	Elderly People Life Quality	GMV-S
CITY	*RELATED NBS*	
VALLADOLID	Green cycle lane; Tree related actions; Vertical and horizontal GI; Green resting areas; Cycle-pedestrian green paths; Urban carbon sink	

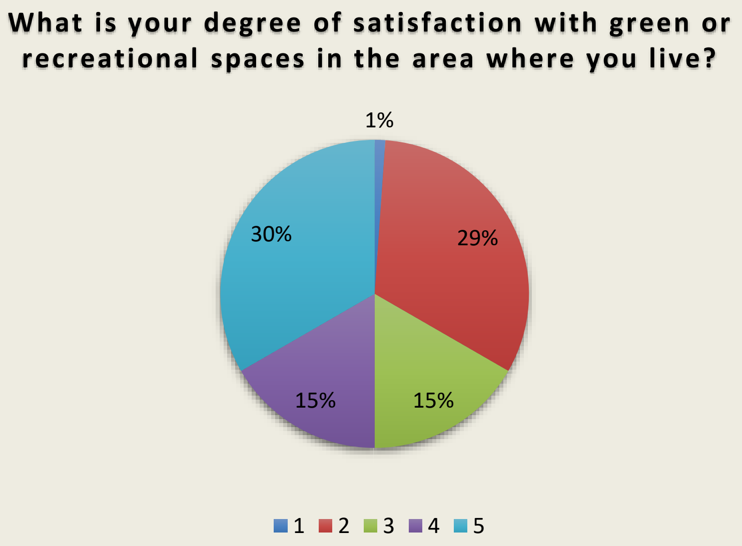
1.23.1 Results and Discussion

Table of results (summary, from Task 5.4)

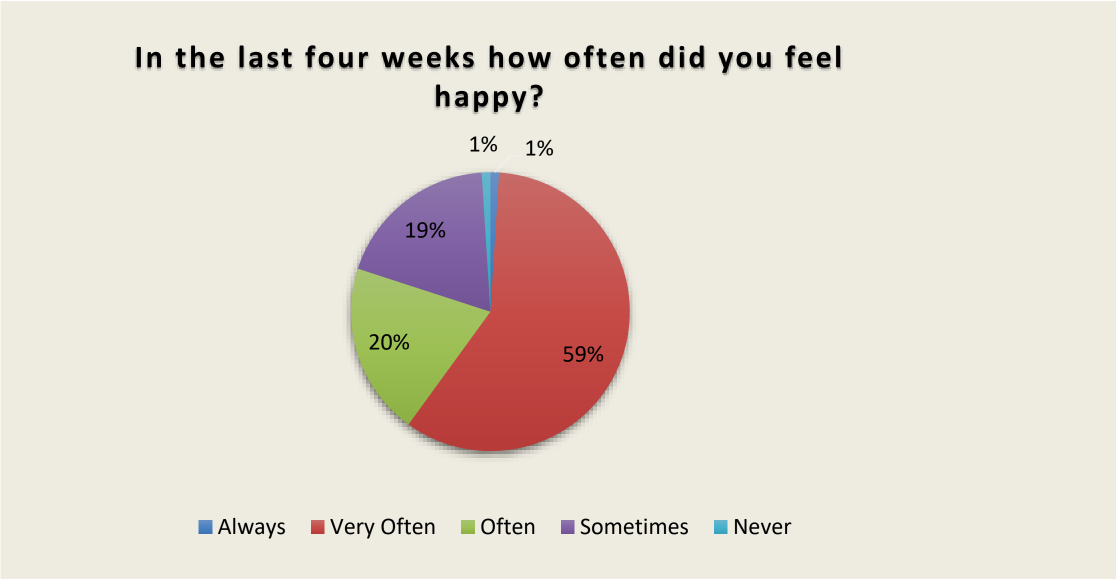
The KPI is calculated as a numeric value on a likert scale (from 1 to 5) using the results of the survey. The application used to present the surveys was not available prior to the deployment of the NBSs (the initial deployment was in September 2021, so there are not previous values for the baseline.

The current value is 3.775, which is quite positive, although more samples are required to see the evolution of the value.

Sample responses for the period are represented below:



Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.



1.23.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
Deployment of the application was late, since it needed to display information about the NBSs. Also, interventions in the Green Corridor needed to be in place for the monitoring	When a sufficient amount of information was available and enough NBSs were deployed, the application was published to the public.
Economical barriers	How they have been addressed
N/A	N/A
Social barriers	How they have been addressed
The user base for the application is still low, and elderly people within the user base are only a small fraction	The Valladolid municipality has published ads and press articles about the application to promote its use.
Environmental (including COVID)	How they have been addressed
N/A	N/A

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further values are required to measure the impact of the interventions on the KPI, but the initial scores gathered are positive.

What was the impact? (positive/negative, significant/non-significant)?

N/A

1.23.3 Other comments

Optional: Any other relevant comments that you would like to include.

There is not enough expertise in the consortium about sociological analysis to develop a survey tailored for this KPI. Therefore, existing surveys in the public domain have been used as the basis for the surveys used in the project (slightly simplified for the presentation in a smartphone).

Such considerations shall be taken into account when building the consortium, to ensure that not only the technical know-how but also other areas are sufficiently covered.

1.24 CH0411 Connectivity Perception

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH…0411	Connectivity Perception	GMV-S
CITY	*RELATED NBS*	
VALLADOLID	Green cycle lane; Tree related actions; Vertical and horizontal GI; Green resting areas; Cycle-pedestrian green paths; Urban carbon sink	

1.24.1 Results and Discussion

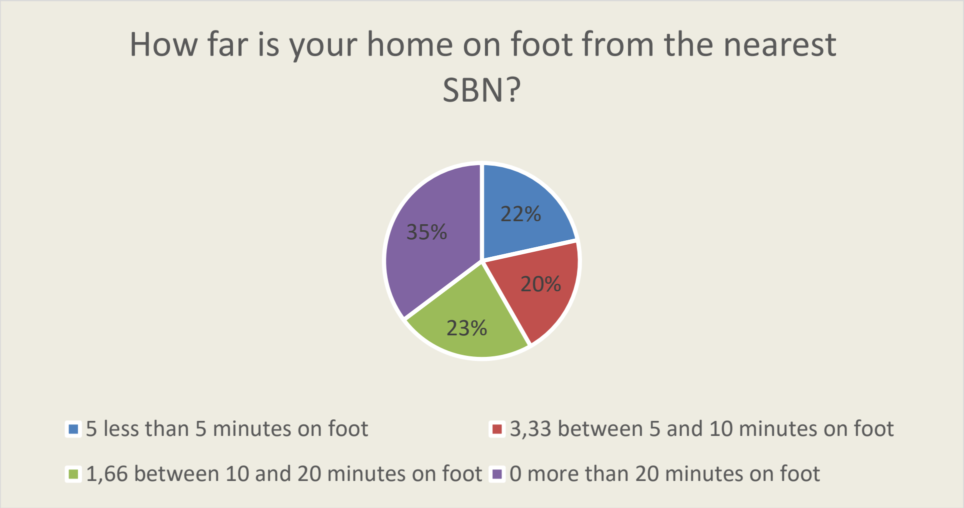
Table of results (summary, from Task 5.4)

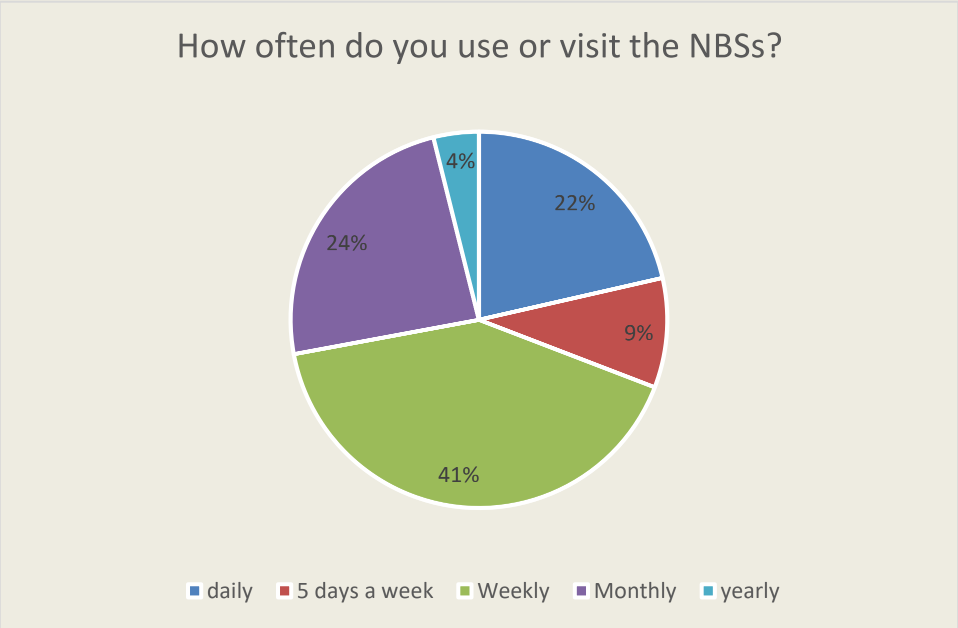
The KPI is calculated as a numeric value on a likert scale (from 1 to 5) using the results of the survey. The application used to present the surveys was not available prior to the deployment of the NBSs (the initial deployment was in September 2021) so Valladolid Municipality presented a manual survey to gather information.

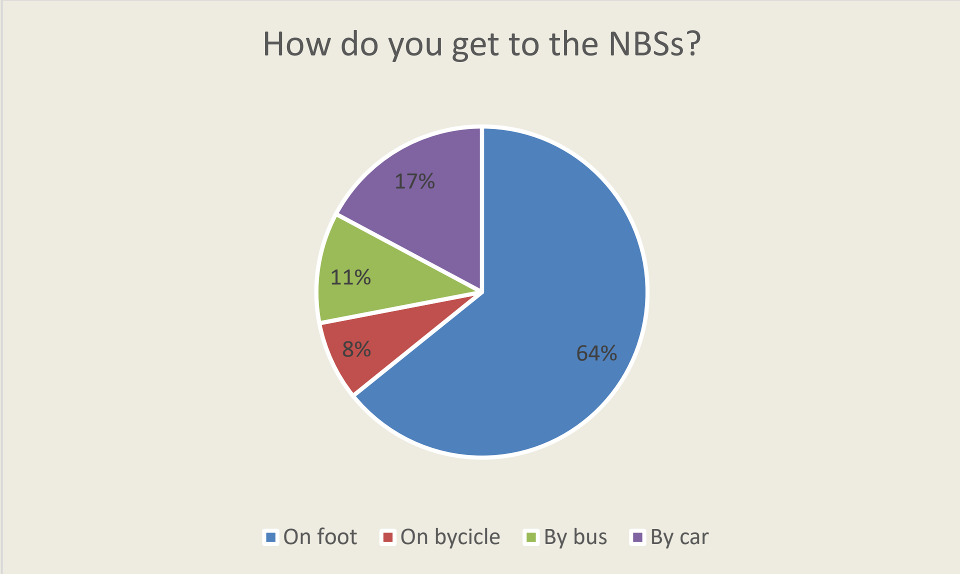
The current value measured is 2.85 which is slightly above average, although more samples are required to measure the evolution of the indicator.

Sample responses for the period are represented below:

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.







1.24.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
Deployment of the application was late, since it needed to display information about the NBSs. Also, interventions in the Green Corridor needed to be in place for the monitoring	Valladolid's municipality performed a manual survey to gather information before the application was published
Economical barriers	How they have been addressed
N/A	N/A
Social barriers	How they have been addressed
There is opposition from some individuals towards the NBS, so they responded nonsensical answers to the survey	They have been interpreted as the lowers score (rather than filtered out)
Environmental (including COVID)	How they have been addressed
N/A	N/A

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further information is required to measure the impact of the interventions on the KPI

What was the impact? (positive/negative, significant/non-significant)?

N/A

1.24.3 Other comments

Optional: Any other relevant comments that you would like to include.

Further data will be gathered with the smartphone application in order to track the evolution of the value

1.25 CH0413 Pollinator species increase

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0413	POLLINATOR SPECIES INCREASE	CARTIF
CITY	*RELATED NBS*	
VAL	POLLINATOR MODULES	

1.25.1 Results and Discussion

Table of results (summary, from Task 5.4)

TYPE OF INDICATOR: Biological

UNIT: % , Nº

SCALE: Urban and street

ECOSYSTEM SERVICES: Supporting

DEFINITION: Increased habitat for pollinators in NBS GI may contribute to increased abundance of pollinators in the wider urban area.

METHODOLOGY: Measured pollinator's species richness and nº of visits by pollinating insects in located samples.

METERING SPECCIFICATIONS: Statistical data measured

DATA SOURCE: Measuring through observations (statistics)

FRECUENCY OF DATA COLLECTION: monthly

OUTPUT DATA: table values (.xlsx)

BASELINE: Just completed. Module locations are not known until March 2022. (pollinators modules)

POST-INTERVENTION: Not started, implementation of pollinator modules has not finish. The implementation of the modules structure has not been completed and they have not been correctly installed.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

STATUS:

2020:

Monitoring started in February 2020 and was suspended during the months of March to May due to COVID-19.

At the end of May - June , it was restarted.

Monitoring was suspended in September for various reasons: abundant rainfall, review meeting and average temperatures below 15º.

The first frosts occurred in 12th October. Therefore, monitoring was ruled out for that month and the following months.

2021:

The mild temperatures at the end of January meant that many plants had already started to sprout, so the monitoring was restart in February with the beginning of the flowering season.

2022:

The month of February was characterised by frequent frosts but with high hours of sunshine, so that some plants that resisted the night frosts began to flower, such as the almond trees. Monitoring began in March, despite being a very rainy month.

April 2022 status:

During the 2022 monitoring, the original sampling points were adapted to suit the locations of the pollinator modules, which in March and April were still under construction.

Therefore, the baseline will continue until the infrastructures are prepared and the plants are installed.

The KPI specifies that the unit must be % or Nº, so during the monitoring the number of pollinators observed in the are is recorded without capture for later exact identification. In order to obtain more data, a more specific classification is made by dividing the observed biodiversity into four large groups:

- Butterflies
- Flies
- Beetles
- Bees
- Others

'Others' include:

- Ants: that collaborate in the seeds dispersal.
- Ladybugs: they act as a biological control of pests so they favor the health of flowers and therefore more pollinators.
- Spiders: reduction of pollinators
- Lizzards: also pollinators, dragging pollen from certain plants

There are 4 sampling areas: Urban Carbon Sink (UCS), Natural Wastewater Plant (NWP), Orchards Park Alameda (OPA), City Centre Route (CCR).

EX ANTE (BASELINE)					
Ref. 2017	Ref. 2018	Ref. 2019	Ref. 2020	Ref. 2021	Ref. Baseline (1 data)
Baseline Value_1	Baseline Value_2	Baseline Value_3	Baseline Value_4	Baseline Value_5	Final Value
-	-	-	26,58	44,4	35,49

Figure 1.1. Baseline total values (number)

		Butterflies	Flies	Beetles	Bees	Others	Average
UCS	2020	2,67	4,89	0,78	1,64	0,92	**9,97**
	2021	4,1875	3,00	0,28	2,19	1,47	**9,66**
NWP	2020	1,47	2,13	0,07	0,20	2,20	**3,87**
	2021	0,48	2,78	0,40	0,93	1,58	**4,58**
OPA	2020	0,48	1,81	1,71	1,38	1,10	**5,38**
	2021	1,25	3,57	0,30	4,14	1,39	**9,27**
	2020	0,21	0,57	0,10	0,37	0,28	**1,25**

CCR	2021	0,16	1,80	0,09	1,28	0,74	**3,33**

Figure 1.2. Summary of the average values according sampling area and type of pollinator

The presence of pollinators has significantly increased from one year to the next due to several factors:

- There are more Green Infrastructures, overall in city centre which increase connectivity between green areas.
- In 2020 less sampling was done due to the lockdown. Moreover, printemps is the season where more presence of pollinators is recorded and due to the lockdown, the monitoring started at the end of this season when high temperatures starts and pollinators found less food.
- It is expected that the implementation of the pollinator modules will have a positive effect on the increase of pollinators, although it depends on the development of the installed plants, since the first year they usually have less flower production due they are in the root prospecting phase. That is why two years of monitoring is necessary once the NBS have been installed.

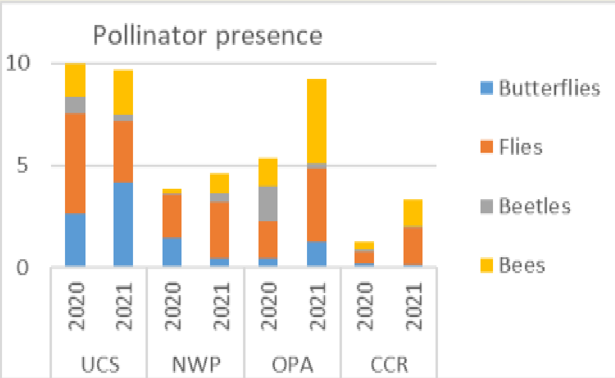


Figure 1.3. Pollinator presence average per year

Beetles

Butterflies

Bombus

Bees

Flies

Figure 1.4. Examples of the relevant pollinators categories found in the sampling areas

1.25.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Lack of knowledge of the final location of both natural and compact pollinator modules; The frequency of mowing and weeding of green areas cancels out the presence of pollinators, significantly altering data collection; In the urban area, relocations of NBS and accesses cut off due to activities and social events prevent data collection of some points;	The number of sampling points for the baseline has been doubled and other NBS that were not originally going to be monitored in this KPI has been included as baseline; The closest accessible points to NBS has been chosen as monitoring point;

Inability to monitor some of the NBS due to their height;	
Economical barriers	How they have been addressed
Field surveys require high time dedication and qualified personnel for the identification of species. This means high personnel costs.	To optimize times, the frequency of data collection is monthly instead of weekly.
Social barriers	How they have been addressed
Citizens have not been involved as part of engagement activities due to data needs to be collected by trained staff.	Dissemination days have been held, through articles and photographs.
Environmental (including COVID)	How they have been addressed
During the lockdown (March, April and May 2020), field surveys could not carry out, affecting baseline data collection. The deconfinement caused the population to occupy green spaces for recreation and sports, so that in some places the presence of pollinators was reduced.	There is baseline for those months in 2021 and 2022 to complement the shortcomings of the unaccounted months.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

The presence of GI favours the presence of pollinators. The plant species provide food almost all year round, but it is scarce and not constant. Larger pollinators such as large bees and butterflies are sighted in peri-urban areas. There is currently no connectivity in the NBSs corridor. There is still no post-implementation data of pollinator modules so no final conclusions can be drawn.

What was the impact? (positive/negative, significant/non-significant)?

Positive impact in the GI; Non-significant impact in control points

1.25.3 Other comments

Optional: Any other relevant comments that you would like to include.

The monitoring is carried out only during day-hours, firstly in the morning. Therefore, no nocturnal species are being counted.

The constant weeding of green areas and GI makes it impossible to maintain pollinator friendly areas.

1.26 CH0501 Annual levels of fine particles, $PM_{2,5}$

RELATED KPI CODE	*NBS NAME*	*PARTNER(S)*
CH0501	Annual levels of fine particles, $PM_{2,5}$	CAR
CITY	*RELATED NBS*	
VAL	VAc24, VAc25, VAc27 & Vac29,	

1.26.1 Results and Discussion

Table of results of this KPIs for the relevant NBS interventions in the city of Valladolid. In this case, as introduction for each NBS is indicated the reference site selected to calculate the CH0501 KPI. The selection of the reference site has been done according the NBS implementation site characteristics among the available reference data.

The calculation of this KPI has been done individually for each NBS because, as these NBS have building or street scale, the evaluation of all of them at district or city scale joining all the date, has no interest itself.

VAc25 Green Façade (Ending implementation date 30/06/2020)

NBS intervention site (El Corte Inglés Building in Constitución St.) is an urban space with PM background levels because there is no traffic in the area. Reference site (Montero Calvo St. in Valladolid) is also considered an urban space with background levels because has no traffic.

$PM_{2,5}$ reduction	VALUE	UNITS	Year
Ex-ante (2019)	98	%	
Ex-post (2020)	66	%	
Ex-post (2021)	49	%	

CH0501	**49**	**%**	**2021**

VAc 27 Green Covering Shelter (Ending implementation date 24/02/2020)

NBS intervention site in España Sq. Reference site (Rinconada Sq. in Valladolid). Both sites are squares and have similar levels of traffic.

$PM_{2,5}$ reduction	VALUE	UNITS	Year
Ex-ante (2019)	102	%	
Ex-post (2020)	111	%	
Ex-post (2021)	97	%	
CH0501	**97**	**%**	**2021**

VAc29 Green shady structures (Ending implementation date 26/02/2021)

NBS intervention site in Santa María St. Reference site (Montero Calvo St. in Valladolid). Both places are considered with urban background pollution levels without traffic.

$PM_{2,5}$ reduction	VALUE	UNITS	Year
Ex-ante (2019)	123	%	
Ex-post (2020)	97	%	
Ex-post (2021)	127	%	
CH0501	**127**	**%**	**2021**

Discussion of results: In the results and discussion section, all the related KPIs will be put in common and contextualized in terms of the challenges addressed. This section should be supported with photos, tables, charts, maps, etc.

The discussion of the results of this KPI has been also done individually for each NBS because, as these NBS have building or street scale, the evaluation of all of them at district or city scale joining all the date, has no interest itself. However, the individual evaluation of each NBS will support the selection of the proper NBS when a PM concentration reduction is being aimed.

VAc25 Green Façade (Ending implementation date 30/06/2020)

The assessment of this KPI show that this NBS has a positive influence in the $PM_{2,5}$ city background levels. The reference location also with city background levels is close to the NBS intervention site. Additionally, this result should be checked with further studies to check this conclusion.

VAc 27 Green Covering Shelter (Ending implementation date 24/02/2020)

This result in 2021 indicates that the Green covering shelter (VAc27) has no influence on $PM_{2,5}$ concentration in the urban air. It is a location with relevant traffic levels (also in the reference site).

VAc29 Green shady structures (Ending implementation date 26/02/2021)

This result in 2021 seems to indicate (in comparison with 2019) that the implementation of the green shady structures in the Santa María St. has no influence in the PM2,5 concentration in air.

Anyway, it is relevant that collected values are most of them under the legal limits. However, data are quite variable and it is recommended to assess the impact during 2022 summer time in order to know if this intervention could affect maximum temperatures in the area.

1.26.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Measurements are highly affected by punctual high emitters such a car started but unmoved. It is especially relevant for pedestrian streets.	It would be better to propose a monitoring campaign shorter but denser in terms or data in order to assess the impact of the NBS. In this way it can be reduced the influence of external factors in the measurements.
Economic barriers	How they have been addressed

PM monitoring tools are quite expensive and it is not possible to install one device in all the monitoring sites selected. Additionally, the ones with highly connectivity are too expensive.	One portable tool was acquired and periodic monitoring campaigns were performed. This procedure has the limitation of the reduced representativity because
Social barriers	How they have been addressed
It is a highly extended practice to keep the engine on when vehicles (especially diesel ones) are stopped for some minutes.	Continuous monitoring campaigns with autonomous devices are better to identify potential outlayers. For pedestrian streets, data for analysis can be limited to hours without vehicles (out of commercial schedule).
Environmental (including COVID)	How they have been addressed
During the lockdown, in general, all the parameters associated to air pollution decreased due to the lack of traffic.	In that case, monitoring campaign should be moved.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

As it has been previously introduced, impacts depend on the type of NBS and its location. Anyway, this KPI assess the impact of vegetation on the PM concentration. Many research papers report about it, and most of the agreed that even when PM can be captured by tree's leaves, the impact on PM concentration in urban air is very reduced due to the emission levels are much higher than capture capacity by the green infrastructure.

In this sense, NBS assessed with this KPI show similar conclusions by resulting in no differences appreciated after the implementations of the NBS except for the green façade.

What was the impact? (positive/negative, significant/non-significant)?

VAc25 Green Façade – Positive, significant

VAc 27 Green Covering Shelter – Non-significant

VAc29 Green shady structures – Non-significant

1.26.3 Other comments

Optional: Any other relevant comments that you would like to include.

Other NBS in Valladolid have been partially monitored but data collected do not allow an adequate analysis and so these results have not been included in this document.

Additionally, it is recommended to assess this KPI during 2022 in order to value the real impact of the interventions thinking that the vegetation is fully developed this year.

1.27 CH0502 Annual levels of fine particles, PM_{10}

RELATED KPI CODE	*NBS NAME*	*PARTNER(S)*
CH0502	Annual levels of fine particles, PM10	CAR
CITY	*RELATED NBS*	
VAL	VAc24, VAc25, VAc27 & Vac29,	

1.27.1 Results and Discussion

Table of results of this KPIs for the relevant NBS interventions in the city of Valladolid. In this case, as introduction for each NBS is indicated the reference site selected to calculate the CH0502 KPI. The selection of the reference site has been done according the NBS implementation site characteristics among the available reference data.

The calculation of this KPI has been done individually for each NBS because, as these NBS have building or street scale, the evaluation of all of them at district or city scale joining all the date, has no interest itself.

VAc25 Green Façade (Ending implementation date 30/06/2020)

NBS intervention site (El Corte Inglés Building in Constitución St.) is an urban space with PM background levels because there is no traffic in the area. Reference site (Montero Calvo St. in Valladolid) is also considered an urban space with background levels because has no traffic.

$PM_{2,5}$ reduction	VALUE	UNITS	Year
Ex-ante (2019)	94	%	
Ex-post (2020)	93	%	
Ex-post (2021)	44	%	
CH0501	**44**	**%**	**2021**

VAc 27 Green Covering Shelter (Ending implementation date 24/02/2020)

NBS intervention site in España Sq. Reference site (Rinconada Sq. in Valladolid). Both sites are squares and have similar levels of traffic.

$PM_{2,5}$ reduction	VALUE	UNITS	Year
Ex-ante (2019)	108	%	
Ex-post (2020)	90	%	
Ex-post (2021)	98	%	
CH0501	**98**	**%**	**2021**

VAc29 Green shady structures (Ending implementation date 26/02/2021)

NBS intervention site in Santa María St. Reference site (Montero Calvo St. in Valladolid). Both places are considered with urban background pollution levels without traffic.

$PM_{2,5}$ reduction	VALUE	UNITS	Year
Ex-ante (2019)	123	%	
Ex-post (2020)	85	%	
Ex-post (2021)	54	%	
CH0501	**54**	**%**	**2021**

Discussion of results: In the results and discussion section, all the related KPIs will be put in common and contextualized in terms of the challenges addressed. This section should be supported with photos, tables, charts, maps, etc.

The discussion of the results of this KPI has been also done individually for each NBS because, as these NBS have building or street scale, the evaluation of all of them at district or city scale joining all the date, has no interest itself. However, the individual evaluation of each NBS will support the selection of the proper NBS when a PM concentration reduction is being aimed.

VAc25 Green Façade (Ending implementation date 30/06/2020)

The assessment of this KPI show that this NBS has a positive influence in the PM_{10} city background levels. The reference location also with city background levels is close to the NBS intervention site. Additionally, this result should be checked with further studies to check this conclusion.

VAc 27 Green Covering Shelter (Ending implementation date 24/02/2020)

This result in 2021 indicates that the Green covering shelter (VAc27) has no influence on PM_{10} concentration in the urban air. It is a location with relevant traffic levels (also in the reference site).

VAc29 Green shady structures (Ending implementation date 26/02/2021)

This result in 2021 seems to indicate (in comparison with 2019) that the implementation of the green shady structures in the Santa María St. has a positive influence in the PM_{10} concentration in air.

Anyway, it is relevant that collected values are most of them under the legal limits. However, data are quite variable and it is recommended to assess the impact during 2022 summer time in order to know if this intervention could affect maximum temperatures in the area.

1.27.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Measurements are highly affected by punctual high emitters such a car started but unmoved. It is especially relevant for pedestrian streets.	It would be better to propose a monitoring campaign shorter but denser in terms or data in order to assess the impact of the NBS. In this way it can be reduced the influence of external factors in the measurements.
Economic barriers	How they have been addressed
PM monitoring tools are quite expensive and it is not possible to install one device in all the monitoring sites selected. Additionally, the ones with highly connectivity are too expensive.	One portable tool was acquired and periodic monitoring campaigns were performed. This procedure has the limitation of the reduced representativity because
Social barriers	How they have been addressed
It is a highly extended practice to keep the engine on when vehicles (especially diesel ones) are stopped for some minutes.	Continuous monitoring campaigns with autonomous devices are better to identify potential outlayers. For pedestrian streets, data for analysis can be limited to hours without vehicles (out of commercial

	schedule).
Environmental (including COVID)	How they have been addressed
During the lockdown, in general, all the parameters associated to air pollution decreased due to the lack of traffic.	In that case, monitoring campaign should be moved.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

As it has been previously introduced, impacts depend on the type of NBS and its location. Anyway, this KPI assess the impact of vegetation on the PM concentration. Many research papers report about it, and most of the agreed that even when PM can be captured by tree's leaves, the impact on PM concentration in urban air is very reduced due to the emission levels are much higher than capture capacity by the green infrastructure.

In this sense, NBS assessed with this KPI show similar conclusions by resulting in no differences appreciated after the implementations of the NBS except for the green façade.

What was the impact? (positive/negative, significant/non-significant)?

VAc25 Green Façade – Positive, significant

VAc 27 Green Covering Shelter – Non-significant

VAc29 Green shady structures – Positive, significant

1.27.3 Other comments

Optional: Any other relevant comments that you would like to include.

Other NBS in Valladolid have been partially monitored but data collected do not allow an adequate analysis and so these results have not been included in this document.

Additionally, it is recommended to assess this KPI during 2022 in order to value the real impact of the interventions thinking that the vegetation is fully developed this year.

1.28 CH0508 Air quality parameters. NOX and PM

RELATED KPI CODE	*NBS NAME*	*PARTNER(S)*
CH0508	Air quality parameters. NO_X and PM.	CAR
CITY	*RELATED NBS*	
VAL	Vac30	

1.28.1 Results and Discussion

Initially, the plan involved measuring air concentrations of NO, NO_2, and $PM_{2.5}$ at sampling points located at varying distances from the NBS site both before and after the intervention. These measurements would be compared to data collected at equivalent locations on comparable stretches of street without NBS, at similar times of the day and on the same dates. In the case of the biofilter, which was the main focus of this key performance indicator (KPI), the plan also included taking measurements inside the underground car park.

However, it was not feasible to install an air quality measurement device outside the underground car park as originally planned, necessitating a modification in the methodology for evaluating this indicator. Nevertheless, an air quality measurement device was successfully installed inside the underground car park. Consequently, this information can be utilized in conjunction with the airflow recorded by the biofilter extractor and its capture efficiencies to estimate the quantity of contaminants captured by the biofilter.

As mentioned, an air quality monitor was not installed outside the biofilter after all. Therefore, the analysis of the designated reference locations collected from the Air Quality Control Network of the Valladolid City Council is also not included.

Due to the limitations in installing the outdoor air quality monitor, a new indicator has been designed utilizing the available information: the indoor air quality within the parking facility, the airflow filtered by the biofilter, and the nominal efficiencies of the biofilter in capturing PM, NO, and NO_2.

Thus, the average annual concentrations have been calculated for the 12 hours of daily operation of the biofilter. With these values, knowing that the nominal flow rate of the biofilter is 3,000 m^3 per hour, and the capture efficiencies for PM, NO, and NO_2 are 95%, 95%, and 99% respectively, the annual quantities of these pollutants captured by the system have been calculated.

The calculation of this specific KPI has been tailored for each biofilter individually due to its high potential in capturing pollutants. However, it should be noted that this KPI entails significant investments of both time and financial resources, making it less feasible for application to the majority of NBS projects.

VAc30 Urban Garden Biofilter (Ending implementation date November 2021)

NBS intervention site (Portugalete square in Valladolid) is an urban space with PM background levels because there is no heavy traffic in the area.

Parameter	Annual mean concentration indoor ($\mu g/m^3$)	Biofilter Capture yield (%)	Annual amount capture (kg)
$PM_{2,5}$	4,64 (max. 252)	95	0,06
NO	237 (max. 2543)	95	3,13
NO_2	51 (max. 734)	99	0,70

Discussion of results: In the results and discussion section, all the related KPIs will be put in common and contextualized in terms of the challenges addressed. This section should be supported with photos, tables, charts, maps, etc.

The assessment of this KPI show that this NBS has a positive influence in the $PM_{2.5}$ (and consequently in the PM_{10}), NO and NO_2 city background levels. The implementation of this easy solution in stationary sources of pollution coming from vehicles such as underground car parks (public and private) or tunnels will have a positive impact on the city.

However, due to the cost associated with installing this solution, particularly in existing infrastructure, it is necessary to select locations where installation is straightforward and does not require significant construction work. Additionally, it is highly recommended for any new construction or remodeling projects planned in urban environments.

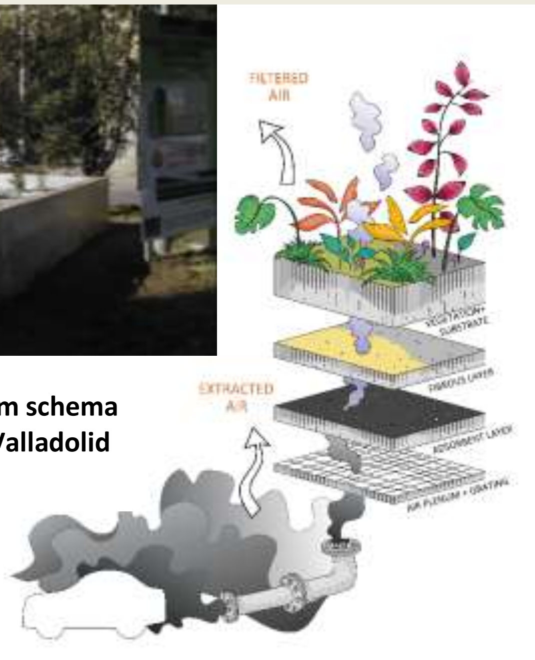


Figure 1. Biofilter system schema and pilot unit built in Valladolid (VAc30).

1.28.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Most air quality measurement stations require an electrical connection, which complicates their installation due to limited available connection points.	A strong involvement from the competent authority is necessary, mobilizing all relevant departments that may have jurisdiction. These departments can include mobility and lighting departments, as potential installation points could be traffic lights or street lamps.

Economic barriers	How they have been addressed

PM and NO_X monitoring tools are quite expensive and it is not possible to install one device in all the monitoring sites selected. Additionally, the ones with highly connectivity are too expensive.	Invest money in three units even when finally, only 1/2 were used in the project because of administrative issues. Once the impact of the biofilter has been studied other cheaper indicators can be proposed such the used of periodic passive measurements in the area and apply for the collaboration of the car park managers.
Social barriers	How they have been addressed
Vandalism	Awareness campaigns and education
Environmental (including COVID)	How they have been addressed
During the lockdown, in general, all the parameters associated to air pollution decreased due to the lack of traffic.	In that case, monitoring campaign should be moved.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

As it has been previously introduced, impacts depend on the type of NBS and its location. Anyway, this KPI assess the impact of vegetation on the PM concentration. Many research papers report about it, and most of the agreed that even when PM can be captured by tree's leaves, the impact on PM concentration in urban air is very reduced due to the emission levels are much higher than capture capacity by the green infrastructure.

In this sense, NBS assessed with this KPI show similar conclusions by resulting in no differences appreciated after the implementations of the NBS except for the green façade.

What was the impact? (positive/negative, significant/non-significant)?

VAc30 Urban Garden Biofilter – Positive, significant

1.28.3 Other comments

Optional: Any other relevant comments that you would like to include.

For the proper evaluation of the impact of this solution, the information gathered here should be combined with the parking occupancy levels and the electricity consumption related to ventilation before and after the implementation of the biofilter.

Furthermore, as mentioned earlier, it would be necessary to assess the air quality outside the parking facility in the vicinity of the biofilter with the system turned on and off for periods not less than one month.

1.29 CH0514 Air Quality Monetary Values

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0514	Air Quality Monetary Values	ACC
CITY	*RELATED NBS*	
VAL	VAC07 and Tree-planting actions: VAC2, VAC3, VAC4, VAC5	

1.29.1 Results and Discussion

Table of results (summary, from Task 5.4)

Challenge	KPI	Weight	Results
Air Quality	25.823.652 %	3,533	91.234.962,5

Data provided for the KPI calculation is referred to the Urban Carbon Sink action (VaC07) and Urban Tree Plantation (VaC2, VaC3, VaC4, VaC5).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Having calculated the Co2 Emission Data due to the implementation of trees in Valladolid, and taking into account the price of Co2 for March 2020 and 2022, we have been able to calculate the savings in euros that this solution has meant for the city of Valladolid.

URBAN TREE PLANTATION — Number of trees * CO2 fixation/tree

Number of trees	20 years	25 years	30 years	35 years	40 years	Total Tons Co2	Price (March 2020)	Cost
2.391,00	254,42	467,74	662,85	944,20	1.204,17	3.533,38	19,83	70.066,93 €

URBAN CARBON SINK — Number of trees * CO2 fixation/tree

Number of trees	20 years	25 years	30 years	35 years	40 years	Total Tons Co2	Price (March 2022)	Cost
1.989,00	176,43	325,91	492,57	640,98	868,71	2.504,60	75,13	188.170,60 €
							TOTAL	258.237,52 €

1.29.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No technical barriers detected.	
Economical barriers	How they have been addressed
No economic barriers detected.	
Social barriers	How they have been addressed
No barriers detected.	
Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
The Air Quality Monetary Values has been increased 258.237,52€ between the Urban Tree Plantation and the Urban carbon Sink.
What was the impact? (positive/negative, significant/non-significant)?
Regarding the Urban Carbon Sink and Tree planting actions, the contribution to the Air Quality and its translations to Monetary Values has been a success.

1.30 CH0602 Benefits from interventions

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0602	BENEFITS FROM INTERVENTIONS	
CITY	*RELATED NBS*	
VAL		

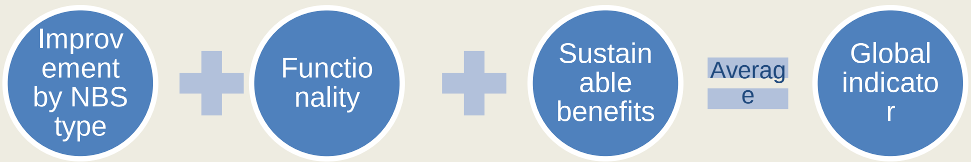
1.30.1 Results and Discussion

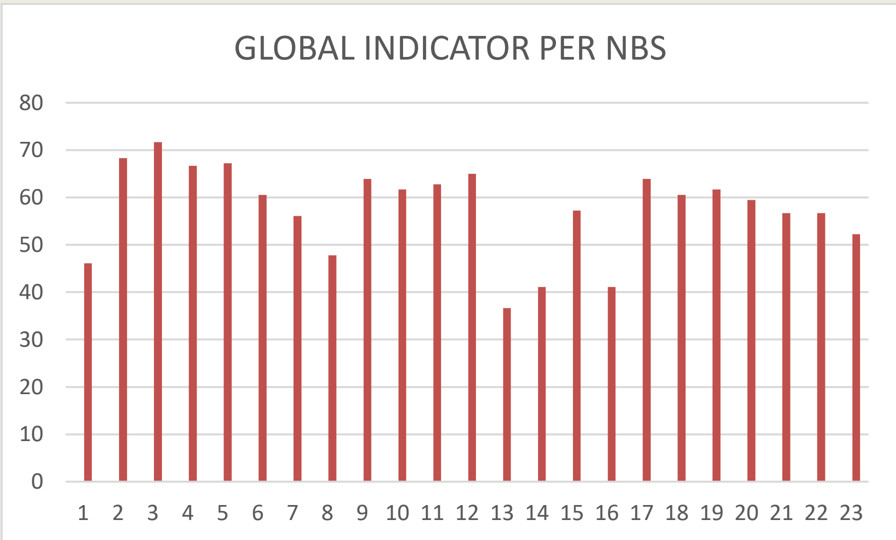
Table of results (summary, from Task 5.4)

EX POST	
TOTAL NBS AVERAGE	58%

Global between	Number of NBS
0-25%	0
25-50%	5
50-75%	18
75-100%	0

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.





Results from a total of 23 NBS have been calculated. Only 5 interventions have obtained a reults lower than 50%, and the rest are between 50% and 75%. The average of all of them is 58%.

1.30.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The assessment of the questions that make up each of the three criteria has a certain degree of subjectivity. The results depend on the calculation of other KPIs	Questions can be answered with yes/No, so this minimize the subjectivity. Methodology has changed to solve the lacks
Economical barriers	How they have been addressed
Not identified	
Social barriers	How they have been addressed
Not identified	
Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
To make the analysis more robust, other technicians could complete it and stakeholders, and calculate an average of results.
What was the impact? (positive/negative, significant/non-significant)?
Positive and Significant. The impact of this KPI is positive since it assigns a score to each NbS of Valladolid Demonstration, which allows determining the degree of sustainability as Very high, high, medium, low or very low (Likert scale of 5). It is considered Significant since it is calculated individually for each of the NbS. And the methodology is easily replicable to other cities with any NbS.

1.31 CH0701 OPPENNESS OF PARTICIPATORY PROCESSESS

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0701	OPPENNESS OF PARTICIPATORY PROCESSESS	VAL

CITY	*RELATED NBS*
VALLADOLID	Non-technical activities (VAc38 Sponsoring, Vac41 Support NBS, Vac42 City mentoring)

1.31.1 Results and Discussion

Table of results

Quality and openness of the participatory processes' analysis. This KPI is based on the participation actions delivered in the city of Valladolid. The qualitative score evaluates from 1-5 points, where 1-Low quality and 5-High quality.

EX ANTE (BASELINE)				
2017	2018	2019	2020	Σ Baseline
-	2,950	3,272	3,090	Score 3,104

EX POST			
2020	2021	2022	Σ Expost
3,090	3,360	2,750	Score 3,104

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The methodology defines two steps: ▪Step 1. Data collection and characterization: There is a scoring that differentiates Participation techniques, Degrees of participation, Co-creation & Co-production agent.

▪Step 2. Evaluation of participatory processes: A quantitative evaluation (nº processes /year) and a qualitative evaluation (Score 1-5).

There are included: Participatory actions (scientific, civil society, economic agents) and Participatory Budgets.

The result of the KPI is expressed in the Average score of the total Participatory actions (score 1-5).

Table. Qualitative scoring for "Openness of participatory processes"

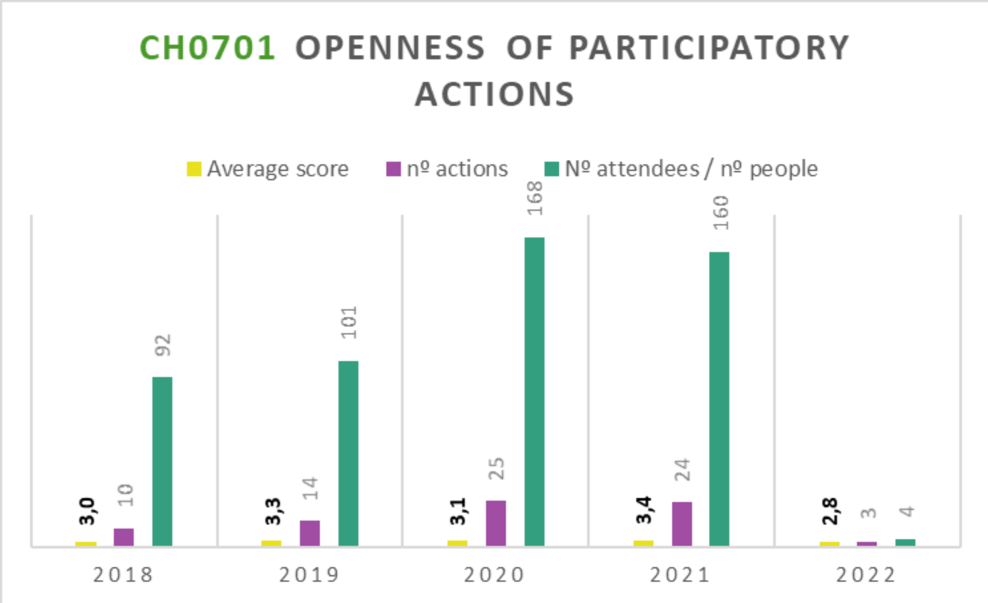
Criteria	Type	Score (points)
Scope	Quantitative	International, National, Regional = 1 point. Local = 0 points.
Communication model	Quantitative	In-person meeting = 1 point. Video conference/Online meeting/Audio conference/Call = 0,5 points. Email = 0 points.
Participation technique	Qualitative	From 0-1 depending on the quality and different types (Newsletter, Reports, Presentations, public hearings, Internet webpage, Interviews, questionnaires and surveys, Field visit and interactions, Workshop, Participatory mapping, Focus group, Citizen jury, Geospatial/ decision support system, Cognitive map, Role playing, Multicriteria analysis, Scenario analysis, Consensus conference)
Degree of participation	Quantitative	Information, Consultation = 0 points. Collaboration = 0,5 points. Co-decission, Empowerment = 1 point.

Attendees type	Quantitative	For >1 type = 1 point. Only 1 type = 0 points.

The following table shows the results broken down for each type of participatory activity (with the Scientific Community, with Economic Agents, and Others stakeholders such as cities, politicians or citizens), and the score assigned.

The graph shows that both the number of annual citizen participation activities and the number of citizens who have attended them have increased, despite the decrease in 2020 due to the pandemic Covid-19. Likewise, the quality of this type of participation actions, shown by the score, indicates that quality has also been improved (for example, actions aimed at the high-impact scientific community, or actions of an international nature, etc., which are consider with higher score).

Name	Unit	2017	2018	2019	2020	2021	2022	Total
Participatory actions (Total)	nº actions	-	10	14	25	24	3	**73**
	Nº people	-	92	101	168	160	4	**521**
	Average score	-	**2,950**	**3,272**	**3,090**	**3,360**	**2,750**	**3,104**
Participatory actions (Scientific Community)	nº actions	-	5	5	8	9	2	**25**
	Nº people	-	37	23	16	8	2	**84**
	Average score	-	3,200	3,600	3,714	3,125	2,750	**3,505**
Participatory actions (Economic Agents)	nº actions	-	5	9	9	5	1	**28**
	Nº people	-	55	78	74	8	2	**215**
	Average score	-	2,700	2,944	3,333	3,500	3,000	**2,993**
Participatory actions (Other)	nº actions	-	-	-	9	11	-	**20**
	Nº people	-	-	-	78	144	-	**222**
	Average score	-	-	-	2,222	3,455	-	**2,222**



1.31.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
Greater difficulty in interpreting the results of the actions of the Participatory Budgets, because the data of the actions requested to the actions finally executed are not clear.	Participatory Budgets have been included since 2020.

Economical barriers	How they have been addressed
Most of the actions have no cost for the citizen or interested party. On the part of the City Council, the cost is passed on as personnel cost. Some more far-reaching citizen participation actions do have a cost for the City Council (local communication & dissemination activities)	Actions with cost (subcontracted) must be foreseen with municipal funds since it is not covered by EU funds.

Social barriers	How they have been addressed

Low participation in some of the participation actions organized by the Valladolid City Council, with greater effort in terms of resources, time and cost.	Citizens go to the Single desk of the Valladolid City Council to request all kinds of participation actions: interviews, field visits, workshops, etc. Tailored actions have been provided.
Environmental (including COVID)	How they have been addressed
▪The Covid-19 pandemic forced the cancellation of several non-technical events for 2020.	▪Non-technical actions recovered early but virtual, starting in fall 2020. The activities of 2020 and 2021 have been mostly virtual.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Yes. The KPI CH0408 is part of the CHALLENGE 7: Participatory Planning and Governance.

The methodology defined for this KPI CH0701 includes several criteria such as the degree of participation, the type of stakeholder, scope, etc. that allows scoring quite well every action delivered by Valladolid City Council for URBAN GreenUP, as well as, it identifies the quality of the participatory processes.

What was the impact? (positive/negative, significant/non-significant)?

Positive and Significant. The City Council has an updated inventory of every non-technical activity that is delivered in the city for the URBAN GreenUP project.

1.31.3 Other comments

This indicator is easy to monitor, and to feed with real data. An updated inventory can be made of all the non-technical activities carried out in the city on the occasion of URBAN GreenUP. This is easily replicable to other cities that implement non-technical interventions.

1.32 CH0703 Citizen perception

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0703	CITIZEN PERCEPTION	VAL
CITY	*RELATED NBS*	
VALLADOLID	All technical NbS implemented (Vertical and horizontal green infrastructure; Electro wetland; Green corridor (green cycle lane, resting areas, cycle-pedestrian green paths); Rain gardens; Green	

	Parking Pavements;)

1.32.1 Results and Discussion

Table of results (summary, from Task 5.4)

This KPI measures identified green space characteristics by the two following well-being variables and one geolocation variable: a) Green space visitors' level of satisfaction, that is directly related with the urban green space (UGS) quality. b) Self-reported quality of life (QoL). c) Frequency of green space visitors' crowd-sourced geo-tagged data in NBS sites. The result is expressed in a Likert scale (1-5).

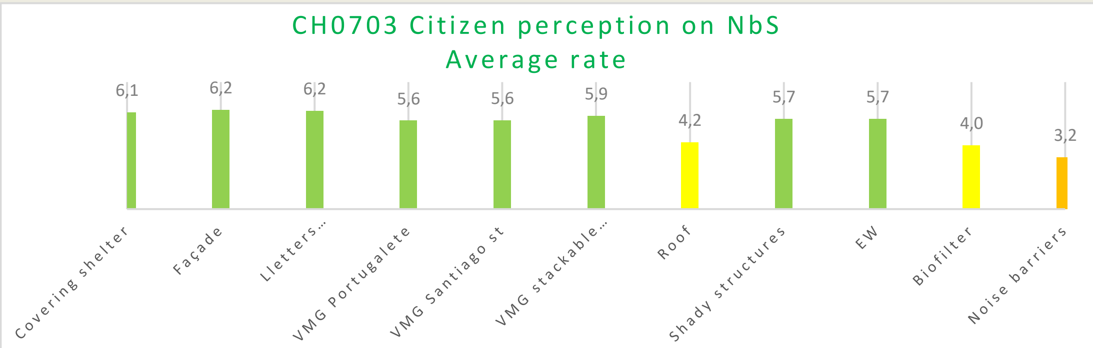
EX ANTE (BASELINE)				
2017	2018	2019	2020	Baseline
n/a	n/a	n/a	2,93 score	2,93 score

EX POST			
2020	2021	2022 (until 14th March)	Expost
3,03 score	2,45 score	1,62 score	2,37 score

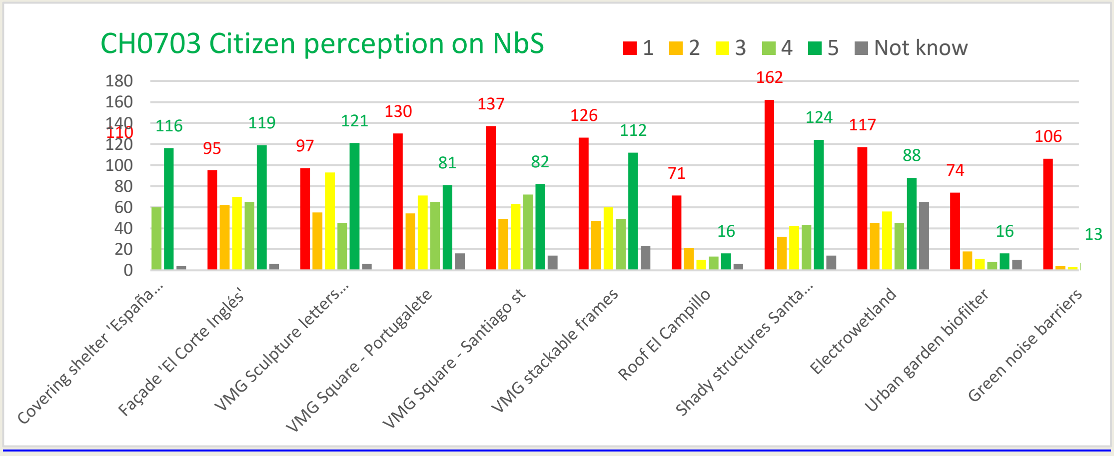
Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Data for this KPI is captured by a citizen's participation survey launched by Valladolid City Council https://forms.gle/iS3EXtAHADygmMzR7 , and the mini-surveys launched by the URBAN GreenUP mobile application (GMV-S). Scoring for this KPI is calculated on the average basis from 1-5 (Average rate). However, the Citizen perception can also be identified for every NbS independently.

The following graph shows the score of the citizens of Valladolid to the NbS of URBAN GreenUP (updated to March 2022, with a total of >400 responses).



On the other hand, this graph includes the number of people who vote for each value (1-5). It is appreciated that most of the citizens vote 1 (red) or vote 5 (dark green). This means that opinions are extreme.



1.32.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
Not all citizens answer a digital survey (for example, older people).	A street-level paper survey has not been launched.
Only data until 14th March 2022, due to technical problems	More robust server for the survey

Economical barriers	How they have been addressed
Not identified.	

Social barriers	How they have been addressed
The degree of participation in the survey is medium. Although it has exceeded expectations.	In a few months we will again relaunch a participation campaign focused on getting more responses.

Environmental (including COVID)	How they have been addressed
Not identified.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
Yes. The KPI CH0703 is part of the CHALLENGE 7: Participatory Planning and Governance. The best way to know the citizen's perception is to ask, through a participation survey. We have shown that the longer an NbS has been installed, the better its rating (better citizen perception).

What was the impact? (positive/negative, significant/non-significant)?

Positive and Significant. The calculation of the KPI is positive. However, not all the results obtained from citizen perception are positive. Some NbS get low ratings (poor perception).

1.33 CH0801 Crime reduction (N)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0801	CRIME REDUCTION (N)	CAR
CITY	*RELATED NBS*	
VAL	ALL	

1.33.1 Results and Discussion

Table of results (summary, from Task 5.4)

	2017	2018	2019	2020
Total number of crimes	**1218**	**1195**	**1155**	**893**
Variation	**-**	**-23**	**-40**	**-262***

*Baseline data from years 2017, 2018, 2019 and (partially) 2020

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Data provided by Policía Municipal de Valladolid.

- Numb. crimes by street
- Crimes reported are civil faults.
- Baseline data from years 2017, 2018, 2019 and (partially) 2020.
- Performance reports of the municipal police

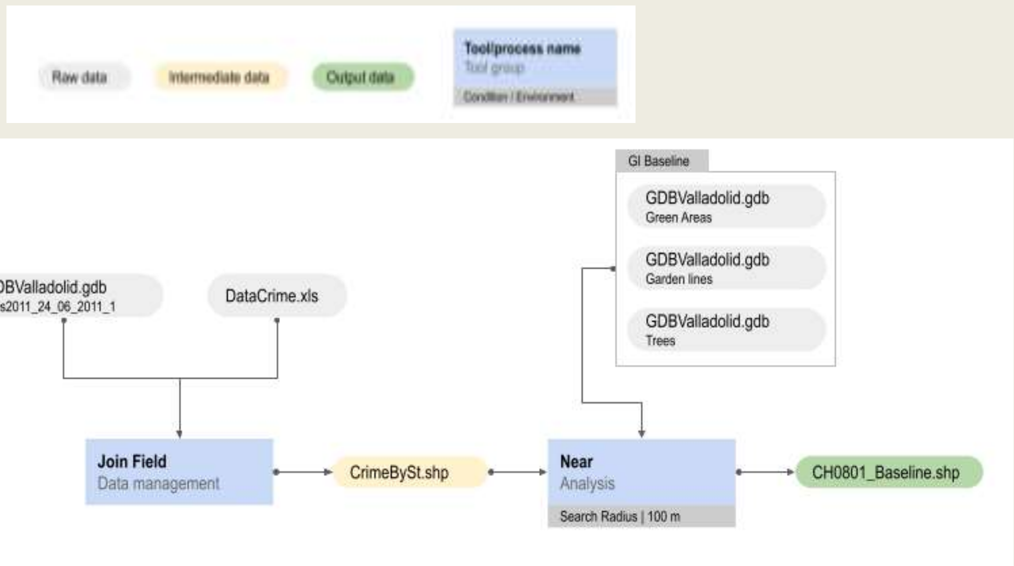
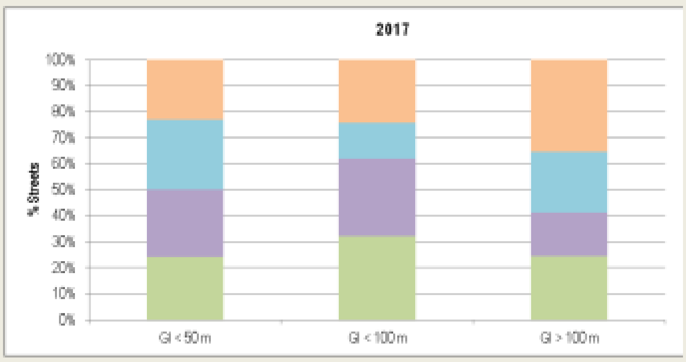


Figure 1.5: KPI algorithim dataflow scheme

According to the data analysed, the number of crimes has been decreasing since the beginning of the study. However, this KPI has only been measured at Baseline level as the data provided includes the full years 2017 to 2019, and 2020 partially (until March). Considering also that during subsequent years there have been lockdown due to COVID, it is estimated that the post-intervention results may not reflect a natural trend, but disturbances due to this exceptional situation.



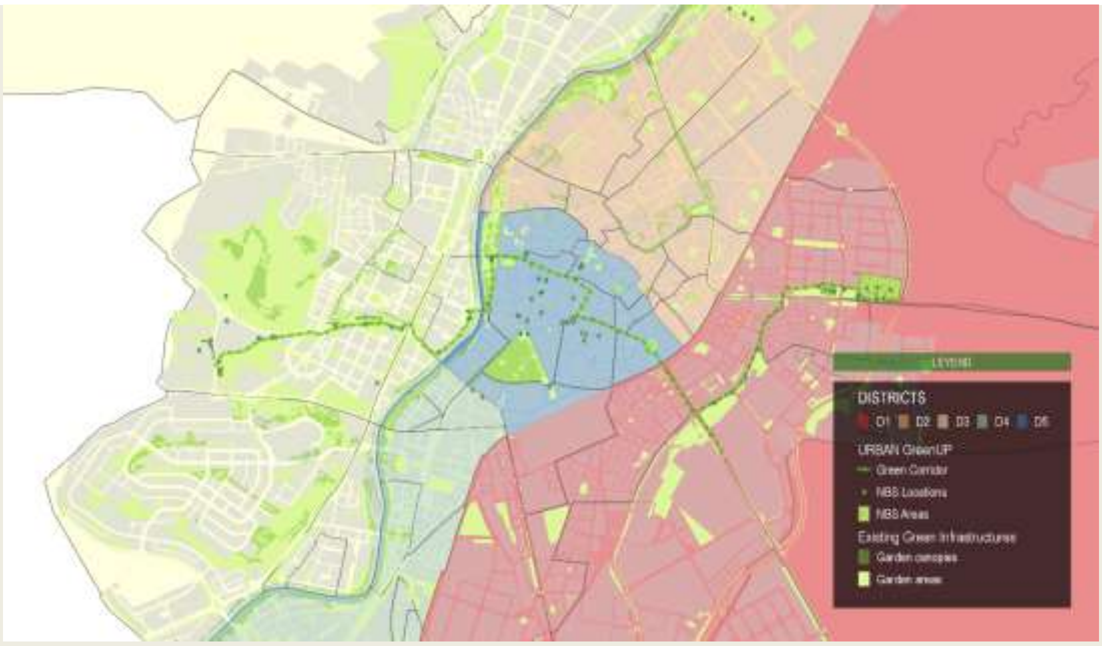
For this KPI, the approximate distance from each street where the crime occurred to a green infrastructure has also been calculated. The graphs shown on the left show for each year, the % of streets where crimes have occurred grouped by the distance of each street to a green infrastructure (within 50, 100 and more than 100 m distance to a GI). In addition, for each group of distances, the intensity (number of crimes)

occurred is distinguished (>10, 5-10, 1-4 and no crimes).

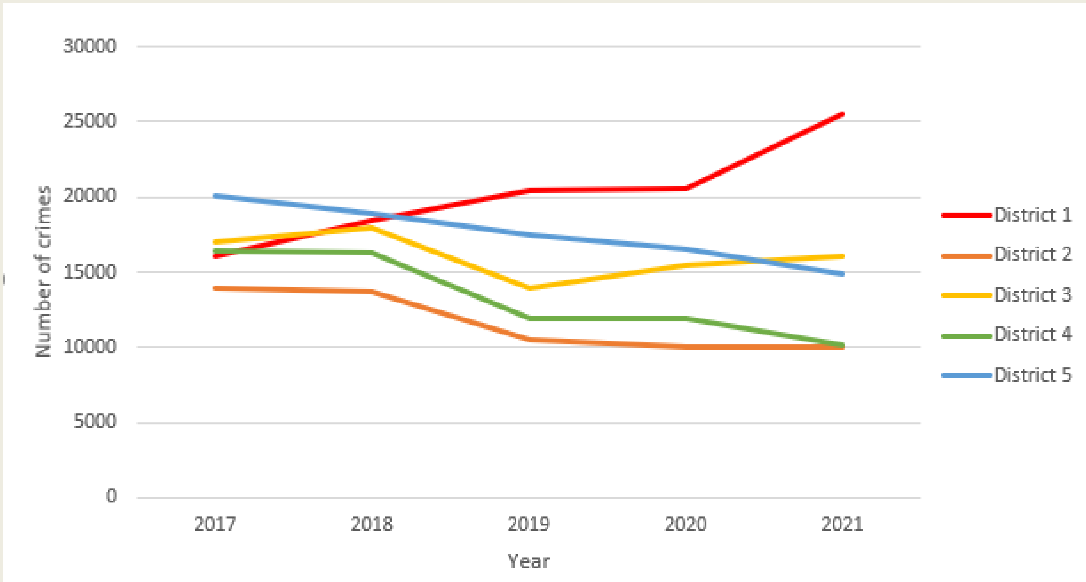
It has been found that more crime occurs near the GIs. This is mainly due to the type of crimes that the local police have referred for this study. Although very detailed, the report only includes crimes classified as "minor crimes" and does not include more serious crimes. The type of crimes reported include damage to litter bins, trees, street furniture, etc., which makes these types of incidents more frequent in parks.

The following image shows the distribution of the districts of action of the municipal police. To complete the study, we have taken the data that the local police show in their annual reports. At the time of writing this document, information is available up to 2021. The crimes are evaluated at District level, and include more varied typologies than in the case of the data provided at the request of the project team.

The NBS of the URBAN GreenUP project are mainly located in district 5 (city centre), and in districts 3 (west of the city) and 1 (east).



As can be seen in the graph below, in general crimes show a decreasing trend since 2017 with the exception of districts 1 and 3, where they have increased from 2017 to 2021, especially in district 1. In the centre district, where a higher number of project actions are concentrated, the incidence of crimes has progressively decreased from 2017 to 2021.



1.33.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The data provided by the authorities are at street level and without associated code or coordinates. This means, apart from the arduous task of address recoding, that on long streets the data are not valid for the analysis of proximity to green areas as we cannot know where the crime has been committed. In addition, the authorities only provided data concerning vandalism or similar crimes, which makes the analysis incomplete and even penalizes proximity to green spaces (as categories include damage to trees, theft of plants, etc.).	Data analysis and cleaning has been carried out, addresses have been coded.
Economical barriers	How they have been addressed
-	
Social barriers	How they have been addressed
Since the necessary data are not in publicly available and accessible information, access to them requires an institutional data request process. Incomplete data.	A meeting was held with the authorities to explain the destination and use of the data. KPI calculated only at baseline level.
Environmental (including COVID)	How they have been addressed
Lockdown situation during the COVID may affect the results of the KPI.	This has been taken into account in the data analysis.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
The number of crimes has been reduced. However, the number of crimes is higher in areas near to GI than other areas. It cannot be established whether the impact of NBS on crime reduction is significant or not, as the level of geolocation of the data provided by the authorities does not allow estimating the actual distance from the scene to the green infrastructure, being only estimable for small streets.

What was the impact? (positive/negative, significant/non-significant)?

The bias produced by the type of crimes analyzed, which only include civic behavior, vandalism, etc., means that the number of incidents in green infrastructures is higher. Incidents such as broken branches, material damage to parks or theft of plants are inherent to green areas. On the other hand, other crimes such as personal assaults or theft of personal belongings have not been reported. Therefore, based on the initial data, the number of incidents is higher in or near green areas, but as indicated above, a more detailed evaluation would be required in terms of geolocation of the actions and types of crimes analysed.

1.34 CH0802 Green intelligence awareness (Educational activities)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0802	GREEN INTELLIGENCE AWARENESS (Educational activities)	VAL
CITY	*RELATED NBS*	
VALLADOLID	VAc39 Ecological reasoning and intelligence (only Educational activities, for recreational/cultural, see *CH0406 Recreational value*)	

1.34.1 Results and Discussion

Table of results

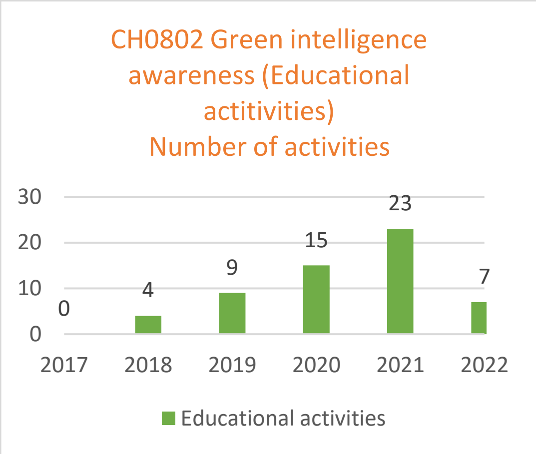
Quantify the number of activities, publications or campaigns focused on the enhancement of green intelligence awareness per year, related to a NbS. Expressed as the number or people that attends to the educational activities (nº attendee/year) and the sum of the educational activities per year (nº activities/year).

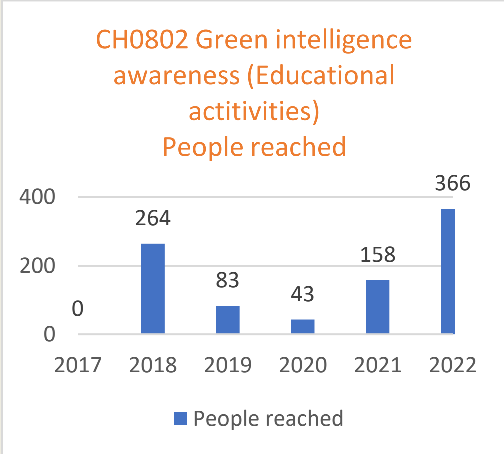
EX ANTE (BASELINE)				
2017	2018	2019	2020	? Baseline
0 people	264 people	83 people	22 people	369 people

	EX POST		
2020	2021	2022	? Expost
21 people	158 people	366 people	550 people

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The following graphs show the comparison between the two units that can express this KPI CH0802: people reached as well as number of activities. In terms of the number of people, there was a clear decrease in 2020, due to the Covid-19 crisis. However, the nº activities launched by the City Council has been clearly increasing yearly since the beginning of the URBAN GreenUP project.





On the other hand, the results expressed for CH0802 do not include the number of participants in the Entrepreneurship Route (ES.- *Ruta del Emprendimiento & VallaCreActivos*). These routes were carried out in until 2019. Secondary school students from many institutes in Valladolid came to the City Hall to learn about the municipal activities. European projects were explained to them at the Innovation Agency, including URBAN GreenUP. So for 2018 and 2019 the number of people that attended these activities increase considerably the results for CH0802, as it is shown in the following table. For 2020, 2021 and 2022 the Entrepreneurship Route, so the differences between years would not be comparable. For this reason, the attendees to the Entrepreneurship Route have not been considered.

EX ANTE (BASELINE) – With *Entrepreneurship Routes*				
2017	2018	2019	2020	⍰ Baseline
0 people	2.409 people	2.059 people	43 people	2.234 people

1.34.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
The quantification of the number of people who attend a non-technical activity is sometimes estimated.	Estimated number of participants, for those events in which there is no attendance list.
Economical barriers	**How they have been addressed**
There is no European funding for local communication actions.	The entire budget for non-technical actions at the local level comes from municipal funds (Valladolid City Council).
Social barriers	**How they have been addressed**

In some non-technical activities there is low citizen participation.	▪Reinforcement of the dissemination of the event. ▪Invitation campaigns to specific groups of stakeholders.
Environmental (including COVID)	How they have been addressed
▪The Covid-19 pandemic forced the cancellation of several non-technical events for 2020.	▪Non-technical actions recovered early but virtual, starting in fall 2020. The activities of 2020 and 2021 have been mostly virtual.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Yes. The KPI CH0802 is part of the CHALLENGE 8: Social Justice and Social Cohesion. This KPI clearly shows the number of citizens who have been reached with non-technical actions, though the Educational activities (Vac39). The results show that the scope of the actions has been increasing, despite the pandemic.

What was the impact? (positive/negative, significant/non-significant)?

Positive and Significant.

1.34.3 Other comments

This indicator is easy to monitor, and to feed with real data. An updated inventory can be made of all the non-technical activities carried out in the city on the occasion of URBAN GreenUP, and the number of people participating can be recorded.

1.35 CH0803 Green intelligence awareness (Communication activities)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0803	GREEN INTELLIGENCE AWARENESS (Communication activities)	VAL
CITY	*RELATED NBS*	
VALLADOLID	VAc38-Sponsoring activities, VAc39-Promotion of ecological reasoning intelligence, VAc41-Support to citizen project of NBS, VAc42-City mentoring strategy (Staff Exchange activities)	

1.35.1 Results and Discussion

Table of results (summary, from Task 5.4)

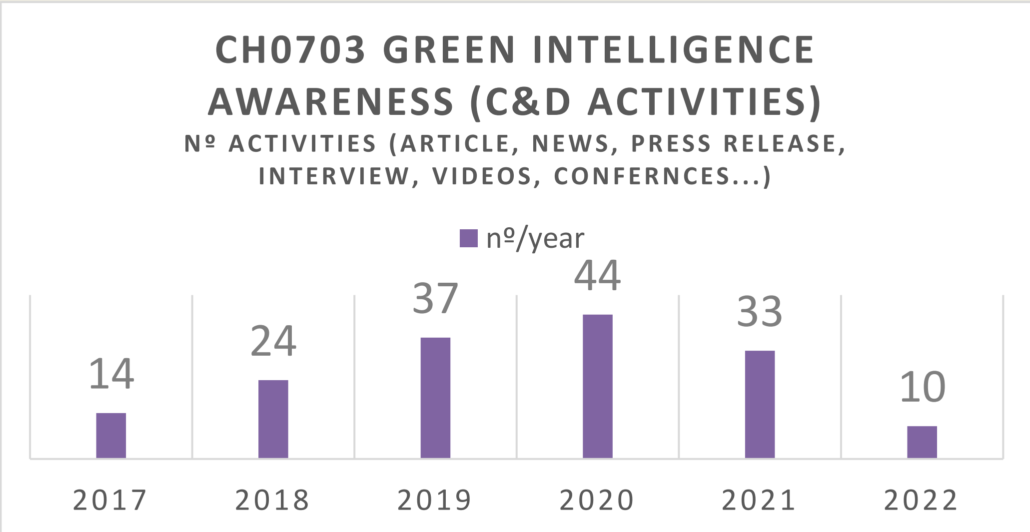
Quantify the number of publications in different communication means such as written press (newspaper, magazines, articles, brouchers), television, radio and social media. This KPI includes the Communication activities: Editorial + Communication actions.

EX ANTE (BASELINE)				
2017	2018	2019	2020 (Jan-May)	Σ Baseline
14 publications	24 public.	37 public.	35 public.	110 publications

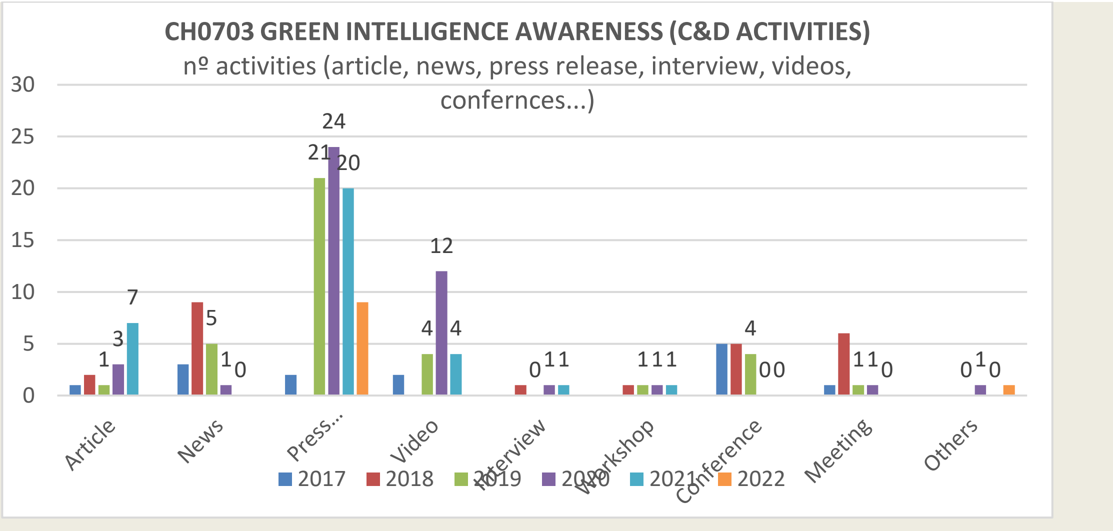
EX POST			
2020 (Jan-May)	2021	2022	Σ Expost
9 public.	33 public.	10 public.	52 publications

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Trends: Despite the Covid-pandemic in 2020 the number of communication activities launched by Valladolid City Council or that the Council participated is being increasing since the beginning of the URBAN GreenUP project.



Additional results can be broken down by type of communication action.



1.35.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
The majority of Valladolid's citizens do not speak English.	Most of the local activities launched by Valladolid City Council are in Spanish.
Economical barriers	**How they have been addressed**
There is no European funding for local communication actions.	The entire budget for non-technical actions at the local level comes from municipal funds (Valladolid City Council).
Social barriers	**How they have been addressed**
The social impact of some NbS is high in the media (social networks, complaints in the 010 municipal communication service, etc).	▪Reinforcement of local communication actions (more articles, news, social media interactions, etc.). ▪Personalized response to each complaint or question received by each citizen.
Environmental (including COVID)	**How they have been addressed**
▪The Covid-19 pandemic forced the cancellation of several non-technical events for 2020.	▪Non-technical actions recovered early but virtual, starting in fall 2020. The activities of 2020 and 2021 have been mostly virtual.

▪Paper documentation is not printed. This may prevent reaching some citizens (especially those who do not attend digital media, such as the elderly).	▪Communication actions include articles and news published in local newspapers (on paper).

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Yes. The KPI CH0803 is part of the CHALLENGE 8: Social Justice and Social Cohesion. This KPI clearly shows the number of communication activities launched by Valladolid City Council about the URBAN GreenUP project, including all the non-technical NbS (Vac38, Vac39, Vac41, Vac42). The results show that the scope of the actions has been increasing, despite the pandemic.

What was the impact? (positive/negative, significant/non-significant)?

Positive and Significant.

1.35.3 Other comments

This indicator is easy to monitor, and to feed with real data. An updated inventory can be made of all the non-technical activities carried out in the city on the occasion of URBAN GreenUP, and the type of activity can be recorded.

1.36 CH0901 Noise reduction

RELATED KPI CODE	*NBS NAME*	*PARTNER(S)*
CH0901	Noise reduction	CAR
CITY	*RELATED NBS*	
VAL	VAc22, VAc23	

1.36.1 Results and Discussion

Table of results of this KPIs for the noise barriers in the city of Valladolid.

The calculation of this KPI has been done only for this NBS because it is supposed the only able to reduce the ambient noise levels.

It is a relevant KPI to be considered at city or district scale, but the scale of intervention of the proposed NBS and this KPI are designed to assess the impact at street scale. Anyway, results can be extrapolated and can be used to propose solutions regarding the noise reduction in other streets or even at district level for citizens (or even fauna) focusing interventions adequately.

VAc22/VAc23 Green noise barriers (Ending implementation date 30/06/2020)

NBS intervention site (Paseo del Hospital Militar St., 31). Reference site (Paseo del Hospital Militar St., 34).

Noise reduction	Average	Maximum	UNITS
Ex-ante (2020/2021)			
Reference site	70,4	100,9	dB
NBS site	66,5 (-3,9)	98,9 (-2,0)	dB
Ex-post (2022)			
Reference site	66,9	100,9	dB
NBS site	65,3 (-1,6)	98,1 (-2,8)	dB
CH0108	+2,3	-0,8	dB

Discussion of results: In the results and discussion section, all the related KPIs will be put in common and contextualized in terms of the challenges addressed. This section should be supported with photos, tables, charts, maps, etc.

This KPI covers the impact assessment of a specific characteristic, the noise reduction that can be got with NBS. Noise reduction with this NBS is focused mainly in the effect of the traffic. So, noise monitoring is highly affected by the traffic conditions. Reference site has been selected in the same street at around 250m far from NBS intervention site. However, there is a cross street in the middle and it affects to the traffic distribution.

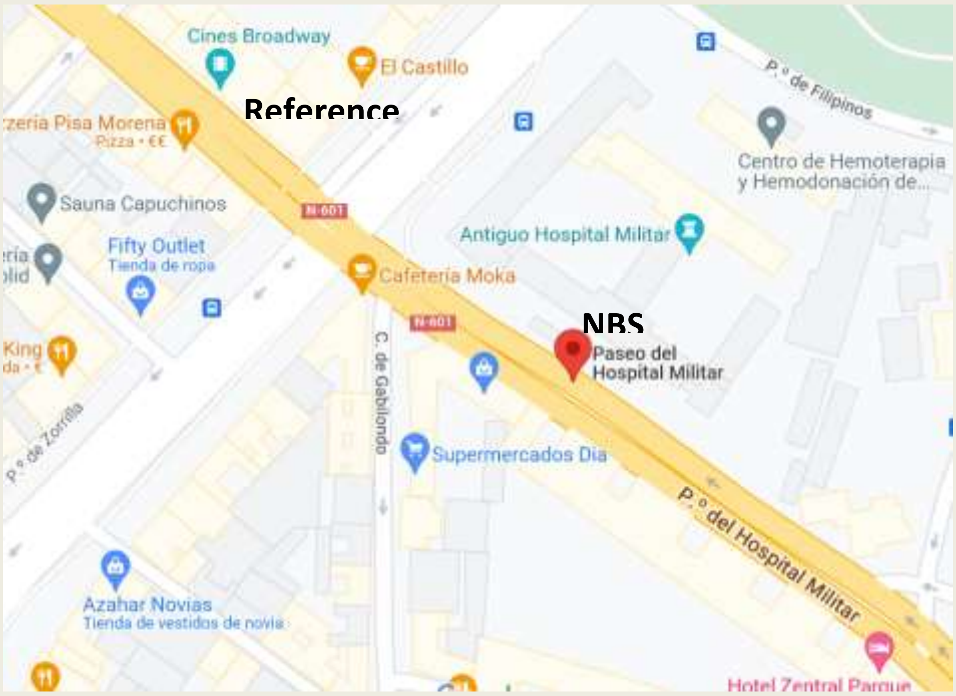
Only 3 monitoring campaigns have been carried out after the intervention. Results until now (only six months after intervention) show an increment in the average values and a slightly reduction in the peak values.

NBS Assessment. NBS site and reference site.	13/01/2022		18/03/2022		10/05/2022	
	Max.	**Av.**	**Max.**	**Av.**	**Max.**	**Av.**

Paseo del Hospital Militar, 34 (Ref.)	99,7	62,1	102	68,6	101	69,9
Paseo del Hospital Militar, 31 (NBS)	91,9	57,8	100,8	69,6	101,7	68,4
Difference	7,8	4,3	1,2	-1	-0,7	1,5

As it can be seen, important differences have been found in the three days monitored. The study will continue in order to explore these variations.

Vegetation is still very small but it is expected to grow within the coming months.



1.36.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No available wifi connections in the streets. Individual gprs or other systems for each sensor is to expensive.	Install Bluetooth connection system for the sensors. However, it requires on site data collection.
Economic barriers	How they have been addressed

No barriers detected.	
Social barriers	How they have been addressed
Vandalism in sensors installed in the streets. So, it is not recommended to install and let alone noise sensors.	Monitoring campaigns are planned periodically to carry out several time limited studies.
Environmental (including COVID)	How they have been addressed
During the lockdown, no monitoring campaigns were carried out. Traffic were reduced deeply.	Hopefully, no more pandemics affect the world.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

As it has been previously introduced, current results do not show relevant impacts on noise reduction by the green noise barriers but data collected show a high variability. It is needed to continue with the monitoring campaigns in order to get more data to carry out the statistical study.

What was the impact? (positive/negative, significant/non-significant)?

Regarding noise reduction, the impact was neglectable.

1.37 CH0903 Cycling area increase

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0903	CYCLING AREA INCREASE	CAR, GMV
CITY	*RELATED NBS*	
VAL	Vac01	

1.37.1 Results and Discussion

Table of results (summary, from Task 5.4)

No data recorded (see conclusions section).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

No data recorded (see conclusions section).

1.37.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Obtaining objective data on the use of the green corridor by citizens, discriminating between cycling and walking.	Module included within the APP to obtain geolocation and activity of the citizens.
Economical barriers	How they have been addressed
Promotion of the use of the application beyond dissemination is needed. A competitive, economic or gamification incentive is required to motivate the user to actively participate in data collection.	Not addressed within the project.
Social barriers	How they have been addressed
Activity data was to be measured through the use of the APP. However, no end user of the APP has provided data on the use of the green corridor.	The application explains quite well how the monitoring works, as shown in the attached pictures, but no one has participated in the data collection.
Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

What was the impact? (positive/negative, significant/non-significant)?

1.38 CH0904 Walking area increase

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0904	WALKING AREA INCREASE	CAR, GMV

CITY	*RELATED NBS*
VAL	Vac01

1.38.1 Results and Discussion

Table of results (summary, from Task 5.4)

No data recorded (see conclusions section).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

No data recorded (see conclusions section).

1.38.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Obtaining objective data on the use of the green corridor by citizens, discriminating between cycling and walking.	Module included within the APP to obtain geolocation and activity of the citizens.
Economical barriers	How they have been addressed
Promotion of the use of the application beyond dissemination is needed. A competitive, economic or gamification incentive is required to motivate the user to actively participate in data collection.	Not addressed within the project.
Social barriers	How they have been addressed
Activity data was to be measured through the use of the APP. However, no end user of the APP has provided data on the use of the green corridor.	The application explains quite well how the monitoring works, as shown in the attached pictures, but no one has participated in the data collection.
Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

What was the impact? (positive/negative, significant/non-significant)?

1.39 CH1001 Tax Reduction

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH1001	Tax Reduction	ACC
CITY	*RELATED NBS*	
VAL	VAc2, VAc4, Vac25, Vac27, Vac28	

1.39.1 Results and Discussion

Table of results (summary, from Task 5.4)

It is not possible to calculate the results, there is no link between the application of the NBS and the subsidies or tax reductions.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Not possible to calculate results

1.39.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
NBS implemented.	
Economical barriers	How they have been addressed
Really difficult to calculate economical barriers related to tax reductions, if there is no relationship between them.	
Social barriers	How they have been addressed
No barriers detected.	
Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
High environmental and economic impact, also enhancing public-private partnerships.
What was the impact? (positive/negative, significant/non-significant)?
It is true that although it has not been possible to measure, these implementations have had a very positive and significant environmental and economic impact.

1.40 CH1002 Job Creation

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH1002	Job Creation	ACC
CITY	*RELATED NBS*	
VAL	VAC22, VAC23, VAC25,VAC27,VAC28, VAC29	

1.40.1 Results and Discussion

Table of results (summary, from Task 5.4)

Data provided for the KPI calculation is related to the actions referred to: Green noise barriers, Green Roof, Green Façade, Green Covering Shelter and Green Shady Structures.

Challenge	KPI	Weight	Results
Potential of economic opportunities and green jobs	87	3,6	31,320

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

We have taken into account for each of the implementations, the workers needed per activity, compiling all of them by typology, the price per hour according to the type of work, the number of hours needed to perform such works. The results show a total of 87 workers needed to execute all the actions.

	Nº OF WORKERS	Nº HOURS	Nº DAYS (8HRS/DAY)	COST
Green noise barriers	16	1290,47124	161,308905	24.711,91 €
Green Roof	17	4170,2436	521,28045	72.911,56 €
Green Facade	10	1519,3715	189,9214375	29.210,54 €
Green Covering Shelter	22	2329,18423	280,4804038	41.882,67 €
Green shady structures	22	814,94982	92,9008525	15.811,51 €
TOTAL	87 workers	10.124,22	1.245,89	184.528,19 €

1.40.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No technical barriers detected.	
Economical barriers	How they have been addressed
No economical barriers detected.	
Social barriers	How they have been addressed

No barriers detected.	
Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

The actions implemented has increased the employment ratio of Valladolid City, cresting a total of 87 works activities. This implementations has created a good economic impact for Valladolid citizens.

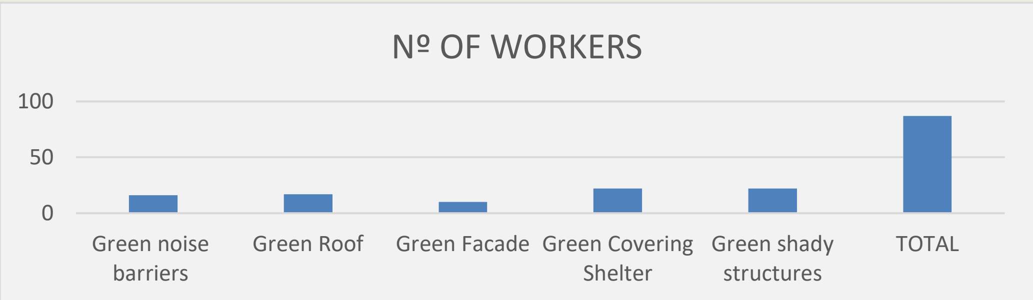
What was the impact? (positive/negative, significant/non-significant)?

The actions implemented has increased the employment ratio of Valladolid City, creating a total of 87 works activities. This implementations has created a good economic impact for Valladolid citizens.

1.40.3 Other comments

Optional: Any other relevant comments that you would like to include.

Regarding all the actions mentioned, the cumulative work creation has increased considerably.



1.41 CH1003 Business Revenue

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH1003	Business Revenue	ACC
CITY	*RELATED NBS*	

VAL	VAc27, VAc29

1.41.1 Results and Discussion

Table of results (summary, from Task 5.4)

Not possible to calculate results, due to the policy of private companies not to make public their profits before and after implementations of nature-based solutions.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Not possible to calculate results, but we assume that the NBS implementations have increased the return on business rates.

1.41.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No technical barriers detected.	
Economical barriers	How they have been addressed
Private companies not to make public their profits.	
Social barriers	How they have been addressed
No barriers detected.	
Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This activity has caused a clear increase in the affluence of people in the areas where these implementations have been developed, being able to observe how they have increased their consumption.

What was the impact? (positive/negative, significant/non-significant)?

There is no doubt that the environmental impact has been positive, as can be seen. It has also been positive at the economic level, in which it has been possible to observe how the influx of people has increased. It is true that both indicators have not been possible to calculate as they are not tangible.

1.42 CH1006 Consumption Benefits

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH1006	Consumption Benefits	ACC
CITY	*RELATED NBS*	
VAL	VAc28	

1.42.1 Results and Discussion

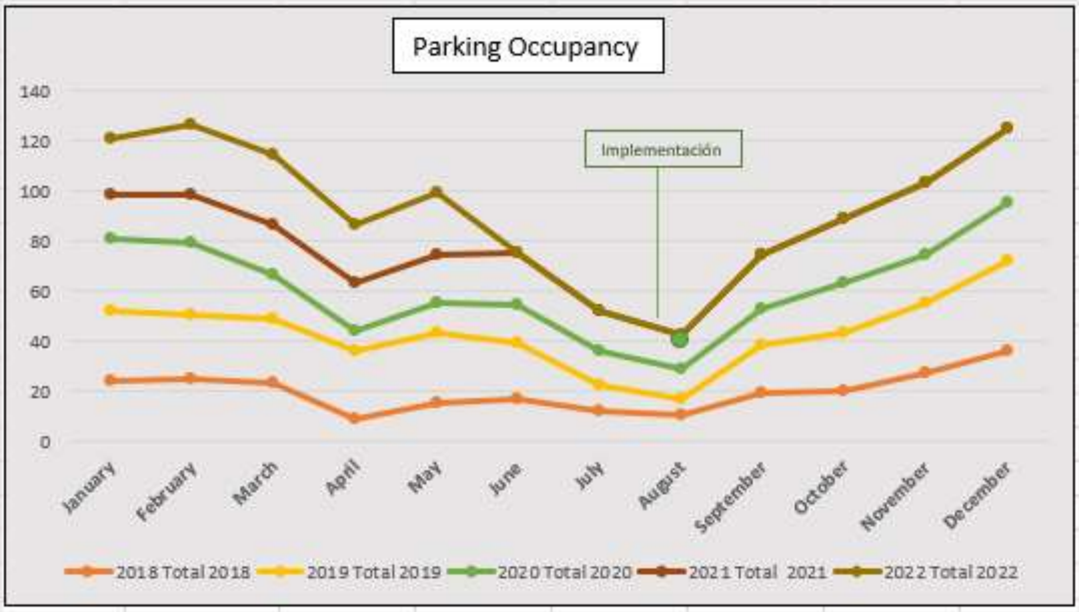
Table of results (summary, from Task 5.4)

Challenge	KPI	Weight	Results
Potential of economic opportunities and green jobs	-23,38	3,33	77,932

Data provided for the KPI calculation is only referred to Green Roof action (VaC28). The data given in the table correspond to the cumulative parking occupation.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The profits obtained in the parking have been calculated, taking into account a rate for subscribers (monthly) and another for non-subscribers (hourly).



	2018		2019		2020		2021		2022	
	Members 2018	Total 2018	Members 2019	Total 2019	Members 2020	Total 2020	Members 2021	Total 2021	Members 2022	Total 2022
January	7	24	6	28	6	29	8	17	9	23
February	7	25	8	25	7	29	6	19	9	28
March	7	23	8	26	6	17	6	20	9	28
April	2	9	6	27	8	8	7	19	7	23
May	4	15	6	28	8	12	5	19	7	25
June	6	17	5	22	6	15	8	21	0	0
July	5	12	4	10	5	14	6	16	0	0
August	5	10	2	7	5	12	5	13	0	0
September	6	19	4	19	5	15	7	21	0	0
October	4	20	5	23	7	20	7	26	0	0
November	7	27	5	28	7	19	6	29	0	0
December	6	36	4	36	7	23	3	30	0	0

	2018		2019		2020		2021		2022	
	Member	Non Members	Member	Non Members	Member	Non Members	Member	Non Members	Member	Non Members
Data Base	66	171	59	220	77	136	72	178	41	86
Totales	237		279		213		250		127	
Price for non-members Parking (2 hours*2€/hour)	4,00 €									
Precio for members monthly (60€/month)	60,00 €									

	2018		2019		2020		2021		2022	
	Member	Non Members	Member	Non Members	Member	Non Members	Member	Non Members	Member	Non Members
Benefit Parking	3.960,00 €	13.680,00 €	3.540,00 €	17.600,00 €	4.620,00 €	10.880,00 €	4.320,00 €	14.240,00 €	2.460,00 €	6.880,00 €
Benefit Total (annual)	**17.640,00 €**		**21.140,00 €**		**15.500,00 €**		**18.560,00 €**		**9.340,00 €**	
Benefit Total (Monthly)	1.470,00 €		1.761,67 €		1.291,67 €		1.546,67 €		1.113,33 €	

1.42.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No technical barriers detected.	
Economical barriers	How they have been addressed
No economical barriers detected.	
Social barriers	How they have been addressed
No barriers detected.	
Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

The implementations in *El Campillo Market* have had an impact on the consumption/buying behavior of customers, making them aware of the need to buy quality and proximity products grown in the building's vegetable orchard.

What was the impact? (positive/negative, significant/non-significant)?

The impact has been positive, not only in the awareness of market customers and the environment due to the orchard, but also has had a positive economic impact by attracting more customers as can be seen in the data obtained by the occupancy of the parking.

2 Liverpool

2.1 CH0103 Carbon stored

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0103	CARBON STORED	CFT with LJMU
CITY	*RELATED NBS*	
LIV	All NBS	

2.1.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: EcoServR

EcoServR: Assumptions on habitat codes for the UGU interventions

Intervention type	**Code**	**Description**	**Notes**
Shade trees	A13	Mixed woodland	No code for trees outside woodland; assuming mixed to average out differences between coniferous and broadleaved trees
Cooling trees			
Green filter trees			
Orchard	A112o	Orchard	
Pollinator planting	J55	Brownfield/garden/park	
SuDS ponds	G1	Standing water	
Green roof	GR	Green roof	Added to EcoservR for UGU (limited evidence base)
Green wall	GW	Green wall	Added to EcoservR for UGU (limited evidence base)
Floating island	FI	Floating island	Added to EcoservR for UGU (limited evidence base)

Smart pollinator pillars	POLL	Pollinator baskets	Added to EcoservR for UGU (limited evidence base)

EcoServR results:

EcoServR: CH0103: Carbon storage (tC)	
Sub demo A	40.54
Sub demo B	2.37
Sub demo C	75.81
Overall Liverpool	138.52

NBS	NBS name	EcoServR: CH0103: Carbon storage (tC)
lac4	Urban catchment forestry	13.41
lac5	shade trees	7.10
lac6	cooling trees	9.52
lac8	SuDs & Rain Garden	0.75
lac12	Pollinator verges and spaces	8.87
lac13	Pollinator walls/vertical	0.07
lac14	Pollinator roofs	0.24
lac16	Floating gardens	0.10
lac17	Green filter area	13.41

Pollinator walls/vertical	EcoServR: CH0103: Carbon storage (tC)
L1 GW	0.04
Parr St GW	0.08

St Johns GW	0.11

Pollinator verges and spaces	EcoServR: CH0103: Carbon storage (tC)
Baltic Hub POLL	16.4
Bott SP Aig Dr POLL	5.3
Cornwallis St POLL	1.2
Lower SuDS POLL	17.2
Park Lane POLL	5.2
Pitt St POLL	0.4
Princes Av POLL	40.3
Princes roundabt POLL	3.0
Strand POLL	4.6
Top SP Aig Dr POLL	4.3
Ullet Rd POLL	3.1
Upper SuDS POLL	2.6
Wapping POLL	11.7

SuDs & Rain Garden	EcoServR: CH0103: Carbon storage (tC)
Upper Pitt St RG	0.75
Lower SuDS	0.00
Upper SuDS	0.00

Floating gardens	EcoServR: CH0103: Carbon storage (tC)

SPL FI	0.06
Wapping FI	0.15

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The EcoServR model describes the carbon sequestered annually by vegetation which accumulates in plant tissues and is incorporated into the soil to remain locked up over longer timescales (30+ years). In the model, semi-natural habitats from the natural capital baseline are assigned a carbon storage value (tonnes of carbon per hectare) representing the amount of carbon that can be stored and/or sequestered by this vegetation type and the top 30 cm of soil. These values are averages taken from the scientific literature, and do not consider habitat condition, land management, or the specific soil type at the location. Estimates were provided by grouping (inter_codes) but this leads to double-counting (as the same tree can be a shade tree and green filter tree etc). The "total" row was corrected for this (sum of carbon stored/sequestered in each physical intervention before aggregating them into their relevant group). In addition, EcoservR normally doesn't include street trees. The UGU trees were assigned woodland codes (linked to a very small intervention), so this may overestimate carbon storage.

Most carbon storage found in Sub-demo C (76 tonnes Carbon), but sub-demo B the least (2 tC). For overall Liverpool, 139 tC were calculated.

Trees within the Urban catchment forestry(13 tC) and green filter area (13tC) in particular were the most important for carbon storage, with green walls (0.1tB) and floating gardens (0.1tC) of the least importance.

From a more detailed assessment comparing the intervention types, larger areas did best for carbon storage, such as St Johns green wall (0.1tC) out of the green walls, Wapping Dock floating island (0.2tC) as compared to 0.1tC for the Sefton Park floating island; and Princes Avenue pollinator planting (40tC) and Wapping Dock planting (12tC), Baltic Hub site (16tC) and Lower SuDs planting (17tC) as compared with the other smaller pollinator sites. Upper Pitt Street rain garden scored 0.8tC as opposed to very low carbon storage scores for the other SuDs sites. This was presumably due to the bias in EcoServR for woodland habitats and no adjustment for SuDs sites. However, all interventions scored positively for carbon storage.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.1.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No EcoServR specific codes for trees outside woodland, pollinator planting, SuDs ponds, green roof, green walls, floating islands and pollinator pillars.	Codes calculated based on nearest possible code or estimated on limited evidence (see table above)
EcoServR may overestimate carbon storage due to street trees assigned woodland codes.	Awareness of limitations of tool.
EcoservR is a spatial tool designed to take into account interaction between landscape features, so some interventions may influence others	Awareness of limitations of tool.
EcoServR: Semi-natural habitats from the natural capital baseline are assigned a carbon storage value (tonnes of carbon per hectare) representing the amount of carbon that can be stored and/or sequestered by this vegetation type and the top 30 cm of soil. These values are averages taken from the scientific literature, and do not consider habitat condition, land management, or the specific soil type at the location.	Awareness of limitations of tool.

Economical barriers	How they have been addressed

n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Interventions added to the carbon storage capacity within Liverpool and within each Sub-Demo in the vegetation and soils for the long term. The larger the area of the intervention, the greater the carbon storage. For overall Liverpool, 139 tC stored were calculated.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.2 CH0104 Carbon sequestration

KPI CODE	*KPI NAME*	*PARTNER(S)*
Ch0104	CARBON SEQUESTRATION	CFT with LJMU
CITY	*RELATED NBS*	
VAL-IZM-LIV	All NBS	

2.2.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL, EcoServR

EcoServR results:

EcoServR: CH0104: Carbon sequestration (tCO2e)	
sub demo A	-0.04
sub demo B	-0.03
sub demo C	-0.83
Overall Liverpool	-3.19

NBS	NBS Name	EcoServR: CH0104: Carbon sequestration (tCO2e)
lac4	Urban catchment forestry	-0.13
lac5	shade trees	-0.45
lac6	cooling trees	-0.62
lac8	SuDs & Rain Garden	-0.83
lac12	Pollinator verges and spaces	
lac13	Pollinator walls/vertical	-0.04
lac14	Pollinator roofs	-0.01
lac16	Floating gardens	
lac17	Green filter area	-0.87

Pollinator walls/vertical	EcoServR: CH0104: Carbon sequestration (tCO2e)
L1 GW	-0.02
Parr St GW	-0.04

St Johns GW	-0.05

NBS	NBS Name	EcoServR: CH0104: Carbon sequestration (tCO2e)
lac4	Urban catchment forestry	-0.13
lac5	shade trees	-0.45
lac6	cooling trees	-0.62
lac17	Green filter area	-0.87

SuDs & Rain Garden	EcoServR: CH0104: Carbon sequestration (tCO2e)
Lower SuDS	-1.45
Upper SuDS	-0.21
Upper Pitt St RG	

GI-VAL results:

CH0104: Carbon sequestration: GI-VAL BENEFITS	Sub-Demo Areas			Overall Liverpool	BENEFIT QUANTIFICATION
Tools	A	B	C		
1.7 Carbon sequestered by trees	-5.73	-22.01	-4.02	-32.82	tCO2e sequestered
1.8 Carbon sequestered through other land use change	-4.35	-4.35	-20.13	-20.13	tCO2e sequestered

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The EcoServR model describes vegetation capture of CO_2 through photosynthesis and emission of CO_2 through respiration. The net balance of these processes results in sequestration (carbon sink: uptake over time) or emission (carbon source: release over time). Creating and maintaining natural sinks of carbon is important in tackling climate change. For the model, semi-natural habitats from the natural capital baseline are assigned a carbon sequestration value (tonnes of CO_2e per hectare per year) representing the amount of carbon that can be sequestered by this vegetation type. These values are averages taken from the scientific literature, and do not consider habitat condition, land management, or the specific soil type at the location. The models do not consider emissions from built-up areas. Note that the negative values and carbon sequestration, so are a positive benefit. Estimates were provided by grouping (inter_codes) but this leads to double-counting (as the same tree can be a shade tree and green filter tree etc). The "total" row was corrected for this (sum of carbon stored/sequestered in each physical intervention before aggregating them into their relevant group).

Using the EcoServR model, sub-demo C was found to sequester the most Carbon (-0.8 tCO2e), but overall Liverpool sowed the most impact (-3.2 tCO2e). Trees and SuDs were the most important interventions for this factor. All the green walls were also important.

A more detailed breakdown of the EcoServR results showed that the green walls were similar in their effect on carbon sequestration, but St Johns green wall showed the greatest effect (-0.05 tCO2e). Out of the tree interventions, the green filter area trees sequestered the most Carbon (-0.87 tCO2e) but cooling and shade trees were also important (-0.62 and -0.45 tCO2e respectively), followed by the Strand urban catchment trees (-0.13 tCO2e). Out of the SuDs, the Lower Suds were best at -1.45 tCO2e followed by the Upper Suds at -0.21 tCO2e).

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The Gi-Val model demonstrated also that most of the carbon sequestration was by trees, (-33 tCO2e for overall Liverpool) but also by other land use changes (-20 tCO2e for overall Liverpool). The most sequestration from the interventions was for Sub-demo B trees (-22 tCO2e) and for Sub-Demo C for other land use changes (-20 tCO2e).

Carbon was sequestered in all areas by all interventions.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.2.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
EcoServR: Semi-natural habitats from the natural capital baseline are assigned a carbon sequestration value (tonnes of CO2e per hectare per year) representing the amount of carbon that can be sequestered by this vegetation type. These values are averages taken from the scientific literature, and do not consider habitat condition, land management, or the specific soil type at the location. The models do not consider emissions from built-up areas. NOTE! Negative values are sequestration; positive values are emissions. The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model Awareness of limitations of model
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

For the GI-Val model, carbon sequestration could most easily be investigated for the difference between trees and grassland; however, we did not have a value for wildflowers so we had to make an assumption that it would be classed as 'improved grassland'.

Both models showed that all the interventions helped with carbon sequestration, particularly the planted trees. For the interventions over all Liverpool, it was calculated that 3.19 tonnes CO2e would be sequestered.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.3 CH0105 Temperature decrease

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0105	TEMPERATURE DECREASE	CFT
CITY	*RELATED NBS*	
LIV	LAc1, LAc2, LAc4, LAc5, LAc6, LAc13, LAc14, LAc15, LAc17	

2.3.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: Reveal Thermal Camera

Quantitative monitoring data results:

QUANTITATIVE DATA SUMMARY									
CH0105: Temperature Decrease	**Pre-Intervention**				**Post-Intervention**				**% Change**
Area	**n_obs**	**n_sites**	**estimate**	**sd**	**n_obs**	**n_sites**	**estimate**	**sd**	
Overall Liverpool	35	15	1.2	3.2	186	50	4.7	3.8	274.6
Sub-Demo A	16	6	0.8	1.8	61	17	5.7	4.4	586.7
Sub-Demo B	19	9	1.6	4.0	125	33	4.2	3.3	160.8

QUANTITATIVE DATA SUMMARY										
CH0105: Temperature Decrease		**Pre-Intervention**				**Post-Intervention**				**% Change**
NBS	**inter_code**	**n_obs**	**n_sites**	**estimate**	**sd**	**n_obs**	**n_sites**	**estimate**	**sd**	
LAc4	Strand Tree SuDS	1	1	16.3		3	1	4.7	2.8	-70.9
LAc5	Shade_TREES					24	10	5.5	2.9	
LAc6	Cooling_TREES					43	18	7.2	4.4	
LAc8	Upper Pitt St RG					5	1	6.2	3.7	
LAc12	Baltic POLL					2	2	6.3	0.7	
LAc12	Cornwallis St POLL					1	1	9.0		
LAc12	Park Lane POLL					2	1	6.4	1.4	
LAc13	L1 GW					12	3	5.8	3.5	
LAc13	Parr St GW	16	6	0.8	1.8	27	5	2.7	2.5	226.4
LAc13	St Johns GW	11	4	0.0	1.9	33	5	3.1	3.0	
LAc14	Royal Court GR					22	5	2.6	2.9	
LAc17	Lime St TREES					1	1	6.5		
LAc17	Stafford St TREES	7	4	2.0	1.2	11	4	3.4	3.5	64.5

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

For related intervention site names, please see table below:

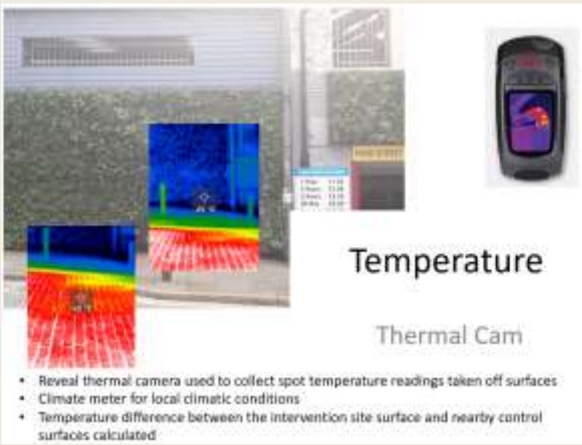
FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0105	TEMPERATURE DECREASE	LAc1	New green cycle route	ALL	ALL	ALL
		LAc2	Green travel route	ALL	ALL	ALL
		LAc4	Urban Catchment forestry		Strand Tree SuDS	
		LAc5	Shade trees	Shade_TREES	Shade_TREES	Shade_TREES
		LAc6	Cooling trees	Cooling_TREES	Cooling_TREES	
		LAc13	Pollinator walls/vertical	Parr St GW	St Johns GW, L1GW	
		LAc14	Pollinator roofs		RoyaL Court GR	
		LAc15	Mobile gardens			
		LAc17	Green filter area with large urban trees		Green_Filter_TREES	

Map of monitoring locations (sub demo areas A and B): Urban catchment forestry, green filter area (Stafford Street), pollinator roof and vertical pollinator walls:

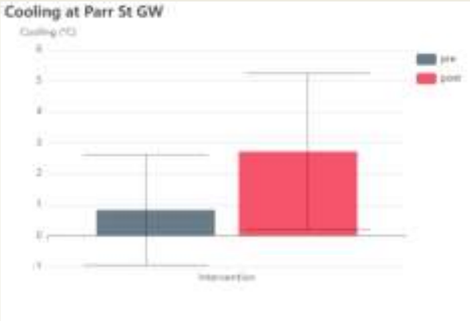
Map of monitoring locations (sub demo areas A and B): Cooling trees:

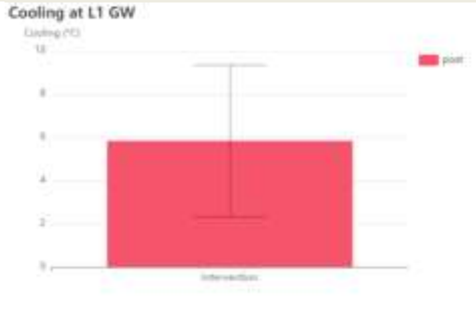
Map of monitoring locations (sub demo areas A and B): Shade trees:

Equipment and methodology:

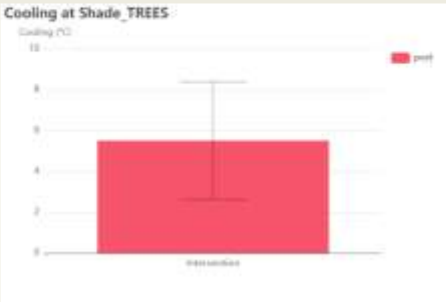


Summary plot example from Sub-Demos A and B: Pollinator vertical wall comparisons

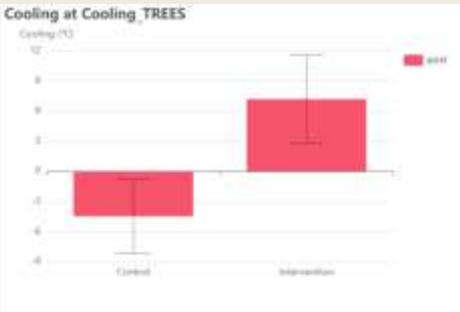




Summary plot example for intervention: Shade trees



Summary plot example for intervention: Cooling trees



The vertical pollinator or green wall comparison plots show that the Liverpool One green wall had the greatest cooling effect (approximately 6C compared to 3C for both the other green walls). Both Parr Street and St Johns's green walls face North-East and North-West respectively, so rarely get any Sun, sot this needs to be taken into account.

The comparison plot examples for shade and cooling trees show between 5.5-7.5C cooling effect. Cooling tree species seemed to show a slightly greater cooling effect. Consideration is needed for the lack of maturity of the trees and there were often difficulties getting an adequate control site and temperatures varied greatly with local climatic conditions and materials of the control site. Further comparisons would help to understand the data variability better.

The data comparison tables do not present a full picture due to the difficulties of pre-intervention monitoring, so the % Change in temperature reduction shows extremes such as for the urban catchment forest, Strand tree SuDs (a 71% increase in temperature with the intervention), bit the Parr Street green wall and Stafford Street trees (green filter area) showed a strong cooling effect. Due to the cooling effect from the many sites in the sub demo A, including the occasional monitoring of the pollinator and rain garden sites, sub demo A was found in the overall data summary to have the most important cooling effect of all the areas studied at 587%. Sub demo B was still important at 160%. Overall all the Liverpool interventions in sub demos A and B, there was found to be a 275% temperature decrease. So, a strong positive effect of the interventions.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.3.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
None	
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	

Environmental (including COVID)	How they have been addressed
None	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further future analyses investigating the influence of surface materials, sunlight, local and Liverpool climatic factors would be beneficial to fully understand the relative importance of the cooling effect.

All interventions observed created a cooling effect and hence temperature decrease. This is even although interventions such as the trees are still young immature trees without a full canopy and not all interventions face the Sun. Overall, the Liverpool sub demo A and B interventions generated a 275% temperature decrease.

What was the impact? (positive/negative, significant/non-significant)?

Positive.

2.4 CH0106 Temperature reduction (projected)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0106	TEMPERATURE REDUCTION (PROJECTED)	CFT with LJMU
CITY	*RELATED NBS*	
LIV	All NBS	

2.4.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: EcoServR, GI-VAL, Star

EcoServR results:

EcoServR: CH0106: Temperature reduction		
extent	**service**	**% Change**

Sub-demo A	Local.climate.regulation	1.7
Sub-demo B	Local.climate.regulation	10.1
Sub-demo C	Local.climate.regulation	0.5
Liverpool LA	Local.climate.regulation	0.0

EcoServR: CH0106: Temperature reduction		
NBS	**NBS Name**	**% Change**
lac4	Urban catchment forestry	24.2
lac5	shade trees	59.7
lac6	cooling trees	46.7
lac8	SuDs & Rain Garden	0.2
lac12	Pollinator verges and spaces	76.3
lac13	Pollinator walls/vertical	3.0
lac14	Pollinator roofs	
lac16	Floating gardens	0.0
lac17	Green filter area	44.7

EcoServR: CH0106: Temperature reduction			
Sub Demo Area	**Pollinator verges and spaces**	**radius (m)**	**% Change**
A	Baltic Hub POLL	20	
A	Baltic POLL	20	9.14
A	Cornwallis St POLL	20	
A	Pitt St POLL	20	

A	Strand POLL	20	226.44
A	Wapping POLL	20	0.02
C	Bott SP Aig Dr POLL	20	
C	Lower SuDS POLL	20	2.21
C	Park Lane POLL	20	
C	Princes Av POLL	20	
C	Princes roundabt POLL	20	
C	Top SP Aig Dr POLL	20	
C	Ullet Rd POLL	20	455.33
C	Upper SuDS POLL	20	-1.86
A	Baltic Hub POLL	100	
A	Baltic POLL	100	6.75
A	Cornwallis St POLL	100	
A	Pitt St POLL	100	
A	Strand POLL	100	21.77
A	Wapping POLL	100	0.79
C	Bott SP Aig Dr POLL	100	0.00
C	Lower SuDS POLL	100	2.15
C	Park Lane POLL	100	
C	Princes Av POLL	100	0.00
C	Princes roundabt POLL	100	0.00
C	Top SP Aig Dr POLL	100	485.13
C	Ullet Rd POLL	100	14.93

C	Upper SuDS POLL	100	-1.71

EcoServR: CH0106: Temperature reduction		
SuDs & Rain Garden	**radius (m)**	**% Change**
Upper Pitt St RG	20	
Upper SuDS	20	-1.90
Lower SuDS	20	2.28
Upper Pitt St RG	100	
Upper SuDS	100	-1.77
Lower SuDS	100	2.18

EcoServR: CH0106: Temperature reduction		
NBS Name	**radius (m)**	**% Change**
shade trees	20	109.98
cooling trees	20	
Green filter area	20	
shade trees	100	9.36
cooling trees	100	46.66
Green filter area	100	44.67

EcoServR: CH0106: Temperature reduction		
Pollinator walls/vertical	**radius (m)**	**% Change**
L1 GW	20	5.30

Parr St GW	20	
St Johns GW	20	
L1 GW	100	0.72
Parr St GW	100	
St Johns GW	100	

EcoServR: CH0106: Temperature reduction		
Floating gardens	**radius (m)**	**% Change**
SPL FI	20	0.00
Wapping FI	20	0.00
SPL FI	100	0.06
Wapping FI	100	0.01

GI-VAL results:

CH0106: Temperature reduction	GI-VAL BENEFITS	Sub-Demo Areas			Overall Liverpool	BENEFIT QUANTIFICATION
Functions	**Tools**	**A**	**B**	**C**		
Shelter from wind	1.1 Reduced building energy consumption for heating	37200.00	0.00	0.00	0.00	kWh/yr energy saved
Shelter from wind	1.2 Avoided carbon emissions from building energy saving for heating	6861.54	0.00	0.00	0.00	kgCO2/yr not emitted

Shelter from wind	1.3 Avoided damage from wind and storms	n.a.	n.a.	n.a.	n.a.	
Reduction of urban heat island effect	1.4 Reduced peak summer surface temperatures	0.02	0.15	0.01	0.00	°C in surf. temperature reduction
Cooling through shading and evapo-transpiration	1.5 Reduced building energy consumption for cooling	326.70	1035.42	0.00	1362.12	kWh/yr energy saved
Cooling through shading and evapo-transpiration	1.6 Avoided carbon emissions from building energy saving for cooling	163.46	518.07	0.00	681.53	kgCO2 not emitted

Star tool results:

Maximum surface temperatures (°C) under Temperature scenario: 2050s High temperature - 50% probability level	
Average decrease across all interventions	**STAR calculation**
Overall Liverpool	0.49
Sub Demo A	0.43
Sub Demo B	0.63
Sub Demo C	0.28

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

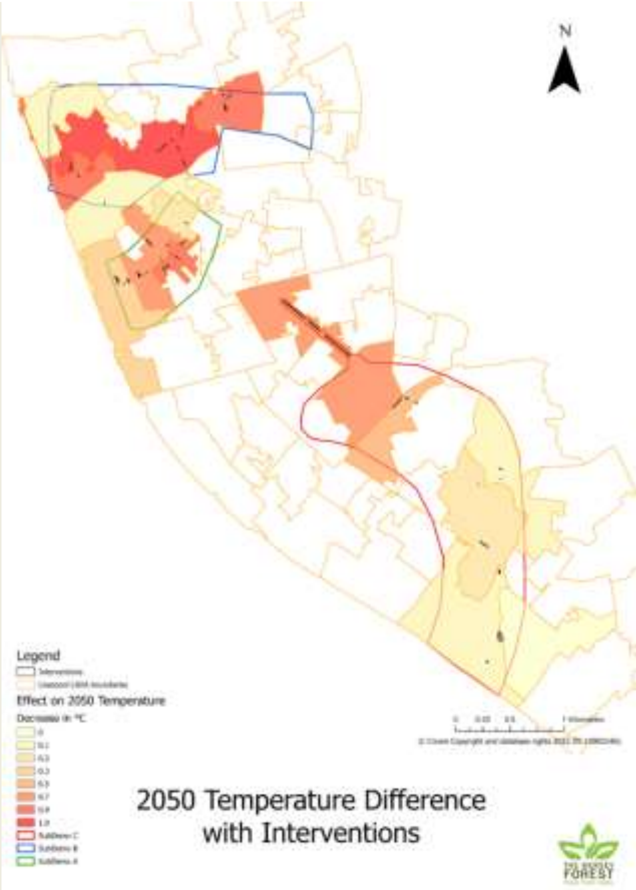
The various models assessed the interventions in various ways.

The EcoServR model described landscape features which provide shade or can absorb heat to help in local climate regulation. Relative scores (0-100) were assigned to habitat types from the natural capital baseline based on their relative capacity to cool down their surroundings. Areas with trees (shade) and bodies of water are especially good at this. Because the benefits that a habitat provides may be felt a certain distance away from the habitat itself, focal statistics sum the scores at a local (300 m) range. Because smaller patches will have less of an impact on their surroundings than large patches, a series of buffers are then used as masks to constrain the cooling scores around the features that provide them (< 2 ha: 20 m | 2-5 ha: 40 m | 5-10 ha: 80 m | > 10 ha: 100 m). Raw units do not represent a biophysical value. A rescaled (0-100) version is provided where 100 is the highest capacity in the area mapped.

The GI-VAL model assessed this factor by analysing the vegetation in various ways. These included shelter from the wind and the associated reduced energy consumption and emissions from heating needs, reduction of the urban heat island effect on surface temperatures and cooling through shade and evapotranspiration (with the associated reduced energy consumption and emissions with respect to the cooling needs). The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

STAR tools allow users to assess the potential of green infrastructure in adapting their areas to climate change. Within the Star too, The surface temperature tool will give the average maximum surface temperature for the study area(s) of interest. Depending on the temperature scenarios selected and whether the tool is run for different land cover scenarios there will be a number of maximum surface temperatures provided. STAR tools can be used at a neighbourhood scale to test the impact of different land cover scenarios of greening and development on surface temperatures, under different temperature scenarios.

In the figure generated by the Star tool, the darker colours correspond with the greatest decrease in degrees Celsius.



The EcoServR model demonstrated that all interventions had a cooling effect, with those in sub-demo B at 10% the most important overall, but negligible for overall Liverpool. Pollinator verges and spaces (76%) were most important, together with trees, but green walls and the SuDs were not shown to be so important. EcoServR, though, does not take SuDs and drainage systems into account and heavily penalises loss of woodland, so scored the Upper SuDs site as negative*.

From a more detailed breakdown of the interventions in terms of pollinator verges, EcoServR showed the pollinator planting on the Strand (Strand POLL) had a very important cooling effect particularly at 20m rather than 100m radius (226% and 22% respectively). Also, the pollinator pillars (Baltic POLL) had a greater cooling effect at a 20m radius than at 100m radius (9 and 7% cooling respectively). The majority of the pollinator verge sites had a better cooling effect in close proximity (20m) than at 100m, as demonstrated by the Ullet road site (Ullet Rd POLL) (455% and 15% at 20m and 100m respectively), except for the Wapping pollinator site which had a greater effect at 100m (0.02% at 20m and 0.79% at 100m radius). The top of Aigburth Drive at the top of Sefton Park (Top SP Aig Dr POLL showed a large change in cooling at 100m, so the combined effect on the nearby Ullet Rd site may have caused this beneficial joint effect.

Other comparisons between interventions at different radii for EcoServR showed the lower SuDs to have a more cooling effect than the Upper Suds. This is due to the bias by the model*. In addition, shade trees had an important cooling effect of 110% at 20m in contrast to 9% at 100m. Cooling trees and green filter trees provided a cooling effect at 100m (47% and 45% respectively). So, trees had an important cooling effect. The Liverpool One green wall (L1 GW) had a better cooling effect at close range too (5% at 20m to 1% at 100m). Although, the floating gardens had a better cooling effect at 100m (0.06% for Sefton Park and 0.01% for Wapping Dock)

From the GI-VAL results, the sub-demo A interventions were found to be most important in reducing building energy consumption for heating (e.g. 37200 KWh/yr energy saved), but those in sub demo B were the best at reducing the building costs for cooling (e.g. 1035KWh/yr energy saved). Sub demo B interventions were also found the best in reducing the urban heat island effect (0.25C temperature reduction) in comparison to sub demos A and C (0.02 and 0.01C respectively). Overall Liverpool showed negligible results for this factor.

The Star tool analyses showed that Sub-demo B interventions would have the most important future effect on temperature reduction (a Star value of 0.63% as compared to the average value overall of 0.49), followed by sub demo A (0.43%), then sub demo C (0.28%). The overall Liverpool calculation was for 0.49% temperature reduction.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.4.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
EcoservR: Relative scores (0-100) are assigned to habitat types from the natural capital baseline based on their relative capacity to cool down their surroundings. Areas with trees (shade) and bodies of water are especially good at this. Because the benefits that a habitat provides may be felt a certain distance away from the habitat itself, focal statistics sum the scores at a local (300	Awareness of limitations of model

m) range. Because smaller patches will have less of an impact on their surroundings than large patches, a series of buffers are then used as masks to constrain the cooling scores around the features that provide them (< 2 ha: 20 m | 2-5 ha: 40 m | 5-10 ha: 80 m | > 10 ha: 100 m). Raw units do not represent a biophysical value. A rescaled (0-100) version is provided where 100 is the highest capacity in the area mapped. *EcoServR does not take drainage systems or SuDs into account. The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Yes, all interventions scored well for cooling (except for SuDs drainage* in EcoServR). Sub-demo B interventions were the best at reducing the urban heat island effect and future probable temperature reduction scenarios. Pollinator verges and trees were found to be the most effective at temperature reduction particularly within 20m radius.

What was the impact? (positive/negative, significant/non-significant)?

Positive for all models

2.5 CH0108 Heatwave risk

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0108	HEATWAVE RISK	CFT with LJMU
CITY	*RELATED NBS*	
LIV	All NBS	

2.5.1 Results and Discussion

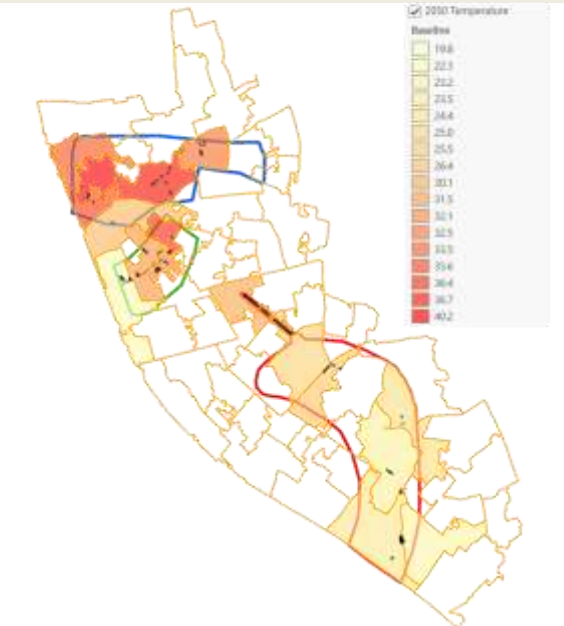
Table of results (summary, from Task 5.4)

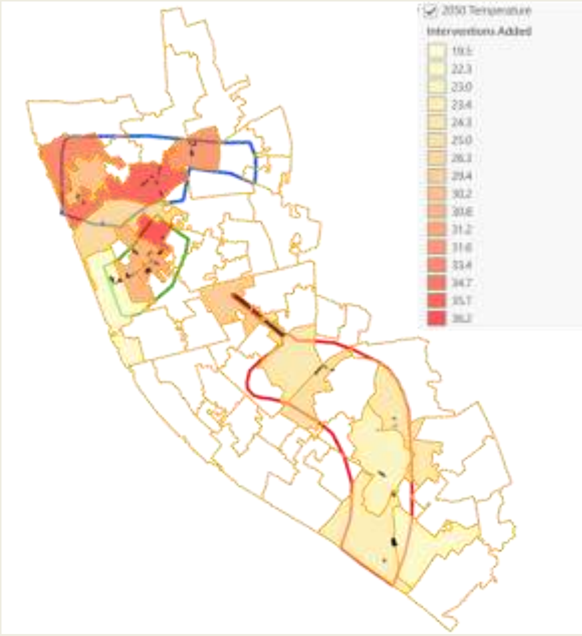
MODELLING: Star

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

STAR tools can be used at a neighbourhood scale to test the impact of different land cover scenarios of greening and development on surface temperatures and runoff, under different temperature and precipitation scenarios.

2050 Maximum Surface Temperature Results from STAR Tools: Pre and post interventions effects are shown together with the sub demo areas and intervention locations:





For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.5.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The Star tool could not include actual numbers of days with an associated heatwave risk, so the results are only per neighbourhood and not on a fine scale.	Awareness of limitations of model.
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	

Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Areas with less GI are at a greater risk of heatwave; thus, it is essential to add GI interventions to areas of impervious (non-GI) surfaces. This is shown form the figures for the most urban area in Liverpool studied (sub demo B) when the interventions are added to the model analyses. So, a slight positive impact was viewed even at this coarse scale.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.6 CH0111 Species movement

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0111	SPECIES MOVEMENT	CFT with LJMU
CITY	*RELATED NBS*	
LIV	All NBS	

2.6.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: Condatis

Ecological Networks: Attempted but inconclusive (see notes 'UGU model notes')

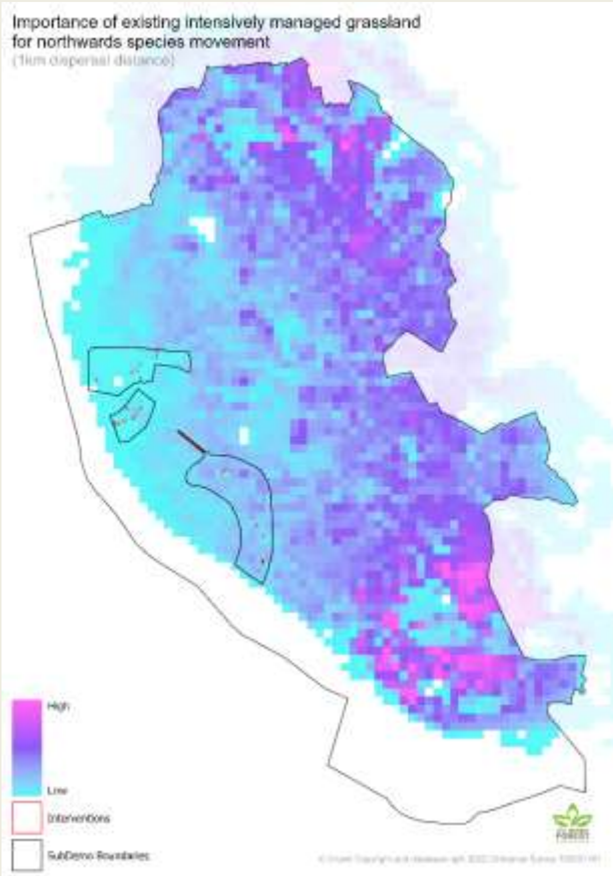
No data downloads except for raster images were possible for the Condatis model.

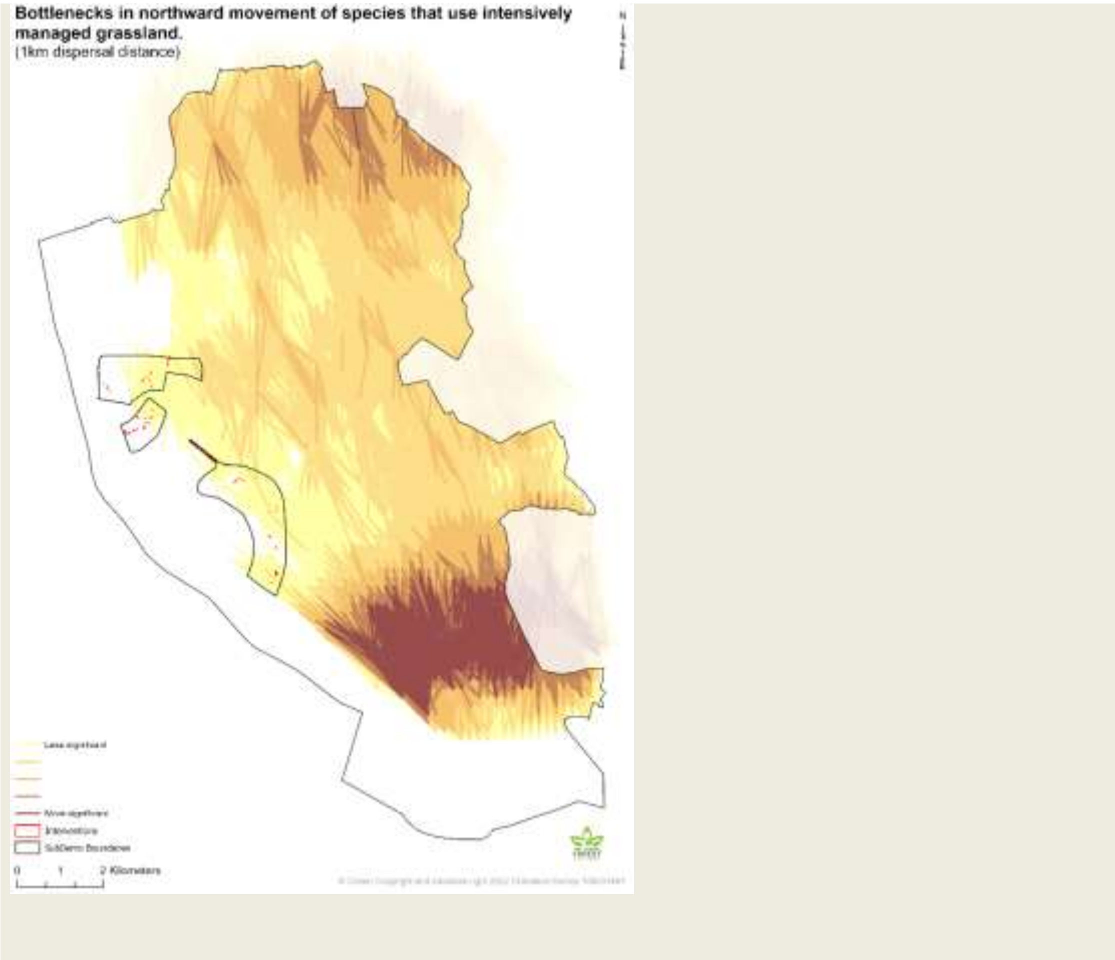
Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

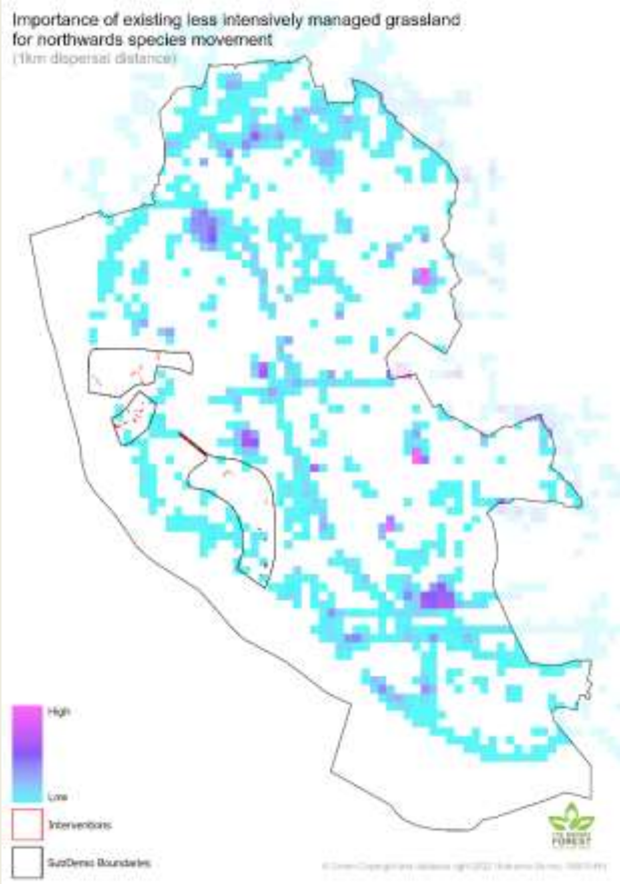
Condatis considers a landscape as analogous to a circuit board, with a source population of species being considered the voltage, the links between habitat useable by these species being the resistors, and the flow of species colonising the available habitat across those links being considered the current.

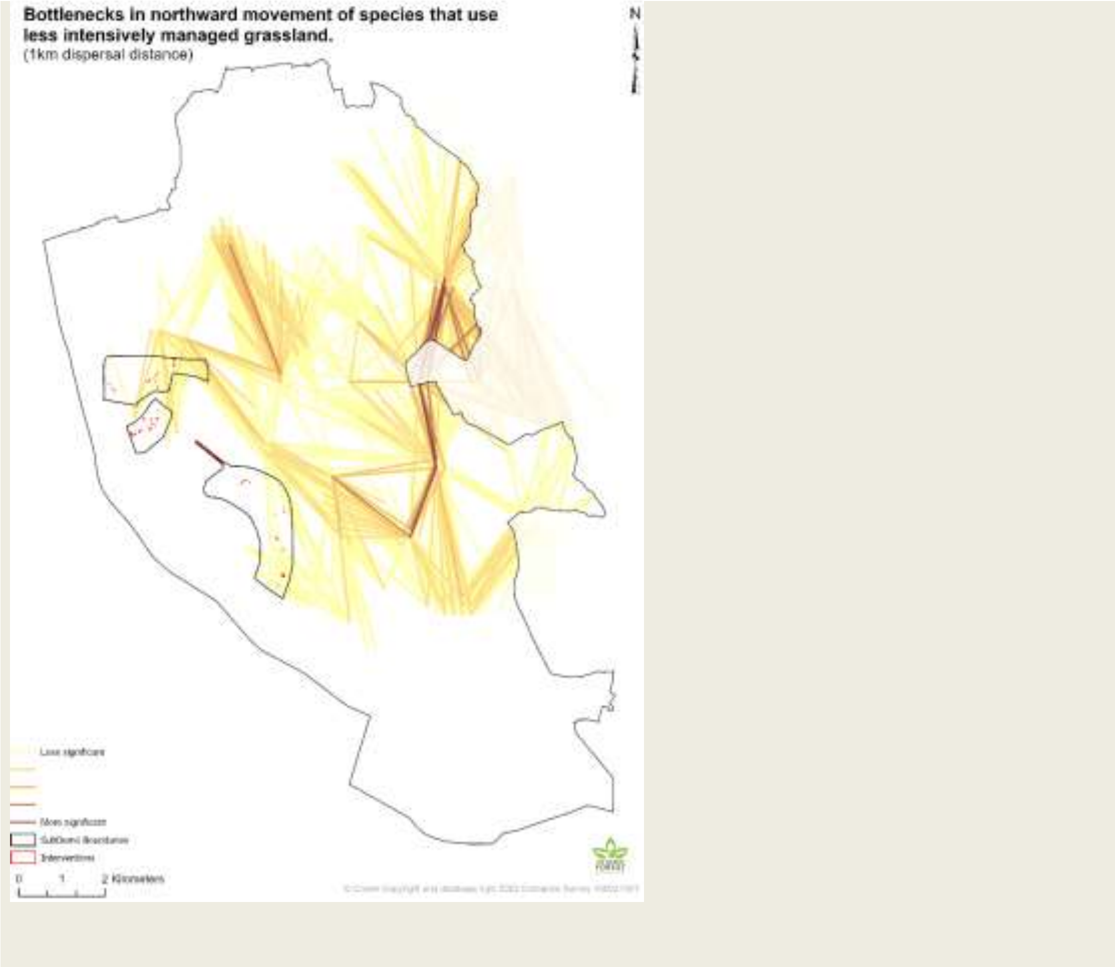
Thus, the bottlenecks and flow maps around Liverpool represent areas where habitat is suitable for the source population of species. This will tell us how species move around the city centre and which habitats are of high importance.

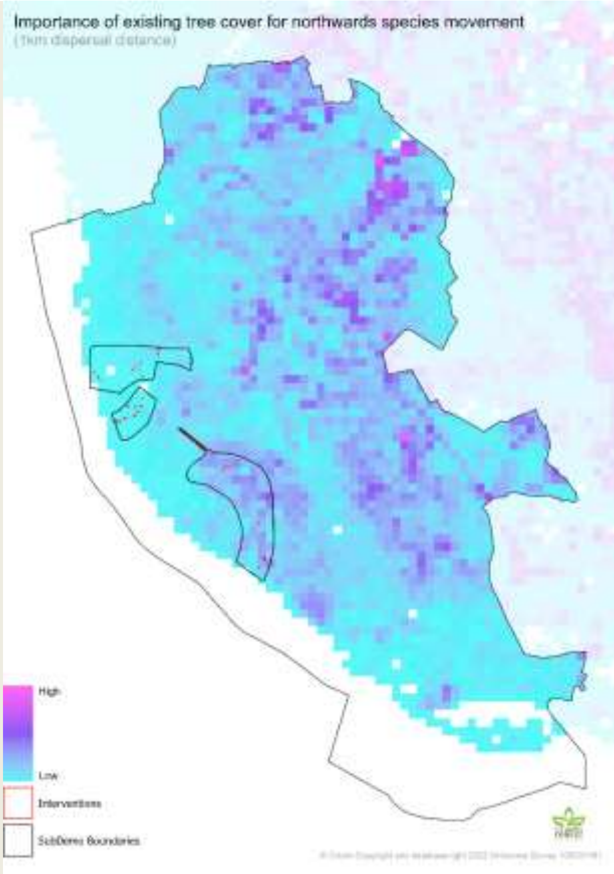
Summary figures shown for intensively managed grassland, less intensively managed grassland and species requiring tree cover:

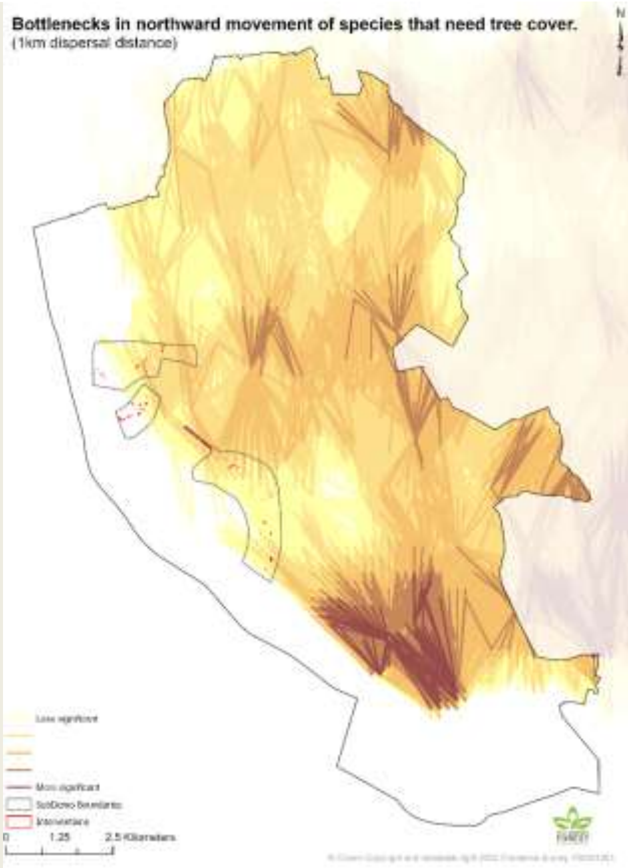



Bottlenecks in northward movement of species that use intensively managed grassland.
(1km dispersal distance)
0 1 2 Kilometers


Importance of existing less intensively managed grassland
for northwards species movement
(1km dispersal distance)
High
Low
Interventions
SubDemo Boundaries


Bottlenecks in northward movement of species that use
less intensively managed grassland.
(1km dispersal distance)
N
0
1
2


Importance of existing tree cover for northwards species movement
(1km dispersal distance)
High
Low
Interventions



From the figures above, it is impossible to decipher at this scale if the introduction of the interventions would be able to influence species movement. So, the effect was found to be inconclusive.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.6.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Ecological Network modelling software was found to produce inconclusive results for the scale of interventions. The models use a minimum patch source size (typically 0.1ha) and a functional threshold (size below which a portion of network is considered	Awareness of limitations of models

ineffective). Even when the latter was reduced from 1ha to 0.001 ha, the results were still inconclusive. Condatis is a coarse landscape tool so was not detailed enough for the interventions.	
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
Due the scale at which the model operated, it was impossible to tell if any species movement opportunities were created by the introduction of the interventions.
What was the impact? (positive/negative, significant/non-significant)?
Inconclusive

2.7 CH0201 Run-off coefficient

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0201	RUN-OFF COEFFICIENT	CFT
CITY	*RELATED NBS*	
LIV	All NBS	

2.7.1 Results and Discussion

Table of results (summary, from Task 5.4)

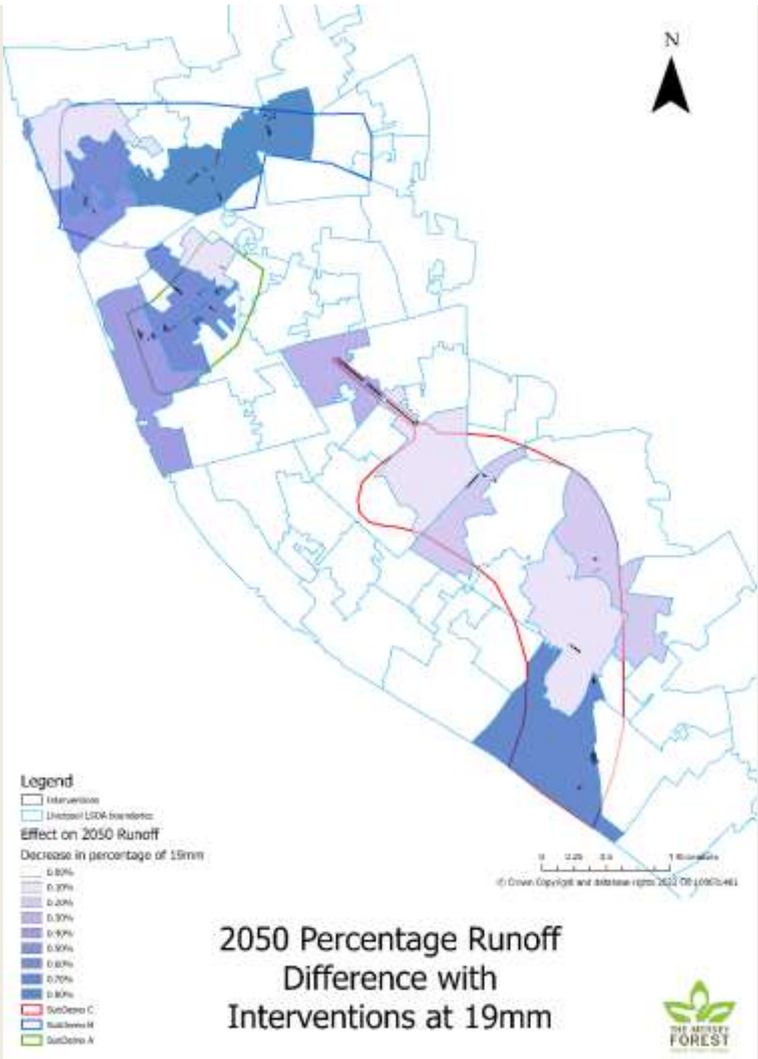
MODELLING: Star

Star tool results:

Surface runoff percentages under the precipitation scenario: 2050s High precipitation - 50% probability level	
Average decrease across all interventions	**STAR calculation**
Overall Liverpool	0.36
Sub Demo A	0.43
Sub Demo B	0.56
Sub Demo C	0.27

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

STAR tools allow users to assess the potential of green infrastructure in adapting their areas to climate change. The surface runoff tool will give the percentage and volume of surface runoff for the study area(s) of interest. This output is available for daily precipitation depths of 0-100mm. You can choose to highlight selected precipitation scenarios and to run the tool for different land cover scenarios. STAR tools can be used at a neighbourhood scale to test the impact of different land cover scenarios of greening and development on surface runoff, under different precipitation scenarios. For these analyses, the study areas were set as the LSOAs as the smallest area possible to represent the interventions. The mm in STAR tools is set to 19mm and then the percentage is representing the amount of decrease in runoff for 19mm. So, the darker colours in the maps represent the greatest decrease in runoff at 19mm.



From the figure, greater decreases in surface water runoff can be found at the Otterspool Woods end of Sub demo C, throughout sub demos A and B. For sub demo B, it can be assumed that the percentage run off was changed particularly with the addition of trees, permeable paving, and tree SuDs. In sub demo A, the rain garden and planting areas were important. Then in sub demo C, the Upper and Lower SuDs water retention ponds were most important. A more detailed breakdown for each intervention is not possible for this tool.

From the data summary, the highest reduction in surface runoff was achieved under the Star scenarios in sub demo B (0.56%), followed by sub demo A (0.36%) then sub demo C (0.27%). The overall average reduction for Liverpool was calculated at 0.36%. So overall positive effects of the interventions were observed.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.7.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
n/a	
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

The Star tool analyses demonstrated overall slight decreases in surface runoff for all areas, in particular in sub demo B. It was assumed that the interventions specifically designed for this had the most impact, but other interventions may have had an added effect.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.8 CH0204 Water slowed down from sewer system

KPI CODE	*KPI NAME*	*PARTNER(S)*

CH0204	WATER SLOWED DOWN FROM SEWER SYSTEM	CFT
CITY	*RELATED NBS*	
LIV	LAc4, LAc8	

2.8.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: EcoServR

QUANTITATIVE: Detectronic flow meter data (see in CH0211). Also refer to soilmania sensor data

EcoServR: Assumptions on habitat codes for the UGU interventions

Intervention type	Code	Description	Notes
Shade trees	A13	Mixed woodland	No code for trees outside woodland; assuming mixed to average out differences between coniferous and broadleaved trees
Cooling trees			
Green filter trees			
Orchard	A112o	Orchard	
Pollinator planting	J55	Brownfield/garden/park	
SuDS ponds	G1	Standing water	
Green roof	GR	Green roof	Added to EcoservR for UGU (limited evidence base)
Green wall	GW	Green wall	Added to EcoservR for UGU (limited evidence base)
Floating island	FI	Floating island	Added to EcoservR for UGU (limited evidence base)
Smart pollinator pillars	POLL	Pollinator baskets	Added to EcoservR for UGU (limited evidence base)

EcoServR results:

EcoServR: CH0204: Water slowed down		% Change
sub demo A	Flood.risk.mitigation	0.10
sub demo B	Flood.risk.mitigation	0.08
sub demo C	Flood.risk.mitigation	-0.07
Overall Liverpool	Flood.risk.mitigation	0.01

EcoServR: CH0204: Water slowed down		
NBS	**NBS Name**	**% Change**
lac4	Urban catchment forestry	0.0
lac5	shade trees	1.0
lac6	cooling trees	2.3
lac8	SuDs & Rain Garden	-10.2
lac12	Pollinator verges and spaces	11.2
lac13	Pollinator walls/vertical	-1.0
lac14	Pollinator roofs	0.0
lac16	Floating gardens	7.3
lac17	Green filter area	1.5

EcoServR: CH0204: Water slowed down		
Floating gardens	**radius (m)**	**% Change**
SPL FI	20	0.0
Wapping FI	20	
SPL FI	100	0.0
Wapping FI	100	22.0

EcoServR: CH0204: Water slowed down		
SuDs & Rain Garden	**radius (m)**	**% Change**
Upper Pitt St RG	20	0.0
Upper SuDS	20	-31.0

Lower SuDS	20	-24.3
Upper Pitt St RG	100	0.0
Upper SuDS	100	-2.7
Lower SuDS	100	-3.1

	EcoServR: CH0204: Water slowed down		
NBS	**NBS Name**	**radius (m)**	**% Change**
lac4	Urban catchment forestry	20	
lac5	shade trees	20	1.7
lac6	cooling trees	20	4.4
lac17	Green filter area	20	2.6
lac4	Urban catchment forestry	100	0
lac5	shade trees	100	0.2
lac6	cooling trees	100	0.1
lac17	Green filter area	100	0.4

EcoServR: CH0204: Water slowed down		
Pollinator walls/vertical	**radius (m)**	**% Change**
L1 GW	20	-2.6
Parr St GW	20	
St Johns GW	20	
L1 GW	100	-0.4
Parr St GW	100	0.0
St Johns GW	100	

	EcoServR: CH0204: Water slowed down		
Sub Demo Area	**Pollinator verges and spaces**	**radius (m)**	**% Change**
A	Baltic Hub POLL	20	-11.5
A	Baltic POLL	20	-2.2
A	Cornwallis St POLL	20	6.9
A	Park Lane POLL	20	-3.8

A	Pitt St POLL	20	-0.4
A	Strand POLL	20	-4.5
A	Wapping POLL	20	67.1
C	Bott SP Aig Dr POLL	20	5.6
C	Lower SuDS POLL	20	-15.6
C	Princes Av POLL	20	156.2
C	Princes roundabt POLL	20	100.0
C	Top SP Aig Dr POLL	20	0.0
C	Ullet Rd POLL	20	17.4
C	Upper SuDS POLL	20	-24.5
A	Baltic Hub POLL	100	-3.6
A	Baltic POLL	100	0.5
A	Cornwallis St POLL	100	2.7
A	Park Lane POLL	100	-0.5
A	Pitt St POLL	100	0.6
A	Strand POLL	100	-2.1
A	Wapping POLL	100	10.7
C	Bott SP Aig Dr POLL	100	0.7
C	Lower SuDS POLL	100	-2.7
C	Princes Av POLL	100	11.5
C	Princes roundabt POLL	100	4.4
C	Top SP Aig Dr POLL	100	0.9
C	Ullet Rd POLL	100	1.0
C	Upper SuDS POLL	100	-2.4

Quantitative monitoring data results:

Ongoing discussion with water experts so expected soon.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The EcoServR model described the flood risk mitigation in the following way to assess the effect of natural habitats to slow the flow of water and alleviate the risk of flooding downstream. The capacity of the landscape to slow down water flow was measured by considering two indicators. First, vegetation roughness was mapped by assigning Manning's Roughness Coefficient to habitats in the baseline. Denser, more complex vegetation structures were better at retaining water. Second, slopes were calculated from a digital elevation model and assigned relative scores, with flatter profiles scoring higher and steeper slopes scoring lower in their ability to slow water. The two indicators were combined (multiplied) to produce the final supply map. Patches smaller than 500 m2 were removed as they are unlikely to provide the service to any meaningful extent. The model does not consider urban drainage systems or built defences. Raw units do not represent a biophysical value. A rescaled (0-100) version was provided where 100 is the highest capacity in the area mapped. The map is a bird's eye view and doesn't allow for features to pile up. For instance the L1 green wall is linked to a loss of amenity grassland and therefore shows a loss in flood mitigation.

The EcoServR model showed a positive impact overall for the impact of the interventions for all areas, except a slight decrease for sub demo C* (-0.07%). Sub demo A showed the best mitigation (0.10%), followed by sub demo B (0.08%). Overall, for the extent of Liverpool, the flood risk reduction due to Urban GreenUP was calculated as 0.01%.

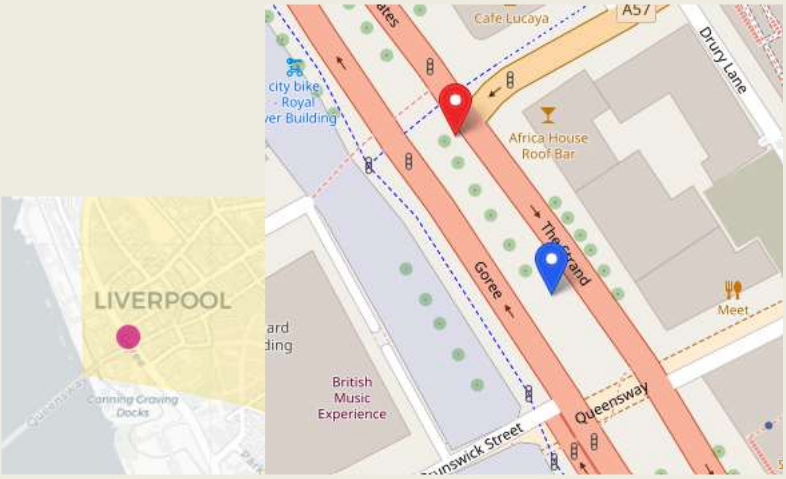
From the breakdown of the interventions, pollinator verges and spaces were the most important at 11.2% reduction, followed by floating gardens (7.3%), then the tree-based interventions, cooling trees, shade trees and green filter area (2.3%, 1.0% and 1.5% respectively); the urban catchment forestry and pollinator roofs showed a negligible change. The pollinator walls (-1.0%) and Suds and rain garden (-10.2%) showed a negative change, possibly due to the constrictions of the model*.

A further detailed look at the interventions demonstrated the following EcoServR generated results at a 20m and 100m radius of influence. The Wapping Dock floating island showed a high influence of 22% at 100m radius, but the Sefton Park island showed negligible results. For the SuDs and rain garden category, the rain garden showed negligible results with both the Suds showing negative effects. These results are all possibly due to the model limitations*. For the tree-based interventions, the cooling tree species had the best impact at close proximity (4.4% at 20m, 0.1% at 100m), followed by the green filter trees (2.6% at 20m, 0.4% at 100m) and shade trees (1.7% at 20m, 0.2% at 100m). The green walls could not always be calculated, but the Liverpool One green wall showed a negative change, but this would be due to the model limitations, as explained*. From the pollinator verge site breakdown, some negative changes were within the output*, but the best reductions in flood mitigation were for the larger sites, such as Princes Av POLL (156% at 20m, 12% at 100m), Princes roundabout POLL (100% at 20m, 4% at 100m), Wapping POLL (67% at 20m, 11% at 100m). The pollinator verge sites also generally showed better flood risk mitigation at closer proximities.

For related intervention site names used in the quantitative data, please see table below:

FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0204	WATER SLOWED DOWN FROM SEWER SYSTEM	LAc4	Urban Catchment forestry		Strand Tree SuDS	
		LAc8	Rain Garden (SUDs)	Upper Pitt St RG		

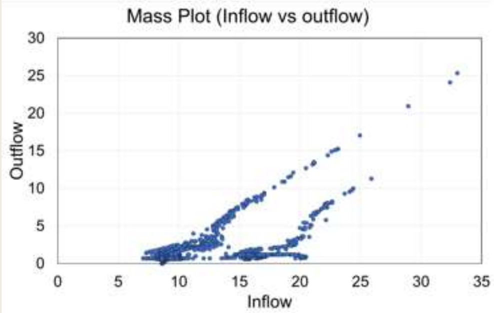
Map of monitoring locations: Sub Demo B: Strand tree SuDS (Urban Catchment Forestry)



Map of monitoring locations: Sub demo A Baltic Rain Garden

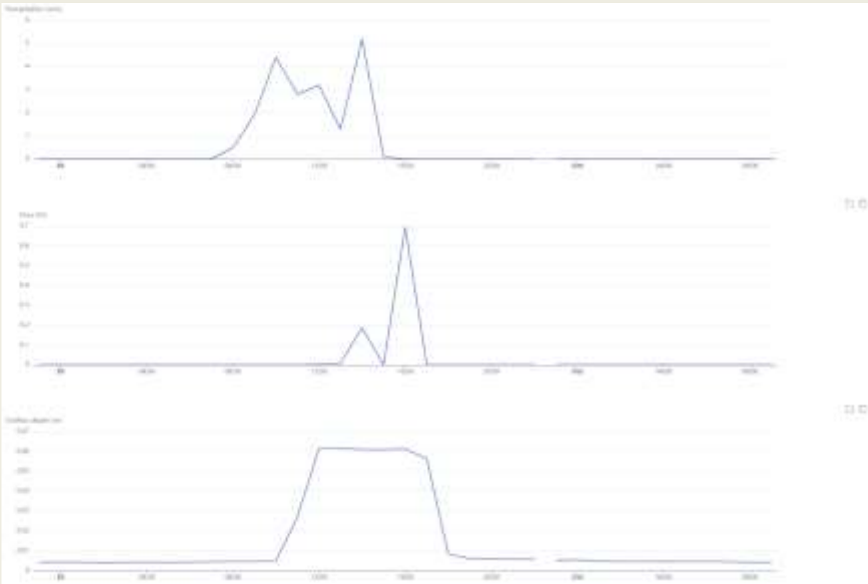
Equipment and methodology: Detectronic flow meter sensors

Summary plot example: Strand: inflow vs outflow



Summary plot example: Strand: example of rainfall event (2/11/22 at 15:00): Precipitation data are from the University of Liverpool campus a short distance away; the Level data are from the flow meter data at the inflow entry point for the tree SuDs or urban catchment forestry on the Strand; the Depth data are from the outflow exit point of the line of tree SuDs. Soil moisture data were from both the first and last trees in the line.

<u>Summary plot example: Baltic rain garden: example of rainfall event (29/09/22 at 10:00):</u> Precipitation data are from the University of Liverpool campus a short distance away; all the flow meter points (flow, depth and velocity) are taken at a point at the outflow section of the rain garden; the soil moisture data are from bed 1 (uppermost part), bed 2 (middle section) and bed 3 (lowest section).



For the quantitative data, data from the flow meters on the Strand were intermittent due to problems caused by silt build-up, so rainfall events were targeted for data analysis and an idea of the performance of the SuDs. The Baltic rain garden had a flow meter only at one point, so a calculation of water slowed may be impossible at this site. Ongoing discussions with water experts may provide further insights.

From the figures above, the Strand inflow vs outflow chart indicates a slowing of the water speed throughout the tree SuDs line. In addition, hydrograph plots (see plot example above) of the rainfall events, the level inflow and depth outflow indicate the water slowing through the SuDs system due to the later peaks of water depth showing a time lag.

The Baltic rain garden (Upper Pitt St RG) demonstrated that after a certain amount of water entering the system, that a discharge with a peak flow and velocity occurred (see example above).

For both the Strand and Baltic systems, the soil moisture meters (provided by Soil Mania and Myerscough College) provided information on the saturation of the soil. This would be expected to highlight where the trees or rain garden reach the limit of water absorption and start to release the water from the system. From the rain garden example plot above, it can be see that bed 3 (the lowermost bed in the rain garden) showed a peak in soil moisture at the time of the discharge of water from the raingarden, when the flow and velocity were also measured by the Detectronic flow meter.

Overall from the indications from the quantitative data and the modelled data, reduction in flood risk and water speeds were observed, so a positive change is seen for this KPI.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.8.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Sensor issues due to silt buildup	Being resolved
*EcoServR is a spatial landscape tool, so doesn't allow for features to pile up. For instance, the L1 green wall is linked to a loss of amenity grassland and therefore shows a loss in flood mitigation. In addition, the models cannot consider SuDs and drainage systems and will penalize loss of woodland excessively.	Awareness of limitations of tool.
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of tool.

Economical barriers	How they have been addressed
None	

Social barriers	How they have been addressed
None	

Environmental (including COVID)	How they have been addressed
None	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

The data were compared with other data such as precipitation and soil moisture data (see Hydrographs). Further analyses investigating the influence of these factors would be beneficial to fully understand the relative importance of the effect on slowing of the water.

Water Flow: NBS & Comparative Data Sources

KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS	OTHER COMPARATIVE DATA SOURCES		
WATER SLOWED DOWN FROM SEWER SYSTEM	LAc4	Urban Catchment forestry	Strand Tree SuDS	Detectronic Flow meter	Soilmania	Precipitation
WATER REMOVED FROM THE WATER TREATMENT	LAc4	Urban Catchment forestry	Strand Tree SuDS	Detectronic Flow meter	Soilmania	Precipitation

Ongoing discussions with water experts are hoped to determine more precise results for this KPI.

EcoServR model results are limited due to lack of consideration of drainage systems and SuDs, so not very meaningful in this instance, but overall, there were positive benefits show for flood risk mitigation.

Overall from the indications from the quantitative data and the modelled data, reduction in flood risk and water speeds were observed, so a positive change is seen for this KPI.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.9 CH0207 Nutrient abatement (COD)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0207	NUTRIENT ABATEMENT (COD)	CFT
CITY	*RELATED NBS*	
LIV	LAc4, LAc8, LAc16	

2.9.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: DSS YSI Water Probe, Nutrient analyses, Metal analyses, Water quality assessments of Wapping Dock

Also refer to soilmania sensor data in CH0211

Quantitative monitoring data results (selection):

QUANTITATIVE DATA SUMMARY					
CH0207 Water % Change	**Specific conductivity**	**Dissolved Oxygen**	**Combined Nitrogen**	**Phosphate**	**all metals**
Overall Liverpool	15.7	6.8	21.8	217.8	984.3
Sub-Demo A		-17.6			
Sub-Demo B	57.8	26.2	90.0	510.0	-16.5
Sub-Demo C	7.9	-8.1	-18.0	93.6	7353.5

QUANTITATIVE DATA SUMMARY					
Nutrients in solution					
CH0207 Water % Change	**Overall Liverpool**	**Sub-Demo A**	**Sub-Demo B**	**Sub-Demo C**	
Ammonium (N-NH4)	-7.2		19.2	-8.3	
Nitrite (N-NO2)	-49.2		-64.7	-23.2	
Nitrate (N-NO3)	51		251.5	-36.2	
Phosphate (SRP)	217.8		510	93.6	

QUANTITATIVE DATA SUMMARY

Metals in solution				
CH0207 Water % Change	Overall Liverpool	Sub-Demo A	Sub-Demo B	Sub-Demo C
Arsenic	4709.2		118.8	55830.7
Cadmium	0		0	0
Chromium	-29		-40.5	-26.3
Cobalt	3252.5		-7.7	0
Copper	148.4		-17.4	851.1
Iron	62.1		-48.8	686.3
Lead	492.8		-40.8	946.3
Manganese	7.4		-60.5	64.5
Nickel	240.4		-17.1	478
Zinc	-25.2		-34.7	-2.4

QUANTITATIVE DATA SUMMARY						
CH0207 Water		% Change				
NBS	NBS name	Specific Conductivity	Dissolved Oxygen	Combined Nitrogen	Phosphate	All metals
LAc4	Urban catchment forestry	57.8	26.2	90.0	510.0	-16.5
LAc8	SuDs & Rain Garden	-15.1	-4.6	-13.2	76.9	39.8
LAc16	Floating gardens	13.8	-5.2	-43.1	48.9	0.2

QUANTITATIVE DATA SUMMARY					
CH0207 Water % Change Nutrients in Solution					
NBS	NBS Name	Ammonium (N-NH4)	Nitrite (N-NO2)	Nitrate (N-NO3)	Phosphate (SRP)
LAc4	**Strand Tree SuDS**	19.2	-64.7	251.5	510.0
LAc8	**Lower SuDS**	-59.9	-6.3	214.7	94.8
LAc8	**Upper Pitt St RG**				
LAc8	**Upper SuDS**	-23.8	16.6	0.1	59.0
LAc16	**SPL FI**	-20.6	-56.9	-69.4	48.9

QUANTITATIVE DATA SUMMARY
CH0207 Water % Change Metals in Solution

NBS	NBS Name	Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron	Manganese	Nickel	Lead	Zinc
LAc 4	Strand Tree SuDS	119		-41	-8	-17	-49	-61	-17	-41	-35
LAc 8	Lower SuDS			-89		489	186	66	38		-68
LAc 8	Upper Pitt St RG										
LAc 8	Upper SuDS			-92		10	18	10	-55	-8	12
LAc 16	SPL FI			-99		0	35	23	-16	48	11

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

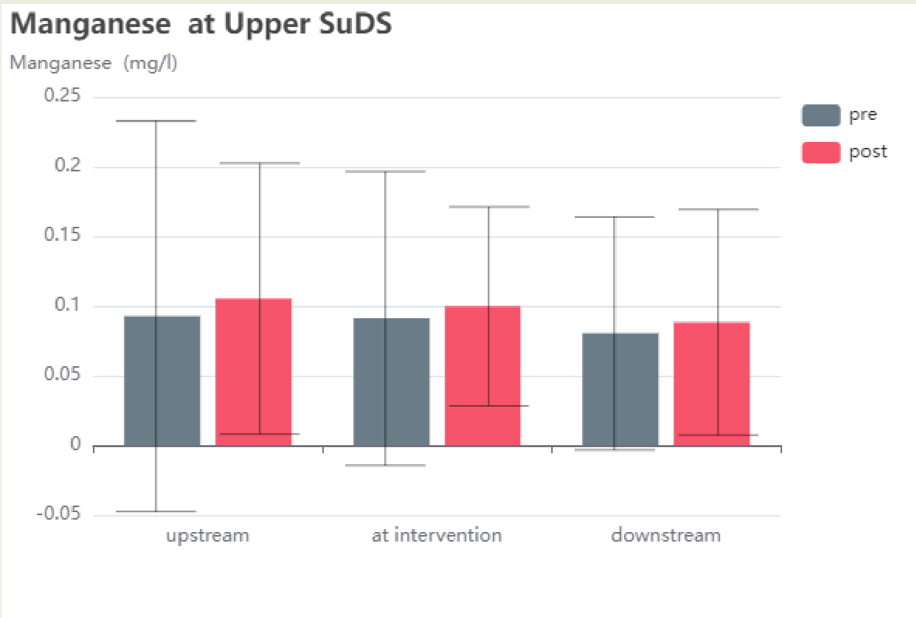
For related intervention site names, please see table below:

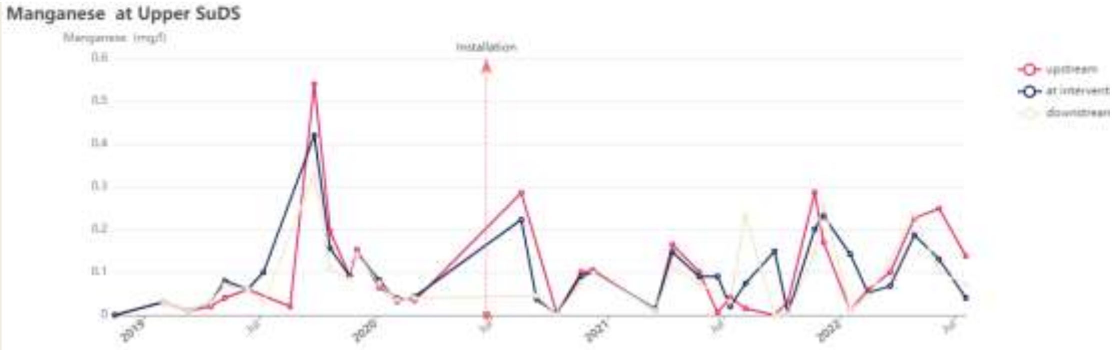
FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0207	NUTRIENT ABATEMENT (COD)	LAc4	Urban Catchment forestry		Strand Tree SuDS	
		LAc8	Rain Garden (SUDs)	Upper Pitt St RG		Upper SuDS, Lower SuDS
		LAc16	Floating gardens	Wapping FI		SPL FI
			LeakyDam			LeakyDam

Map of monitoring locations

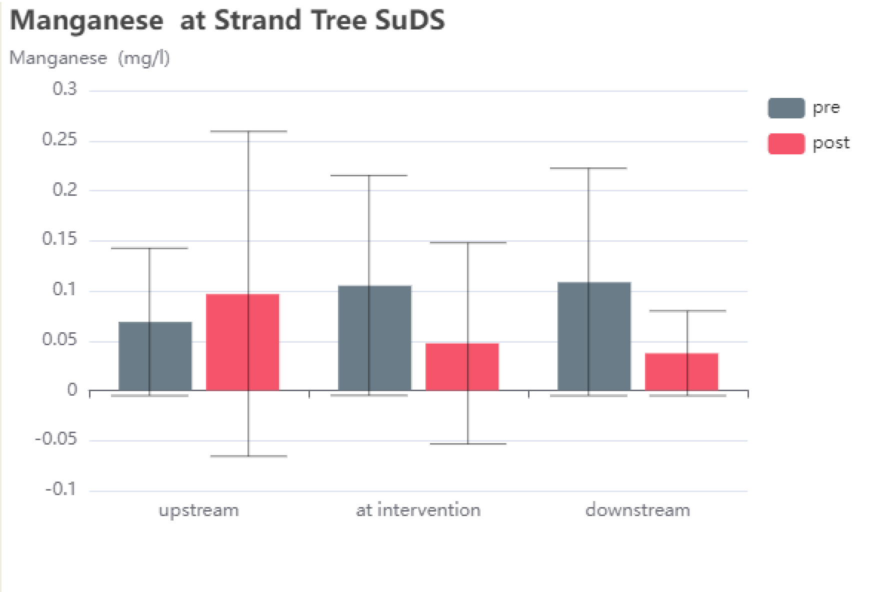
Equipment and methodology:

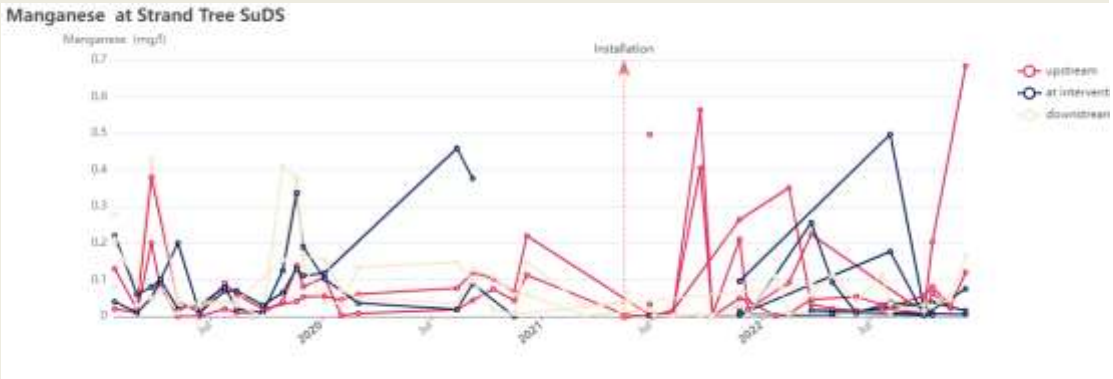
Summary plot example: Manganese at Water retention pond: Upper SuDs: Box plot showing upstream, at intervention and downstream; Time-line plot showing installation date.



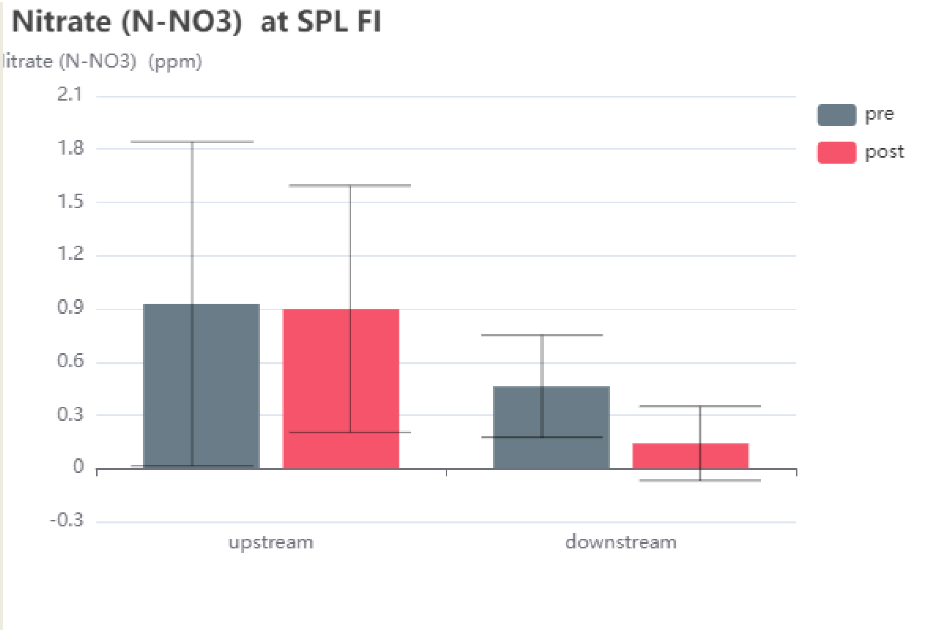


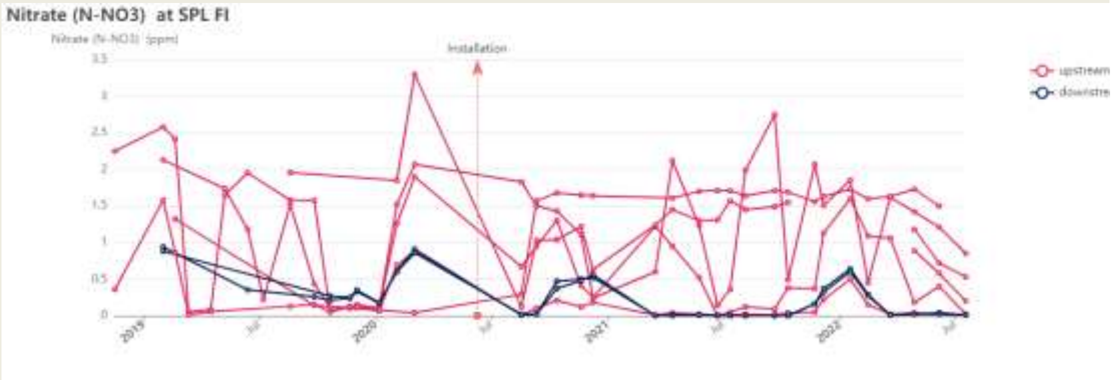
Summary plot example: Manganese at Urban Catchment Forestry: Strand Tree SuDs: Box plot showing upstream, at intervention and downstream; Time-line plot showing installation date.





<u>Summary plot example: Floating island data so far: Sefton Park Floating island: Nitrate (N-NO3):</u> Box plot showing upstream and downstream data pre and post intervention; Time-line plot showing the time of installation.





The water monitoring of the abiotic measures and metal and nutrients in solution demonstrated variable results. The rain garden in sub demo A could not be assessed for any change with installation due to no pre-installation monitoring.

From the summary data table it can be seen that the conductivity (or amount of ions present) increased in all areas, particularly for sub demo B at 58% in contrast to sub demo C at 8%. Overall Liverpool this increased by 16%. Dissolved Oxygen levels decreased adversely in sub demos A and C (-18% and -8% respectively), but increased in Sub demo B (26%) and overall Liverpool at 7%. The combined Nitrogen factor (a combination of Ammonium, Nitrate and Nitrite) showed an increase for all areas (overall Liverpool 22% and sub demo B 90%), but reduced in sub demo C (-18%). Phosphate levels increased for all (overall Liverpool 217% and sub demo B 510%), but was the lowest increase in sub demo C (at 94%). If all the metals were combined a decrease was observed in sub demo B (-17%) but increased dramatically in sub demo C(7353%) and overall Liverpool (984%). So variable results with the best results showing for sub demo C except for decrease in dissolved Oxygen and increase in all metals. Sub demo B seemed to show a positive effect on reducing all the metals.

From an assessment of the nutrients, Nitrite showed the most reduction and reduced over all areas (sub demo B -65%, sub demo C -23% and overall Liverpool -49%). Please see example plot for sub demo C Sefton Park Island. Ammonium decreased over all Liverpool (-7%) and in sub demo C (-8%) but increased in sub demo B (19%). Nitrate increased dramatically in sub demo B (252%) and showed an increase overall Liverpool (51%), but decreased in sub demo C (-36%). Phosphate, as mentioned above increased in all areas.

Within the metals in solutions, Chromium showed the best decrease for overall Liverpool (-29%) and a decrease for sub demos B and C (-41% and -26% respectively). Zinc also showed a reduction overall at -25% for Liverpool, -34% for sub demo B and -2% for sub demo C. Other metals showed variable results. Arsenic increased for all, but all other metals increased over Liverpool as a whole and sub demo C. However, sub demo B showed a reduction for the other metals, particularly for Manganese at -61% (inc contrast to 65% for sub demo C and 7% for Liverpool. Please see the example summary plots for Manganese.

A more detailed look at the effect of individual interventions showed that the Suds and rain garden combined had a beneficial effect on reducing the number of ions (Specific conductivity) with -15% as contrast to the floating gardens at 14% and urban catchment forestry at 58%. Dissolved Oxygen levels dropped slightly except for the urban catchment forestry (Strand SuDs) at 26%. The combined Nitrogen factor, though increased on the Strand (90%), but decreased for the SuDs & rain garden and floating gardens (-13% and -43% respectively). Phosphate increased for all sites. The combined 'all metals' showed a reduction for sub demo B, urban catchment forestry (-17%) but an increase for the Suds & rain garden (40%), with a negligible change for the floating gardens.

For the specific nutrients, reduction were observed for Ammonium for all sites except the Strand SuDs, with the highest reduction for the Lower SuDs site (-60%) followed by the Upper SuDS and Sefton Park floating island (-24% and -21% respectively). For Nitrite, a reduction was observed for all sites, except the Upper SuDs site (17% in contrast to -57% and -65% for the floating island and Strand SuDs respectively). Nitrate increased for all except a negligible result for the Upper SuDs and a decrease of -70% seen for the Sefton Park floating island. Phosphate, as mentioned above, increased for all sites.

For the metals assessment, results were very variable. Chromium was reduced at all sites, particular at the Lower SuDs, Upper SuDs and floating island (at approx. -90% for all and -41% for the Strand SuDs). Nickel also mainly showed a reduction, except for an increase at the Lower SuDs site. Other metals were variable between each site. Overall the Strand tree SuDs appeared to do better in reducing the meals than the other sites, except for an increase in Arsenic.

Therefore, these water results showed variable results at different sites and for the various nutrients and metals investigated. For metal reduction the urban catchment forestry or Strand Tree SuDs sites demonstrated the most reductions. Overall, though the results were too inconclusive to state if the interventions had helped throughout.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.9.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The last metal analyses did not include Zinc analyses so Zinc has not got the same sample size as the other metal samples	Awareness that the Zinc calculations may be incorrect for the time period studied.
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
Some delays and interruptions due to university lab shutdowns in lockdowns and technical staff retirement/changes	Flexibility and resilience; technical issues being resolved

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further data analyses using comparative data sources (as shown in table below) will further the understanding of the importance of the interventions in the nutrient and metal abatement.

KPI NAME	NBS Ref No.	NBS NAME	OTHER POSSIBLE COMPARATIVE DATA SOURCES			OTHER VARIABLES
NUTRIENT ABATEMENT (COD)	LAc4	Urban Catchment forestry	Detectronic Flow meter	Soilmania	Precipitation	COVID lockdown; Road salting
	LAc8	Rain Garden (SUDs)	Detectronic Flow meter		Precipitation	COVID lockdown; Leaky dams; Borehole use; Salting
	LAc16	Floating gardens		Biobank/ iNaturalist records	Precipitation	COVID lockdown; Leaky dams; Borehole use; Salting

These water results showed variable results at different sites and for the various nutrients and metals investigated. For metal reduction the urban catchment forestry or Strand Tree SuDs sites demonstrated the most reductions. Overall, though the results were too inconclusive to state if the interventions had helped throughout.

What was the impact? (positive/negative, significant/non-significant)?

Inconclusive

2.10 CH0209 Nutrient abatement (SST)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0209	NUTRIENT ABATEMENT (SST)	CFT
CITY	*RELATED NBS*	
LIV	LAc4, LAc8, LAc16	

2.10.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: Measuring equipment results (Muffle furnace and XRF)

No data for Baltic sub demo A rain garden as intervention added in 2022.

Quantitative monitoring data results:

QUANTITATIVE DATA SUMMARY			
CH0209 % Change	**Organic matter**	**Suspended sediment**	**All Suspended metals**
Overall Liverpool	407.7	-60.0	-8.2
Sub-Demo A			
Sub-Demo B	118.4	-74.6	8.4
Sub-Demo C	417.2	-19.1	10.4

QUANTITATIVE DATA SUMMARY
Metals in Suspended Sediment

CH0209 % Change	Overall Liverpool	Sub-Demo B	Sub-Demo C
Arsenic	2.8	11.9	10.7
Cadmium	157.9	160.1	178.2
Chromium	-59.4	-63.5	24.1
Copper	-85.9	-78.3	-36.8
Iron	-45.1	-26.8	-18.4
Lead	-28.7	-26.4	-1.3
Manganese	0.9	26.1	-28.1
Nickel	15.2	50.9	17.9
Zinc	8.2	31.3	4.6

QUANTITATIVE DATA SUMMARY				
CH0209 Suspended Sediment Water		% Change		
NBS	NBS name	Organic Matter	Suspended Sediment	All Suspended Metals
LAc4	Urban catchment forestry	118.4	-74.6	8.4
LAc8	SuDs & Rain Garden	296.3	-53.8	59.8
LAc16	Floating gardens	1095.1	47.0	-6.9

QUANTITATIVE DATA SUMMARY										
CH0209 Suspended Sediment Water % Change Metals										
NBS	NBS name	Arsenic	Cadmium	Chromium	Copper	Iron	Manganese	Nickel	Lead	Zinc
LAc4	Strand Tree SuDS	12	160	-64	-78	-27	26	51	-26	31
LAc8	Upper SuDS	185	224	23	-16	34	29	48	41	51
LAc16	SPL FI	-59	207	51	-41	-43	-48	-5	-31	-29

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

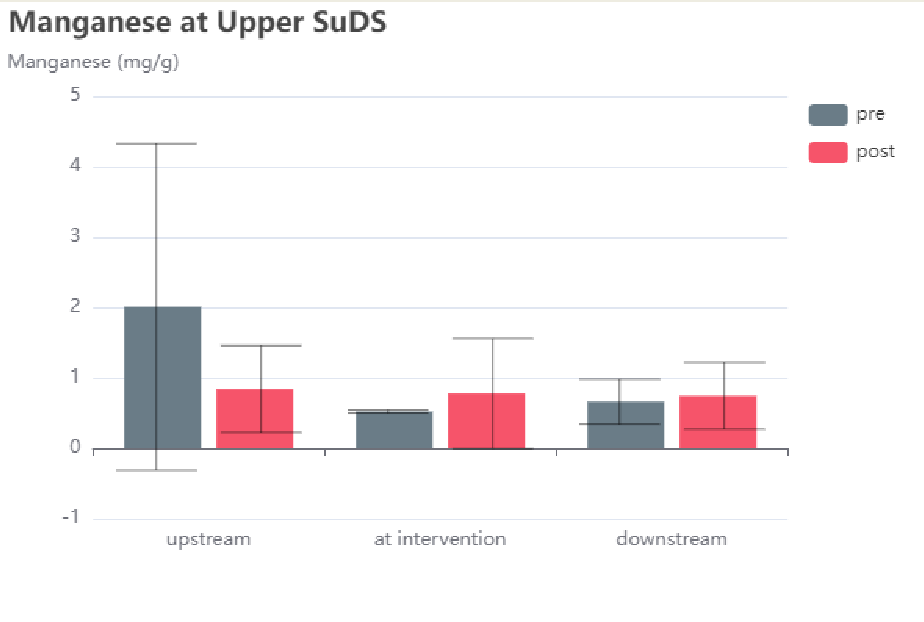
For related intervention site names, please see table below:

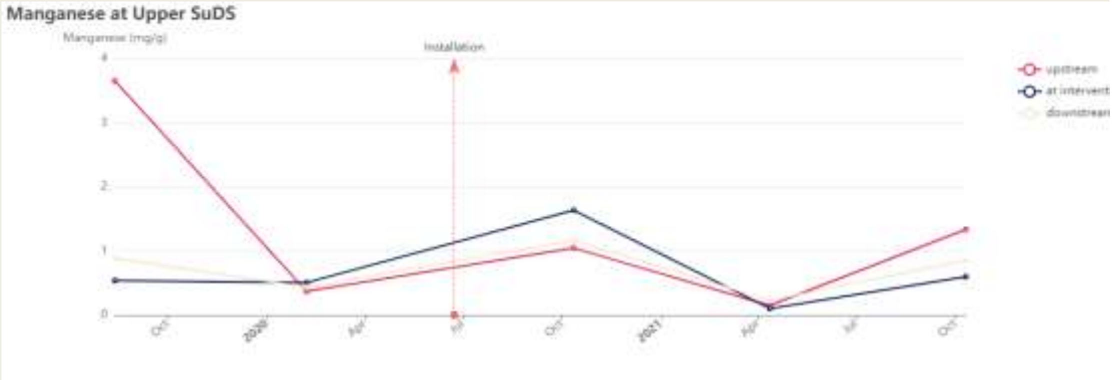
FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0209	NUTRIENT ABATEMENT (SST)	LAc4	Urban Catchment forestry		Strand Tree SuDS	
		LAc8	Rain Garden (SUDs)	Upper Pitt St RG		Upper SuDS, Lower SuDS
		LAc16	Floating gardens			SPL FI

Map of monitoring locations: See CH0207

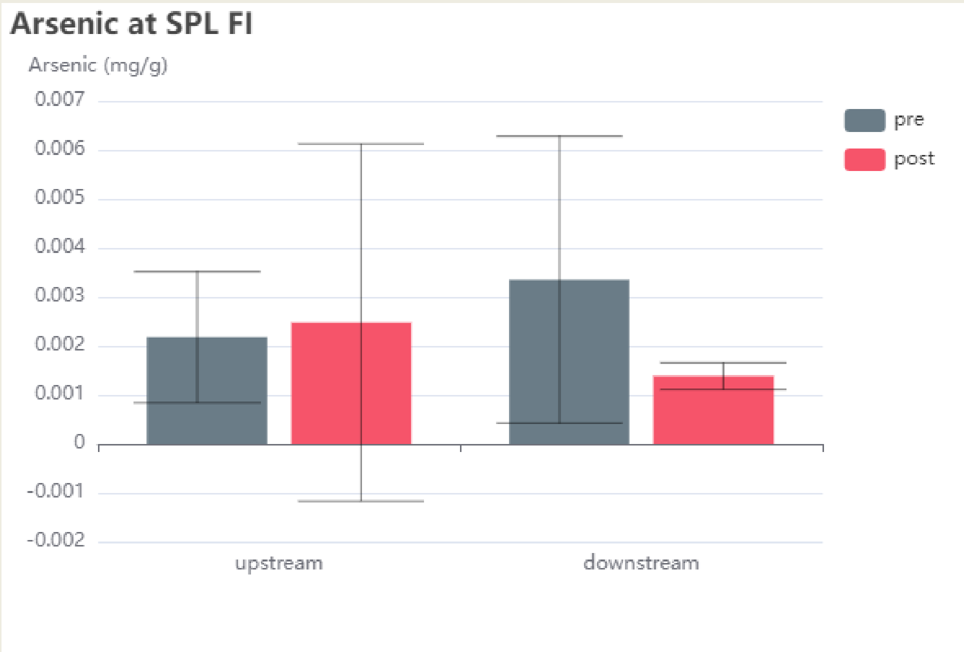
Equipment and methodology: Muffle furnace (photo) and X-ray- fluorescence

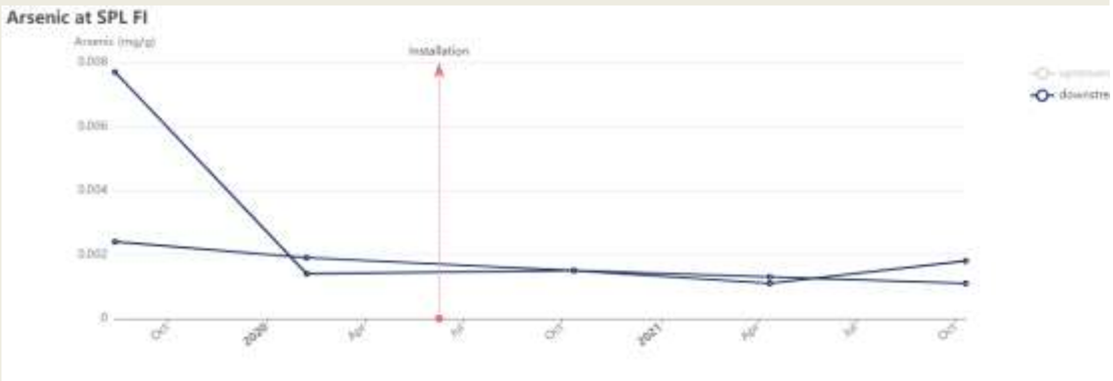
<u>Summary plot example: Manganese in suspended sediment at Water retention pond</u> (see also plot in CH0207): Box plot showing upstream, at intervention and downstream; Time-line plot showing installation date.





Summary plot example: Arsenic in suspended sediment for Sefton Park Floating Island: Box plot showing upstream and downstream; Time-line plot showing installation date and downstream data:





The water monitoring of the metals suspended in sediment demonstrated variable results. The rain garden in sub demo A could not be assessed for any change with installation due to no pre-installation monitoring.

The summary table shows that the metals in suspension increased for sub demos B and C (8% and 10% respectively), but decreased for Liverpool as a whole (-8%).

For individual metals in suspension, Copper decreased most for Liverpool (-86%, together with sub demo B at -78% and C at –37%). In contrast, Cadmium, Nickel, Zinc and Arsenic all increased for all areas. The other metals varied according to the area but decreased overall for Liverpool and all areas for Chromium, Iron and Lead (except for an increase for Chromium for Sub demo C).

From the detailed assessment of the intervention sites, it can be seen in the summary that only the floating islands intervention reduced the suspended metals (-7%) when the urban catchment forestry showed a slight increase at 8% and the Suds & rain garden showed a 60% increase.

The individual metal detail showed variable results. The floating island at Sefton Park demonstrated reductions for all metals, particularly Arsenic at -60% (see example plot), but except for Cadmium and Chromium levels. However, the Upper SuDs site tended to show an increase for all metals, except Copper (-16%). Strand tree Suds or the Urban Catchment Forestry site was very variable with some reductions (particularly for Chromium at -64%, Copper at -78%, Iron at -27% and Lead at -26%) and some increases in metals (including Manganese at 26%). Please see plot examples.

Although, the floating island generally showed a decrease for metals, the results overall were highly variable, so proved inconclusive in determining if the interventions has a positive effect.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.10.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
None	

Economical barriers	How they have been addressed
None	

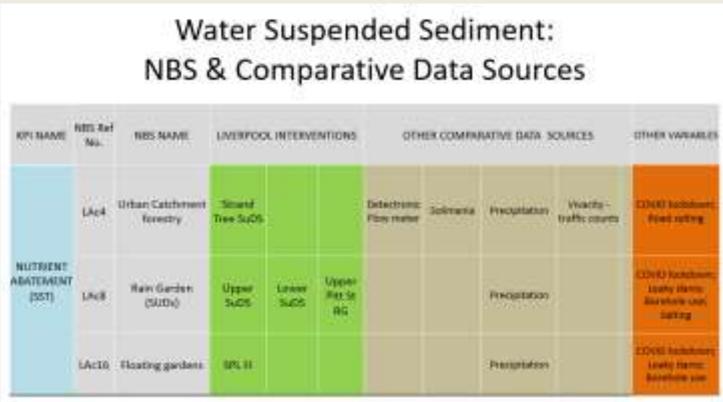
Social barriers	How they have been addressed
None	

Environmental (including COVID)	How they have been addressed
Some due to university lab shutdowns in lockdowns and technical staff retirement/changes	Flexibility and resilience; technical issues being resolved

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further data comparations yet to be made with comparative data sources to increase the understanding of the impact of the interventions.



Reduction in all suspended metal for overall Liverpool, so assumed to have a positive impact but other results inconclusive.

What was the impact? (positive/negative, significant/non-significant)?

Inconclusive

2.11 CH0211 Water removed from the water treatment

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0211	WATER REMOVED FROM THE WATER TREATMENT	CFT with LJMU
CITY	*RELATED NBS*	
LIV	LAc4, LAc8	

2.11.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL,

QUANTITATIVE: Detectronic Flow meter

Soilmania sensor data: Soil moisture, Soil Oxygen index, Soil pH, Soil conductivity, Soil temperature

See CH0204

GI-VAL results:

CH0211: Water removed from water treatment	**GI-VAL BENEFITS**	**Sub-Demo Areas**			**Overall Liverpool**	**BENEFIT QUANTIFICATION**
Functions	**Tools**	**A**	**B**	**C**		
Interception, storage and infiltration of rainwater	2.1 Energy and carbon emissions savings from reduced stormwater volume entering combined sewers	461323	9624052	625635	5205062	L/yr water diverted from sewers

Quantitative monitoring data results:

Ongoing discussion with water experts so calculations on these data are expected in the near future.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The GI-VAL model analysis output showed the addition of the interventions resulted in water diverted from the water treatment systems for all areas, in particular for sub demo B (9,624,052 l/yr). Overall in Liverpool the amount of water diverted was 5,205,062 l/yr.

For the related intervention site names for the quantitative data, please see table below:

FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0211	WATER REMOVED FROM THE WATER TREATMENT	LAc4	Urban Catchment forestry		Strand Tree SuDS	
		LAc8	Rain Garden (SUDs)	Upper Pitt St RG		

Map of monitoring locations See CH0204

Equipment and methodology: See CH0204

Summary hydrograph examples: See CH0204

With an emphasis on the GI-VAL data, overall positive influenced of the interventions were found.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.11.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Sensor issues due to silt buildup for the water flow sensors	Being resolved

Economical barriers	How they have been addressed

None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
None	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

The data were compared with other data such as precipitation and soil moisture data (see Hydrographs). Further analyses investigating the influence of these factors would be beneficial to fully understand the relative importance of the effect on removal of the water.

Water Flow: NBS & Comparative Data Sources

KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS	OTHER COMPARATIVE DATA SOURCES		
WATER SLOWED DOWN FROM SEWER SYSTEM	LAc4	Urban Catchment forestry	Strand Tree SuDS	Detectronic Flow meter	Soilmania	Precipitation
WATER REMOVED FROM THE WATER TREATMENT	LAc4	Urban Catchment forestry	Strand Tree SuDS	Detectronic Flow meter	Soilmania	Precipitation

Ongoing discussions with water experts are hoped to determine more precise results for this KPI.

The Gi-VAL data showed a positive effect of the interventions on the amount of water removed from water treatment, so this a positive change.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.12 CH0212 Savings in treatment of stormwater

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0212	SAVINGS IN TREATMENT OF STORMWATER	CFT with LJMU

CITY	*RELATED NBS*
LIV	All NBS

2.12.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL

GI-VAL results:

CH0212: Savings in treatment of stormwater	**GI-VAL BENEFITS**		**Sub-Demo Areas**			**Overall Liverpool**	
Functions	**Tools**	**GVA value**	**A**	**B**	**C**		**BENEFIT MONETISATION**
Interception, storage and infiltration of rainwater	2.1 Energy and carbon emissions savings from reduced stormwater volume entering combined sewers	**GVA value**	425.4	8874.3	576.9	4799.6	£
Interception, storage and infiltration of rainwater	2.2 Reduced wastewater treatment costs for domestic and commercial water customers	**GVA value**	0.0	0.0	0.0	0.0	£
Interception, storage and infiltration of rainwater	2.3 Avoided costs of traditional water drainage infrastructure	**GVA value**	n.a.	n.a.	n.a.	n.a.	£
		Total Water Management & Flood Alleviation benefit monetisation:	425.4	8874.3	576.9	**4799.6**	£

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The GI-VAL output showed positive savings in stormwater treatment for all factors investigated. The major positive benefits were from the energy and carbon emission savings from the reduced stormwater volume entering the combined sewers. These savings were greatest for sub demo B (£8874), followed by sub demo C (£577) and sub demo A (£425). Overall, for the extent of Liverpool, the savings were £4800.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.12.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

GI-Val showed a positive impact of the Urban GreenUP interventions for savings from the reduced stormwater entering the water treatment drainage system.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.13 CH0403 Green Space accessibility

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0403	GREEN SPACE ACCESSIBILITY	UOL/UOM
CITY	*RELATED NBS*	
LIV	All NBS	

2.13.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL, EcoServR

SOCIO-ECONOMIC: Data in CH0904. Also refer to report 'Analysis of NBS in Liverpool' which assesses CH0403-Green Space Accessibility, CH0702 Citizen Participation, CH0703 Social Learning, CH0705 Engagement with NBS and CH0904 Health Quality Perception.

EcoServR: Assumptions on habitat codes for the UGU interventions

Intervention type	**Code**	**Description**	**Notes**
Shade trees Cooling trees Green filter trees	A13	Mixed woodland	No code for trees outside woodland; assuming mixed to average out differences between coniferous and broadleaved trees
Orchard	A112o	Orchard	

Pollinator planting	J55	Brownfield/garden/park	
SuDS ponds	G1	Standing water	
Green roof	GR	Green roof	Added to EcoservR for UGU (limited evidence base)
Green wall	GW	Green wall	Added to EcoservR for UGU (limited evidence base)
Floating island	FI	Floating island	Added to EcoservR for UGU (limited evidence base)
Smart pollinator pillars	POLL	Pollinator baskets	Added to EcoservR for UGU (limited evidence base)

EcoServR results:

EcoServR: CH0403: Green Space Accessibility		
Mean	**households**	**population**
sub demo A	929	1679
sub demo B	641	1025
sub demo C	1189	2530
Overall Liverpool	11702	23449

	EcoServR: CH0403: Green Space Accessibility		
NBS	**NBS Name**	**households**	**population**
lac4	Urban catchment forestry	454	670
lac5	shade trees	3413	5817
lac6	cooling trees	2910	5031
lac8	SuDs & Rain Garden	1161	2491
lac12	Pollinator verges and spaces	1314	2651
lac13	Pollinator walls/vertical	922	1580
lac14	Pollinator roofs	764	1247
lac16	Floating gardens	306	545
lac17	Green filter area	2538	4409

EcoServR: CH0403: Green Space Accessibility		
Pollinator walls/vertical	**households**	**population**
L1 GW	538	877
Parr St GW	1422	2557
St Johns GW	806	1307

	EcoServR: CH0403: Green Space Accessibility		
NBS	**Site**	**households**	**population**
lac4	Urban catchment forestry	454	670
lac5	shade trees	3413	5817
lac6	cooling trees	2910	5031
lac17	Green filter area	2538	4409

EcoServR: CH0403: Green Space Accessibility		
Floating gardens	**households**	**population**
SPL FI	360	658
Wapping FI	252	431

GI-VAL results:

CH0403: Greenspace accessibility: GI-VAL BENEFITS		Sub-Demo Areas			Overall Liverpool	BENEFIT QUANTIFICATION
Functions	**Tools**	**A**	**B**	**C**		
Catalyst for community cohesion and pride	3.1 Willingness to pay for a view of urban green space	340	1003	1108	817	more households with a view of green space
Catalyst for community cohesion and pride	3.2 Increase in volunteering	10	10	10	10	new volunteers

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final)

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The EcoServR model access output was produced in the following way. Domestic buildings were extracted from the natural capital baseline. The average population per home was extracted from census data. The interventions were buffered by 500 m, and this catchment was intersected with the household layer to get an estimate of the catchment population. The EcoServR output then described households and populations with a view of green space. The overall Liverpool calculation was over the footprint of all interventions and was smaller than the sum of the sub-demo area to avoid double-counting due to some locations counting towards several inter code categories. These totals of 11702 households and 23449 residents are therefore the overall UGU program impact and possibly the most useful metric.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

Green space accessibility worked really well in GI-Val as we could update the number of people and households that were within 300m and 1200m of the interventions. The benefit output shows an increase in the number of households with a view of green space (817) and the economic value associated with the willingness to pay for this and an increase in volunteering (10).

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final)

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.13.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Model: Domestic buildings were extracted from the natural capital baseline. The average population per home is extracted from census data. The interventions were buffered by 500 m, and this catchment was intersected with the household layer to get an estimate of the catchment population. The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model Awareness of limitations of model
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
Impacts on number of face-to-face surveys due to Covid restrictions	Online interviews and postal surveys became the focus of the Socio-economic investigations

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

EcoServR produced an output of a total of 11702 households and 23449 residents within Liverpool having better access to green space as a result of the Urban GreenUP interventions.

The GI-VAL analyses also showed a positive increase in the number of households (817) with a view of green space.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final) and CH404.

All data indicated a positive benefit.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.14 CH0404 Green infrastructure connectivity

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0404	GREEN INFRASTRUCTURE CONNECTIVITY	UOL/UOM with CFT
CITY	*RELATED NBS*	
LIV	All NBS	

2.14.1 Results and Discussion

Table of results (summary, from Task 5.4)

SOCIO-ECONOMIC: No data directly but linked to other KPIs so refer to other socio-economic KPIs such as CH0403-Green Space Accessibility

MODELS: modelling not possible as mapping not carried out as planned.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final)

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final)

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.14.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Model development not progressed as planned in terms of mapping	Focus of KPI assessment on Socio-economic data with reference to other KPIs
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
Impacts on number of face-to-face surveys due to Covid restrictions	Online interviews and postal surveys became the focus of the Socio-economic investigations

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final): Overall, responses to the social, economic, and environmental impacts of greenspace/NBS were predominantly positive in both sites, suggesting that local people are aware of the multifaceted and interconnected benefits greenspace/NBS can offer.

Hence the outcome was indicated as positive.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.15 CH0410 Pollinator species increase

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0410	POLLINATOR SPECIES INCREASE	CFT
CITY	*RELATED NBS*	
LIV	LAc1, LAc2, LAc8, LAc12, LAc13, LAc14, LAc16	

2.15.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELS: EcoServR

QUANTITATIVE: Observational Flower-Insect Timed counts

EcoServR: Assumptions on habitat codes for the UGU interventions

Intervention type	**Code**	**Description**	**Notes**
Shade trees	A13	Mixed woodland	No code for trees outside woodland; assuming mixed to average out differences between coniferous and broadleaved trees
Cooling trees			
Green filter trees			
Orchard	A112o	Orchard	

Pollinator planting	J55	Brownfield/garden/park	
SuDS ponds	G1	Standing water	
Green roof	GR	Green roof	Added to EcoservR for UGU (limited evidence base)
Green wall	GW	Green wall	Added to EcoservR for UGU (limited evidence base)
Floating island	FI	Floating island	Added to EcoservR for UGU (limited evidence base)
Smart pollinator pillars	POLL	Pollinator baskets	Added to EcoservR for UGU (limited evidence base)

EcoServR results:

EcoServR: CH0410: Pollinator increase		**% Change**
sub demo A	Pollination	0.77
sub demo B	Pollination	1.20
sub demo C	Pollination	0.06
Overall Liverpool	Pollination	0.04

EcoServR: CH0410: Pollinator increase		
NBS	**NBS Name**	**% Change**
lac4	Urban catchment forestry	0.70
lac5	shade trees	0.22
lac6	cooling trees	1.74
lac8	SuDs & Rain Garden	1.17
lac12	Pollinator verges and spaces	1.73
lac13	Pollinator walls/vertical	12.78
lac14	Pollinator roofs	23.13
lac16	Floating gardens	7.08
lac17	Green filter area	1.78

EcoServR: CH0410: Pollinator increase		
Pollinator walls/vertical	**radius (m)**	**% Change**
L1 GW	20	19.95
Parr St GW	20	0.78
St Johns GW	20	24.43
L1 GW	100	13.71
Parr St GW	100	0.15
St Johns GW	100	17.66

EcoServR: CH0410: Pollinator increase		
SuDs & Rain Garden	**radius (m)**	**% Change**
Upper Pitt St RG	20	0.60
Upper SuDS	20	0.03
Lower SuDS	20	3.95
Upper Pitt St RG	100	0.15
Upper SuDS	100	0.01
Lower SuDS	100	2.31

	EcoServR: CH0410: Pollinator increase		
NBS	**NBS Name**	**radius (m)**	**% Change**
lac4	Urban catchment forestry	20	0.16
lac5	shade trees	20	0.21
lac6	cooling trees	20	1.71
lac17	Green filter area	20	1.65
lac4	Urban catchment forestry	100	1.23
lac5	shade trees	100	0.22
lac6	cooling trees	100	1.76

lac17	Green filter area	100	1.91

EcoServR: CH0410: Pollinator increase		
Floating gardens	**radius (m)**	**% Change**
SPL FI	20	0.00
Wapping FI	20	15.35
SPL FI	100	0.00
Wapping FI	100	12.98

	EcoServR: CH0410: Pollinator increase		
Sub Demo Area	**Pollinator verges and spaces**	**radius (m)**	**% Change**
A	Baltic Hub POLL	20	4.09
A	Baltic POLL	20	4.79
A	Cornwallis St POLL	20	0.78
A	Park Lane POLL	20	0.16
A	Pitt St POLL	20	0.00
A	Strand POLL	20	0.55
A	Wapping POLL	20	14.42
C	Bott SP Aig Dr POLL	20	0.15
C	Lower SuDS POLL	20	3.98
C	Princes Av POLL	20	0.17
C	Princes roundabt POLL	20	0.13
C	Top SP Aig Dr POLL	20	0.12
C	Ullet Rd POLL	20	0.01
C	Upper SuDS POLL	20	0.06
A	Baltic Hub POLL	100	2.44
A	Baltic POLL	100	3.55
A	Cornwallis St POLL	100	0.18
A	Park Lane POLL	100	0.02
A	Pitt St POLL	100	0.11
A	Strand POLL	100	0.56

A	Wapping POLL	100	9.69
C	Bott SP Aig Dr POLL	100	0.02
C	Lower SuDS POLL	100	2.39
C	Princes Av POLL	100	0.04
C	Princes roundabt POLL	100	0.06
C	Top SP Aig Dr POLL	100	0.01
C	Ullet Rd POLL	100	0.01
C	Upper SuDS POLL	100	0.01

Quantitative monitoring data results:

QUANTITATIVE DATA SUMMARY									
CH0410: Pollinator Count									
Pre-Intervention				Post-Intervention				% Change	Area
n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd		
60	15	4.2	5.8	91	15	10.1	13.7	141.1	**Overall Liverpool**
34	8	4.3	6.5	35	7	13.0	16.2	205.5	**Sub-Demo A**
				12	2	3.6	6.6		**Sub-Demo B**
26	7	4.1	4.9	44	6	9.5	12.5	133.6	**Sub-Demo C**

QUANTITATIVE DATA SUMMARY									
CH0410: Pollinator diversity									
Pre-Intervention				Post-Intervention				% Change	Area
n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd		
60	15	1.6	1.7	91	15	1.8	1.6	17.8	**Overall Liverpool**
34	8	1.5	1.9	35	7	2.0	1.9	35.2	**Sub-Demo A**
				12	2	1.3	1.4		**Sub-Demo B**
26	7	1.7	1.5	44	6	1.9	1.5	12.7	**Sub-Demo C**

QUANTITATIVE DATA SUMMARY		
CH0410: Pollinator Count		
NBS	NBS Name	% Change

LAc8	SuDs & Rain Garden	448.6
LAc12	Pollinator verges and spaces	286.6
LAc13	Pollinator walls/vertical	
LAc16	Floating gardens	-60.0

QUANTITATIVE DATA SUMMARY		
CH0410: Pollinator Diversity		
NBS	**NBS Name**	**% Change**
LAc8	SuDs & Rain Garden	41.8
LAc12	Pollinator verges and spaces	77.7
LAc13	Pollinator walls/vertical	
LAc16	Floating gardens	-60.0

QUANTITATIVE DATA SUMMARY										
CH0410: Pollinator Count		**Pre-Intervention**				**Post-Intervention**				**% Change**
NBS	**inter_code**	**n_obs**	**n_sites**	**estimate**	**sd**	**n_obs**	**n_sites**	**estimate**	**sd**	
LAc8	Lower SuDS	4	1	6.8	5.4	11	1	9.5	11.7	40.1
LAc8	Upper Pitt St RG	6	1	2.3	2.1	3	1	22.3	19.3	857.1
LAc12	Baltic Hub POLL	4	1	11.0	7.7	2	1	20.0	15.6	81.8
LAc12	Bott SP Aig Dr POLL	3	1	0.3	0.6	7	1	3.4	2.2	928.6
LAc12	Cornwallis St POLL	10	1	5.2	9.0	3	1	3.0	5.2	-42.3
LAc12	Lower SuDS POLL	4	1	6.8	5.4	11	1	9.5	11.7	40.1
LAc12	Park Lane POLL	3	1	2.0	3.5	7	1	12.4	11.6	521.4
LAc12	Princes Av POLL					7	1	14.9	21.2	
LAc12	Princes roundabt POLL	5	1	2.8	5.7					
LAc12	Strand POLL	4	1	3.3	2.9	6	1	29.3	24.3	802.6
LAc12	Top SP Aig Dr POLL	4	1	3.8	2.2	2	1	10.5	0.7	180.0
LAc12	Top SP roundabt POLL	1	1	1.0						
LAc12	Ullet Rd POLL	3	1	5.3	8.4	5	1	12.2	13.2	128.8
LAc12	Wapping POLL	5	1	2.6	5.8	2	1	1.0	1.4	-61.5

LAc13	L1 GW					2	1	12.0	15.6	
LAc13	Parr St GW	1	1	0.0		12	1	6.3	9.7	
LAc13	St Johns GW					10	1	1.9	2.7	
LAc16	SPL FI	2	1	2.5	2.1	1	1	1.0		-60.0
LAc16	Wapping FI	1	1	3.0						

QUANTITATIVE DATA SUMMARY										
CH0410: Pollinator Diversity		Pre-Intervention				Post-Intervention				% Change
NBS	inter_code	n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd	
LAc8	Lower SuDS	4	1	2.5	2.1	11	1	2.1	1.7	-16.4
LAc8	Upper Pitt St RG	6	1	1.2	1.0	3	1	2.3	2.1	100.0
LAc12	Baltic Hub POLL	4	1	3.8	1.0	2	1	4.5	0.7	20.0
LAc12	Bott SP Aig Dr POLL	3	1	0.3	0.6	7	1	1.7	0.8	414.3
LAc12	Cornwallis St POLL	10	1	1.7	2.6	3	1	1.0	1.7	-41.2
LAc12	Lower SuDS POLL	4	1	2.5	2.1	11	1	2.1	1.7	-16.4
LAc12	Park Lane POLL	3	1	1.0	1.7	7	1	2.9	2.5	185.7
LAc12	Princes Av POLL					7	1	1.6	1.6	
LAc12	Princes roundabt POLL	5	1	0.8	1.3					
LAc12	Strand POLL	4	1	1.3	1.0	6	1	2.5	2.2	100.0
LAc12	Top SP Aig Dr POLL	4	1	2.3	0.5	2	1	3.0	0.0	33.3
LAc12	Top SP roundabt POLL	1	1	1.0						
LAc12	Ullet Rd POLL	3	1	1.0	1.0	5	1	1.2	1.3	20.0
LAc12	Wapping POLL	5	1	0.6	1.3	2	1	0.5	0.7	-16.7
LAc13	L1 GW					2	1	2.0	1.4	
LAc13	Parr St GW	1	1	0.0		12	1	1.3	1.2	
LAc13	St Johns GW					10	1	1.1	1.4	
LAc16	SPL FI	2	1	2.5	2.1	1	1	1.0		-60.0

LAc16	Wapping FI	1	1	1.0						

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The EcoServR model assessed pollinator habitats in the following way. This model provided a probability of pollinators visiting based on the proximity of suitable habitats. Core habitats (semi-natural grasslands, heathlands, scrub, hedgerows, gardens, as well as green roofs, walls and pollinator planting) and edge habitats (woodlands; suitable for nesting when within 20m of core habitats) were selected from the natural capital basemap. Distances to habitats were calculated (up to 668m which is considered the maximum flight distance) and converted to a visitation probability score (which decreases with increasing distance to habitats). An elevation mask (250m) was applied as areas above this are likely to be too exposed to support pollinators in great numbers. Raw units represented the probability (0-1) of visitation by pollinators. A rescaled (0-100) version was provided where 100 is the highest demand in the area mapped.

The EcoServR model results demonstrated an increase in pollinator habitats for all sub demo areas (A was 0.77% and C was 0.06%), particularly for sub demo B at 1.20%, as well as overall Liverpool (0.04%).

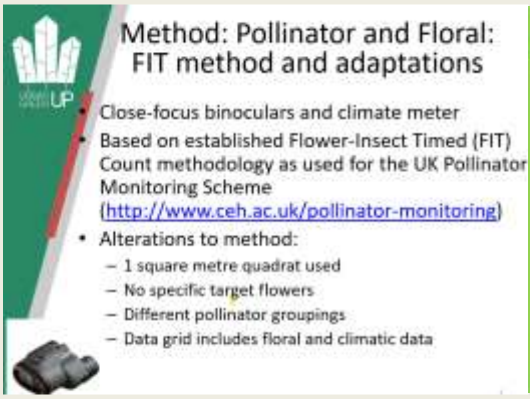
A more detailed breakdown per intervention showed that the pollinator roof had the greatest effect at 23% followed by Vertical pollinator planting(13%) and floating gardens (7%). The tree interventions, Suds, rain garden and pollinator verges also had important positive effects. At a closer radius, the interventions tended to show a greater positive importance. Of the green walls, Parr Street had less of an effect (0.8% at 20m and 0.2% at 100m) than the Liverpool One green wall (20% at 20m and 14% at 100m) and St Johns green wall (24% at 20m and 18% at 100m). The Lower SuDs site had a better positive effect (4% at 20m and 2% at 100m) than the lower SuDs and rain garden sites. The tree-based interventions had much the same effect over both radii, but the Strand trees (urban catchment forestry) had more effect over the 100m radius (0.2% at 20m, 1.2% at 100m). The Wapping dock floating island (15% at 20m, 13% at 100m) had more of an effect than the Sefton park island (negligible). Out of the pollinator planting sites, Wapping POLL had a greater effect than the other sites (14% at 20m, 10% at 100m), but the other larger sites were also important.

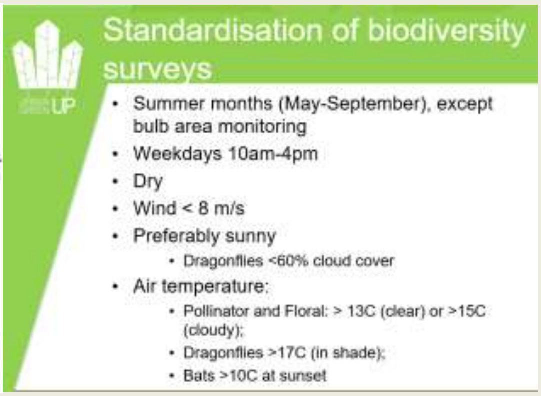
The Quantitative monitoring included many interventions. For the intervention site names, please see table below:

FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0410	POLLINATOR SPECIES INCREASE	LAc1	New green cycle route	ALL	ALL	ALL
		LAc2	Green travel route	ALL	ALL	ALL
		LAc8	Rain Garden (SUDs)	Upper Pitt St RG		Upper SuDS, Lower SuDS
		LAc12	Pollinator Planting Spaces and Verges	Baltic Green Route POLL, Cornwallis St POLL, Pitt St POLL, Park Lane POLL, Baltic Hub POLL, Strand POLL, Wapping POLL		Princes Av POLL, Princes roundabt POLL, Ullet Rd POLL, Top SP Aig Dr POLL, Top SP roundabt POLL, Bott SP Aig Dr POLL, Upper SuDS POLL, Lower SuDS POLL
		LAc13	Pollinator walls/vertical	Parr St GW	St Johns GW, L1GW	
		LAc14	Pollinator roofs		RoyaL Court GR	
		LAc16	Floating gardens	Wapping FI		SPL FI

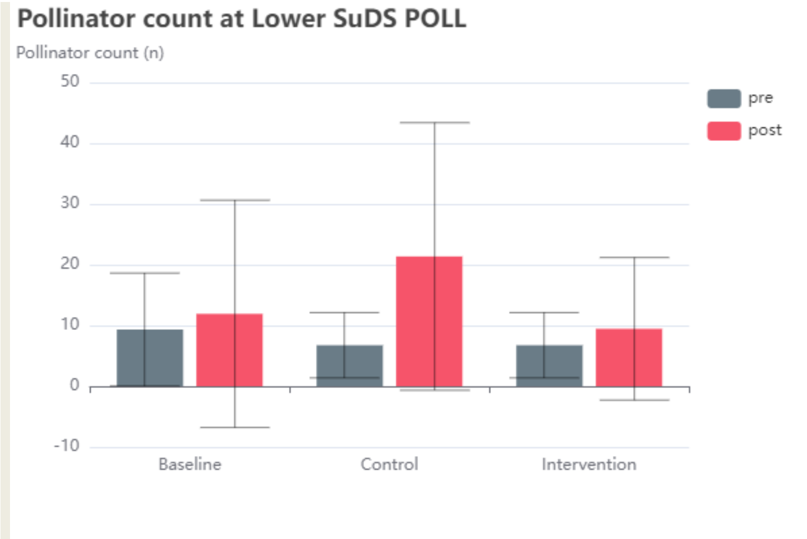
Map of monitoring locations

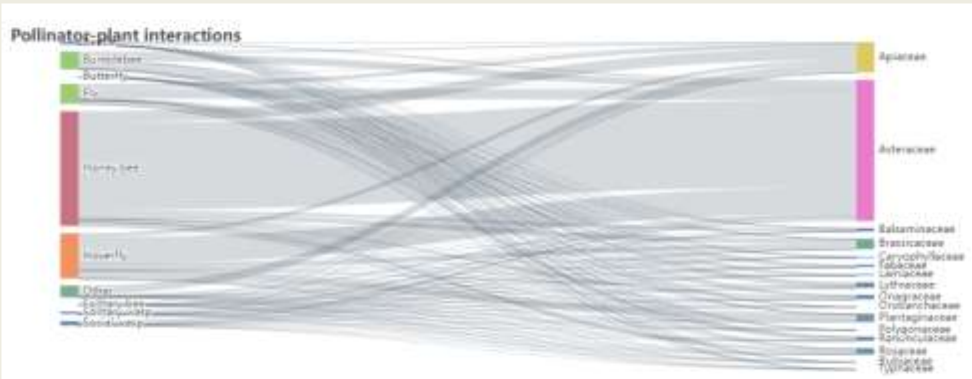
Equipment and methodology:

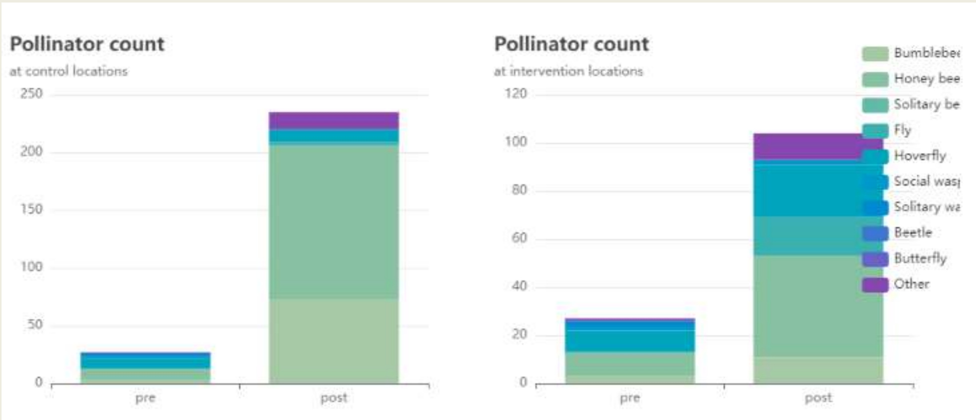


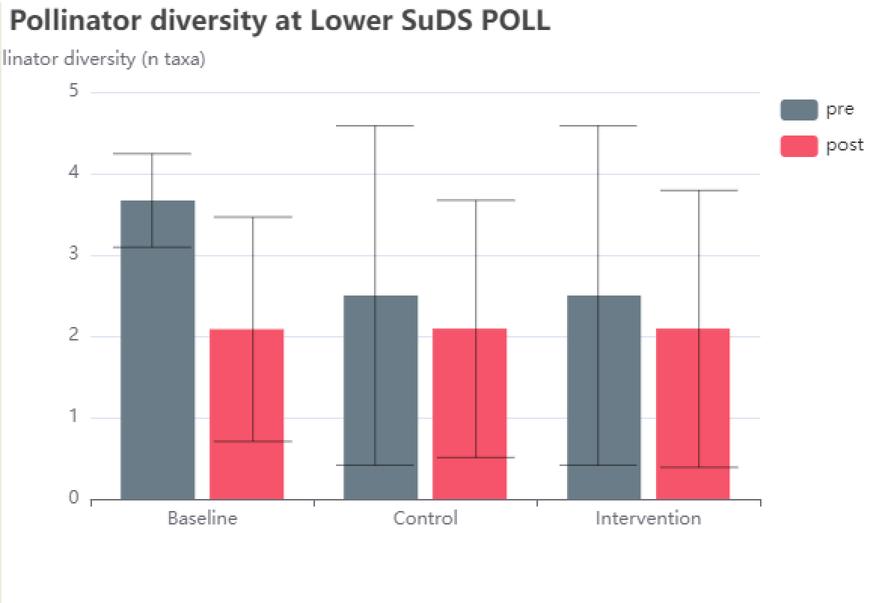


Summary plot example for pollinator verge: Sub-Demo C: Lower SuDs POLL

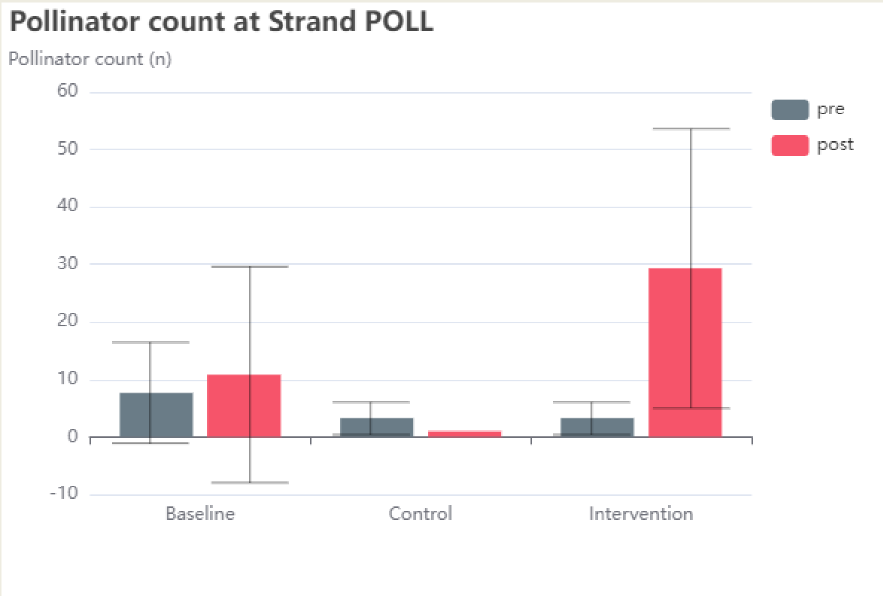

Pollinator count at Lower SuDS POLL
Pollinator count (n)
50
40
30
20
10
0
-10
pre
post
Baseline
Control
Intervention

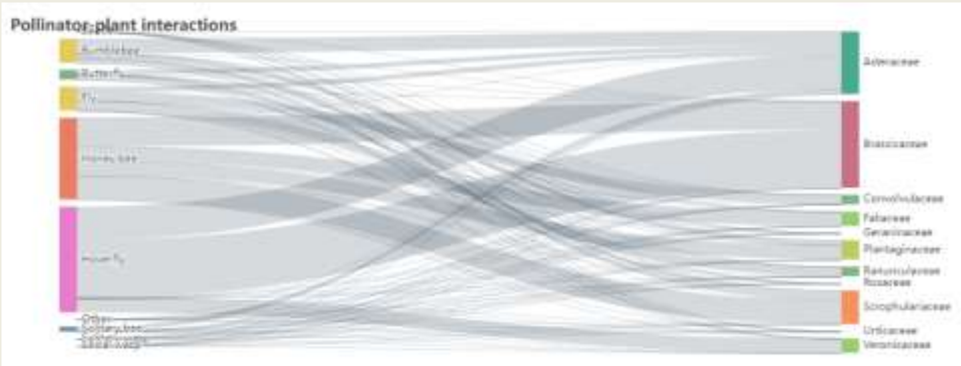

Pollinator-plant interactions

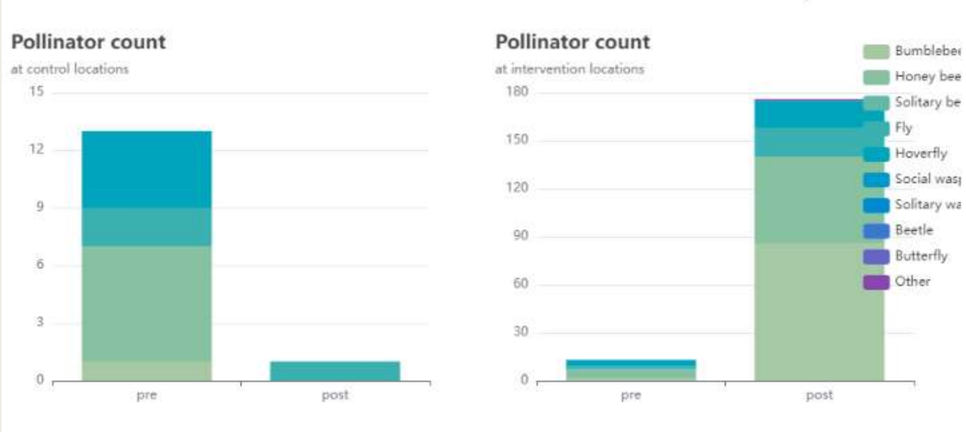

Pollinator count
at control locations
250
200
150
100
50
0
pre
post
Pollinator count
at intervention locations
120
100
80
60
40
20
0
pre
post
Bumblebee
Honey bee
Solitary be
Fly
Hoverfly
Social wasp
Solitary wa
Beetle
Butterfly
Other

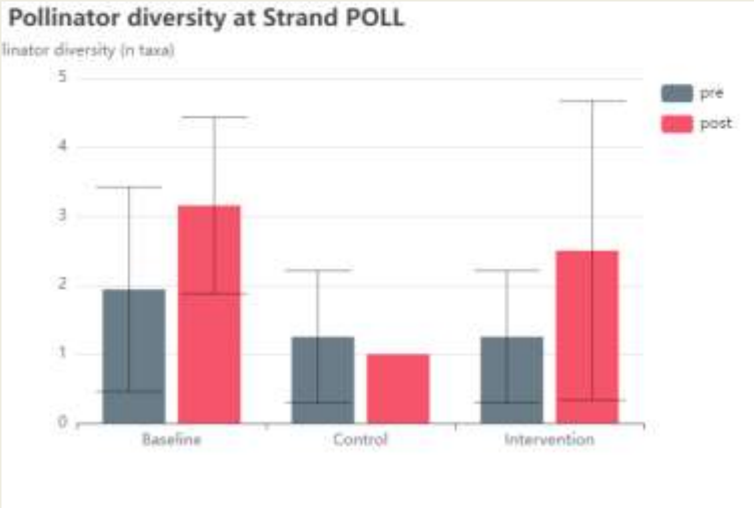


Summary plot example for pollinator verge: Sub-Demo A: Strand POLL

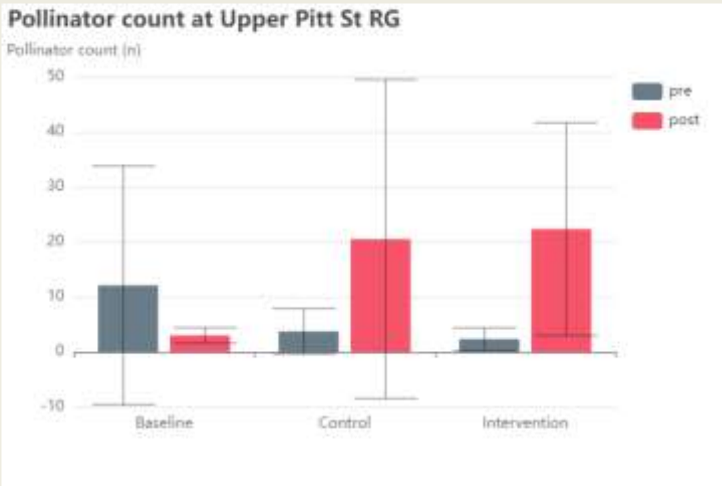


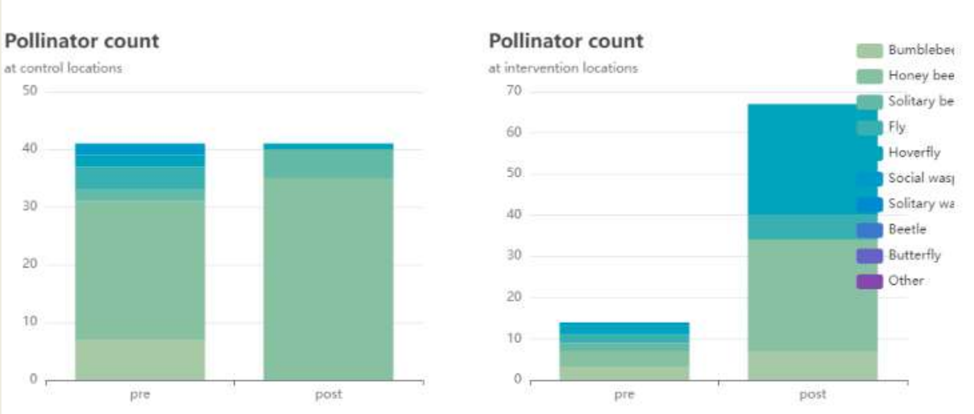


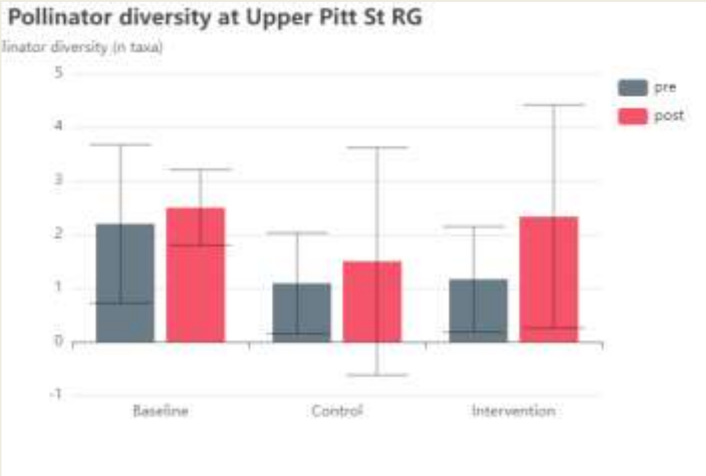




Summary plot example for sub demo A Rain garden:







The quantitative data summaries for both the pollinator count and diversities demonstrated a positive change for all areas (although sub demo B could not be calculated overall), particularly for sub demo A (206% and 35% respectively for pollinator abundance and pollinator diversity), with sub demo C (134% and 13% respectively) and overall Liverpool (141% and 18% respectively) also very important.

From the detailed look at the interventions, the SuDs and rain garden (449% and 42% respectively) were extremely important, followed by the pollinator verge sites (287% and 78% respectively). The pollinator verges showed the most increase in pollinator group diversity though. The floating gardens, though, showed a decreased change (-60%), but with a low number of observations.

The rain garden was particularly important with an 857% positive change in pollinator abundance and 100% increase in pollinator diversity (see also the plot examples). Of the green walls, no % changes could be calculated, but all had a positive effect, with Liverpool One green wall showing the most pollinator abundance (16 pollinators), followed by Parr Street, then St Johns (10 and 3 pollinators respectively). The pollinator verges were really important, particularly the Aigburth Drive (Top SP Aig Dr POLL at 180% and Bott SP Aig Dr POLL at 928%), Ullet road (Ullet Rd POLL at 129%) sites in sub demo C, and the Baltic sites Strand POLL and Park Lane POLL (803% and 521% increase in pollinator abundance respectively). Please also see example plots. The pollinator diversities tended to reflect the pollinator abundance figures accordingly.

Overall, all areas showed a positive change with the introduction of the interventions, particularly the central Liverpool sub demos A and B. Larger planted areas and interventions added into sterile environments (such as the Baltic rain garden) had the most important effects.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.15.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
EcoServR: This model provides a probability of pollinators visiting based on the proximity of suitable habitats. Core habitats (semi-natural grasslands, heathlands, scrub, hedgerows, gardens, as well as green roofs, walls and pollinator planting) and edge habitats (woodlands; suitable for nesting when within 20m of core habitats) are selected from the natural capital basemap. Distances to habitats are calculated (up to 668m which is considered the maximum flight distance) and converted to a visitation probability score (which decreases with increasing distance to habitats). An elevation mask (250m) is applied as areas above this are likely to be too exposed to support pollinators in great numbers. Raw units represent the probability (0-1) of visitation by pollinators. A rescaled (0-100) version is provided where 100 is the highest demand in the area mapped.	Awareness of limitation of model

Economical barriers	How they have been addressed
None	

Social barriers	How they have been addressed
None	

Environmental (including COVID)	How they have been addressed
None	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further data analyses with comparative data sources such as local climate and shading, as shown in the table below, would increase understanding of the impact of the interventions on pollinator levels.

KPI NAME	NBS Ref No.	NBS NAME	OTHER POSSIBLE COMPARATIVE DATA SOURCES		
POLLINATOR SPECIES INCREASE	LAc1	New green cycle route	Local climate	Liverpool climate	
	LAc2	Green travel route	Local climate	Liverpool climate	
	LAc8	Rain Garden (SUDs)	Local climate	Liverpool climate	Detectronic Flow meter
	LAc12	Pollinator Planting Spaces and Verges	Local climate	Liverpool climate	
	LAc13	Pollinator walls/vertical	Local climate	Liverpool climate	
	LAc14	Pollinator roofs	Local climate	Liverpool climate	
	LAc16	Floating gardens	Local climate	Liverpool climate	

The EcoServR data showed a positive benefit of all the interventions, particularly for sub demo B.

These overall positive changes were also reflected in the quantitative data, especially where interventions were larger and introduced into a sterile urban environment.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.16 CH0412 Floral resources increase

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0412	FLORAL RESOURCES INCREASE	CFT
CITY	*RELATED NBS*	
LIV	LAc1, LAc2, LAc8, LAc12 ,LAc13, LAc14, LAc16	

2.16.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: Observational Flower-Insect Timed counts

Quantitative monitoring data results:

QUANTITATIVE DATA SUMMARY									
CH0412: Flower Count									
Pre-Intervention				**Post-Intervention**				**% Change**	**Area**
n_obs	**n_sites**	**estimate**	**sd**	**n_obs**	**n_sites**	**estimate**	**sd**		
60	15	2.5	1.6	91	15	3.9	3.0	55.2	**Overall Liverpool**
34	8	3.5	1.5	35	7	6.1	2.4	73.2	**Sub-Demo A**
				12	2	6.5	2.6		**Sub-Demo B**
26	7	1.2	0.4	44	6	1.4	0.5	20.2	**Sub-Demo C**

QUANTITATIVE DATA SUMMARY		
CH0412: Flower Count		
NBS	**NBS Name**	**% Change**
LAc8	SuDs & Rain Garden	328.7
LAc12	Pollinator verges and spaces	510.8
LAc13	Pollinator walls/vertical	228.8
LAc16	Floating gardens	-10.8

QUANTITATIVE DATA SUMMARY										
CH0412: Flower Count		Pre-Intervention				Post-Intervention				% Change
NBS	inter_code	n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd	
LAc8	Lower SuDS	4	1	37.0	23.9	11	1	267.5	205.8	623.1
LAc8	Upper Pitt St RG	6	1	94.8	58.7	3	1	127.3	42.1	34.3
LAc12	Baltic Hub POLL	4	1	326.0	178.6	2	1	483.0	521.8	48.2
LAc12	Bott SP Aig Dr POLL	3	1	28.0	14.8	7	1	528.1	935.8	1786.2
LAc12	Cornwallis St POLL	10	1	84.8	124.6	3	1	233.3	182.4	175.2
LAc12	Lower SuDS POLL	4	1	37.0	23.9	11	1	267.5	205.8	623.1
LAc12	Park Lane POLL	3	1	37.3	24.9	7	1	401.3	470.9	974.9
LAc12	Princes Av POLL					7	1	402.3	563.9	
LAc12	Princes roundabt POLL	5	1	98.2	144.5					
LAc12	Strand POLL	4	1	67.0	23.6	6	1	565.3	411.1	743.8
LAc12	Top SP Aig Dr POLL	4	1	660.3	1043.5	2	1	1487.5	1594.5	125.3
LAc12	Top SP roundabt POLL	1	1	135.0						
LAc12	Ullet Rd POLL	3	1	170.7	246.3	5	1	269.4	92.6	57.9
LAc12	Wapping POLL	5	1	196.6	293.5	2	1	319.0	161.2	62.3
LAc13	L1 GW					2	1	206.0	217.8	
LAc13	Parr St GW	1	1	50.0		12	1	164.4	190.8	228.8
LAc13	St Johns GW					10	1	378.2	368.5	
LAc16	SPL FI	2	1	115.5	92.6	1	1	103.0		-10.8
LAc16	Wapping FI	1	1	162.0						

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

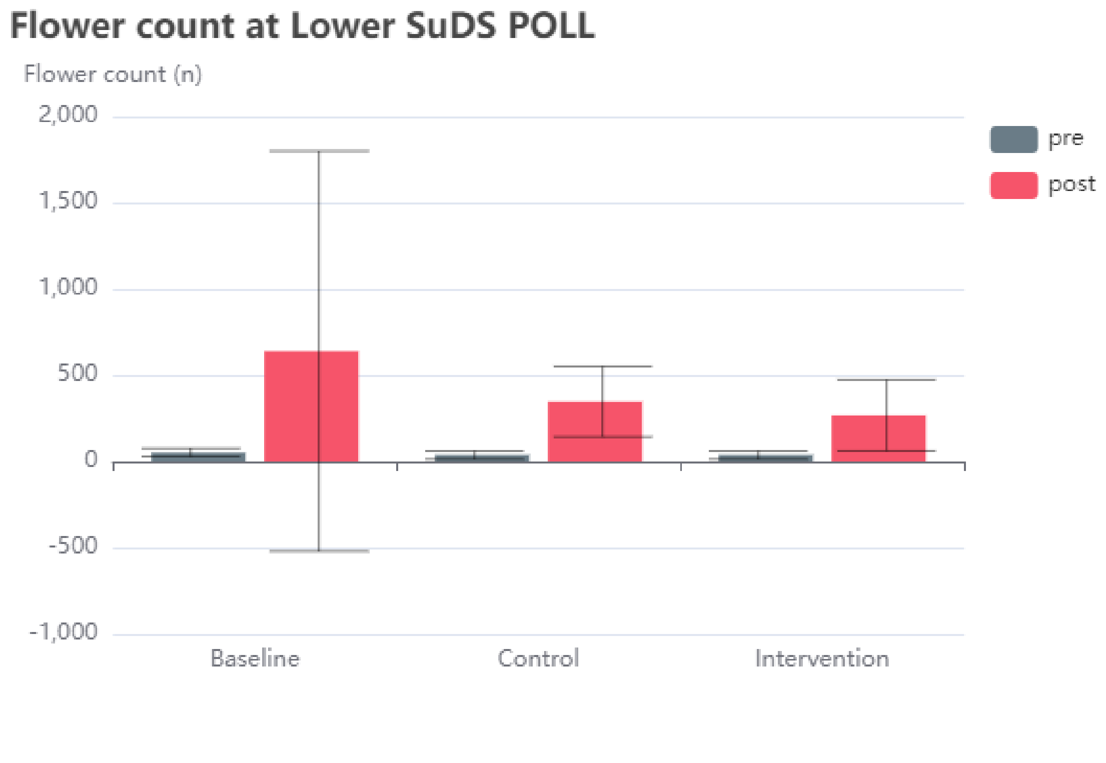
For related intervention site names, please see table below:

FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0412	FLORAL RESOURCES INCREASE	LAc1	New green cycle route	ALL	ALL	ALL
		LAc2	Green travel route	ALL	ALL	ALL
		LAc8	Rain Garden (SUDs)	Upper Pitt St RG		Upper SuDS, Lower SuDS
		LAc12	Pollinator Planting Spaces and Verges	Baltic Green Route POLL, Cornwallis St POLL, Pitt St POLL, Park Lane POLL, Baltic Hub POLL, Strand POLL, Wapping POLL		Princes Av POLL, Princes roundabt POLL, Ullet Rd POLL, Top SP Aig Dr POLL, Top SP roundabt POLL, Bott SP Aig Dr POLL, Upper SuDS POLL, Lower SuDS POLL
		LAc13	Pollinator walls/vertical	Parr St GW	St Johns GW, L1 GW	
		LAc14	Pollinator roofs		RoyaL Court GR	
		LAc16	Floating gardens	Wapping FI		SPL FI

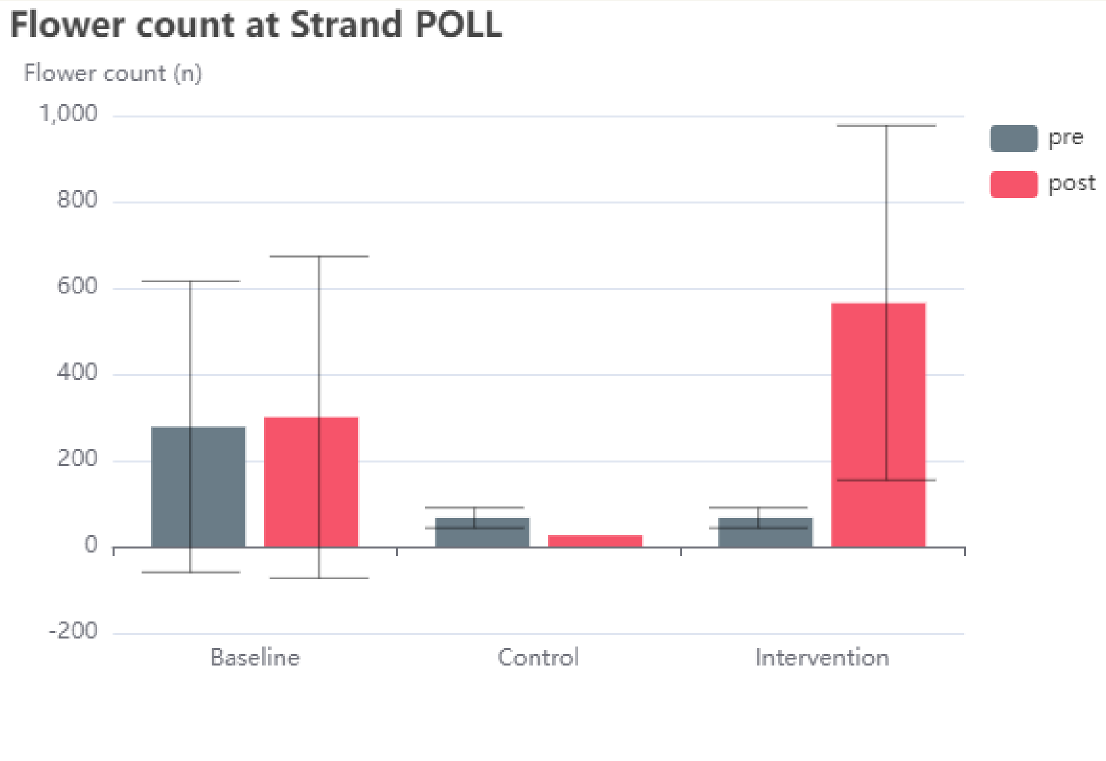
Map of monitoring locations: See CH0410

Equipment and methodology: See CH0410

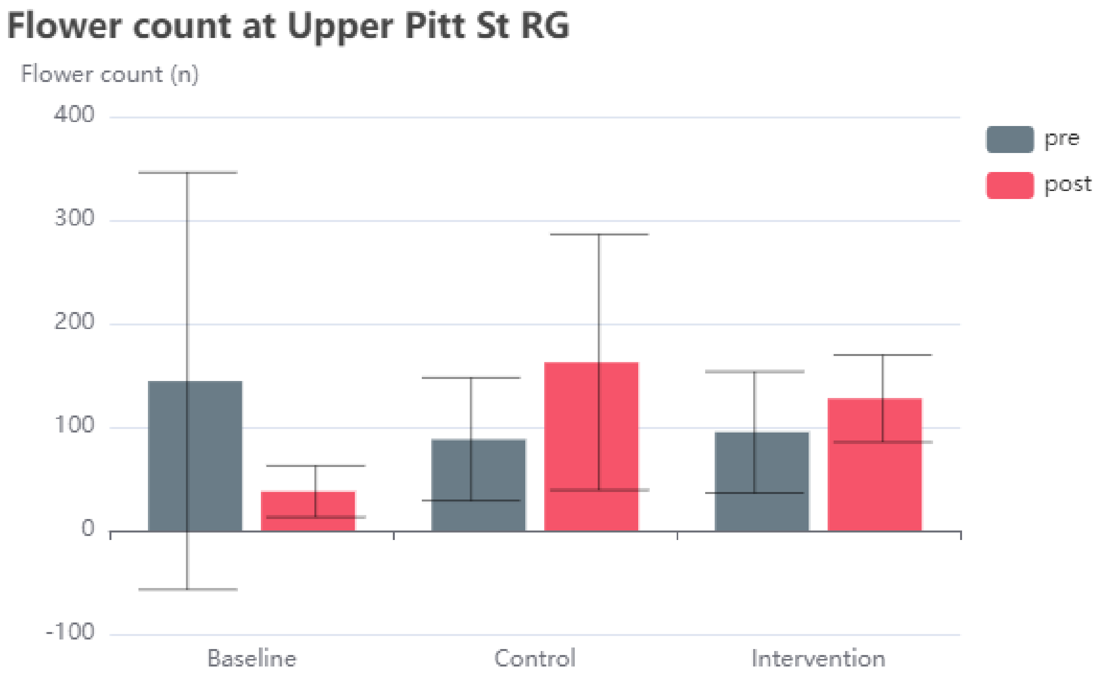
Summary plot example for pollinator verge: Sub-Demo C: Lower SuDs POLL



Summary plot example for pollinator verge: Sub-Demo A: Strand POLL



Summary plot example for sub demo A Rain garden:



The data tended to follow the pattern of the pollinator abundances and diversity results (as in CH0410). Overall, positive changes were observed for all areas, particularly for sub demo A (73% increase in floral abundance) with sub demo C at 20% and overall Liverpool at 55% increase.

From a more detailed assessment of the data, the pollinator verges were shown to have the most increase in flower numbers (511%), followed by the Suds and rain garden (329%) and pollinator vertical walls (229%). The floating gardens showed a slight decreased change, but on a low number of observations.

The rain garden was important with a 34% increase in flowers, with the lower SuDs area as a whole showing a 623% increase in flowers. For the green walls, although the % change could not be calculated for all, these interventions were shown to be important with high number of flowers post-interventions. Parr Street showed a 229% increase. Of the pollinator planting sites, the lower Aigburth Drive site (Bott SP Aig Dr POLL), Park Lane POLL and Strand POLL were the most important (1786%, 975% and 744% increases respectively).

Overall, all sites and areas showed generally positive increases in floral abundances (see summary plots).

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.16.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
None	
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
None	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further data comparisons with comparative data sources such as local BioBank and iNaturalist records would be useful to understand the impact of the interventions on the floral diversity and abundances.

Overall, all sites and areas showed generally positive increases in floral abundances (see summary plots). These changes mainly reflected the pollinator abundances, although some influence of factors such as shade and local climate should be taken into account.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.17 CH0411 Plant species increas

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0411	PLANT SPECIES INCREASE	CFT
CITY	*RELATED NBS*	
LIV	LAc1, LAc2, LAc8, LAc12, LAc13, LAc14, LAc16	

2.17.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: Observational Flower-Insect Timed counts

Quantitative monitoring data results:

QUANTITATIVE DATA SUMMARY									
CH0411: Plant Count									
Pre-Intervention				Post-Intervention				% Change	Area
n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd		
60	15	3.3	2.5	91	15	6.3	5.4	90.2	**Overall Liverpool**
34	8	4.8	2.4	35	7	10.4	4.5	117.5	**Sub-Demo A**
				12	2	10.7	5.0		**Sub-Demo B**
26	7	1.4	0.5	44	6	1.9	0.4	34.2	**Sub-Demo C**

QUANTITATIVE DATA SUMMARY									
CH0411: Plant diversity									
Pre-Intervention				Post-Intervention				% Change	Area
n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd		
60	15	2.5	1.6	91	15	3.9	3.0	55.2	**Overall Liverpool**
34	8	3.5	1.5	35	7	6.1	2.4	73.2	**Sub-Demo A**
				12	2	6.5	2.6		**Sub-Demo B**
26	7	1.2	0.4	44	6	1.4	0.5	20.2	**Sub-Demo C**

QUANTITATIVE DATA SUMMARY		
CH0411: Plant Count		
NBS	NBS Name	% Change
LAc8	SuDs & Rain Garden	68.4
LAc12	Pollinator verges and spaces	77.4
LAc13	Pollinator walls/vertical	1108.3
LAc16	Floating gardens	33.3

QUANTITATIVE DATA SUMMARY										
CH0411: Plant Count		Pre-Intervention				Post-Intervention				% Change
NBS	inter_code	n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd	
LAc8	Lower SuDS	4	1	1.3	0.5	11	1	1.9	0.5	52.7
LAc8	Upper Pitt St RG	6	1	4.2	2.6	3	1	7.7	2.3	84.0
LAc12	Baltic Hub POLL	4	1	7.3	2.5	2	1	11.5	0.7	58.6
LAc12	Bott SP Aig Dr POLL	3	1	1.3	0.6	7	1	2.0	0.0	50.0
LAc12	Cornwallis St POLL	10	1	5.6	2.3	3	1	5.0	1.0	-10.7
LAc12	Lower SuDS POLL	4	1	1.3	0.5	11	1	1.9	0.5	52.7
LAc12	Park Lane POLL	3	1	4.3	2.3	7	1	9.6	5.5	120.9
LAc12	Princes Av POLL					7	1	1.9	0.4	
LAc12	Princes roundabt POLL	5	1	1.4	0.5					
LAc12	Strand POLL	4	1	3.3	0.5	6	1	12.3	3.7	279.5
LAc12	Top SP Aig Dr POLL	4	1	1.5	0.6	2	1	2.0	0.0	33.3
LAc12	Top SP roundabt POLL	1	1	2.0						
LAc12	Ullet Rd POLL	3	1	1.7	0.6	5	1	1.8	0.4	8.0
LAc12	Wapping POLL	5	1	4.4	2.3	2	1	9.0	4.2	104.5
LAc13	L1 GW					2	1	2.0	0.0	

LAc13	Parr St GW	1	1	1.0		12	1	12.1	4.7	1108.3
LAc13	St Johns GW					10	1	12.4	3.2	
LAc16	SPL FI	2	1	1.5	0.7	1	1	2.0		33.3
LAc16	Wapping FI	1	1	4.0						

QUANTITATIVE DATA SUMMARY		
CH0411: Plant diversity		
NBS	**NBS Name**	**% Change**
LAc8	SuDs & Rain Garden	52.4
LAc12	Pollinator verges and spaces	55.0
LAc13	Pollinator walls/vertical	541.7
LAc16	Floating gardens	0.0

QUANTITATIVE DATA SUMMARY										
CH0411: Plant diversity		Pre-Intervention				Post-Intervention				% Change
NBS	**inter_code**	**n_obs**	**n_sites**	**estimate**	**sd**	**n_obs**	**n_sites**	**estimate**	**sd**	
LAc8	Lower SuDS	4	1	1.0	0.0	11	1	1.4	0.5	36.4
LAc8	Upper Pitt St RG	6	1	3.2	1.6	3	1	5.3	1.2	68.4
LAc12	Baltic Hub POLL	4	1	3.8	1.5	2	1	5.5	0.7	46.7
LAc12	Bott SP Aig Dr POLL	3	1	1.0	0.0	7	1	1.7	0.5	71.4
LAc12	Cornwallis St POLL	10	1	4.7	1.3	3	1	3.3	0.6	-29.1
LAc12	Lower SuDS POLL	4	1	1.0	0.0	11	1	1.4	0.5	36.4
LAc12	Park Lane POLL	3	1	2.7	0.6	7	1	6.3	3.5	135.7
LAc12	Princes Av POLL					7	1	1.3	0.5	
LAc12	Princes roundabt POLL	5	1	1.2	0.4					
LAc12	Strand POLL	4	1	3.3	0.5	6	1	7.5	2.1	130.8
LAc12	Top SP Aig Dr POLL	4	1	1.3	0.5	2	1	2.0	0.0	60.0
LAc12	Top SP roundabt POLL	1	1	1.0						

LAc1 2	Ullet Rd POLL	3	1	1.7	0.6	5	1	1.0	0.0	-40.0
LAc1 2	Wapping POLL	5	1	3.0	1.6	2	1	5.5	0.7	83.3
LAc1 3	L1 GW					2	1	2.0	0.0	
LAc1 3	Parr St GW	1	1	1.0		12	1	6.4	2.4	541.7
LAc1 3	St Johns GW					10	1	7.4	1.8	
LAc1 6	SPL FI	2	1	1.0	0.0	1	1	1.0		0.0
LAc1 6	Wapping FI	1	1	2.0						

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

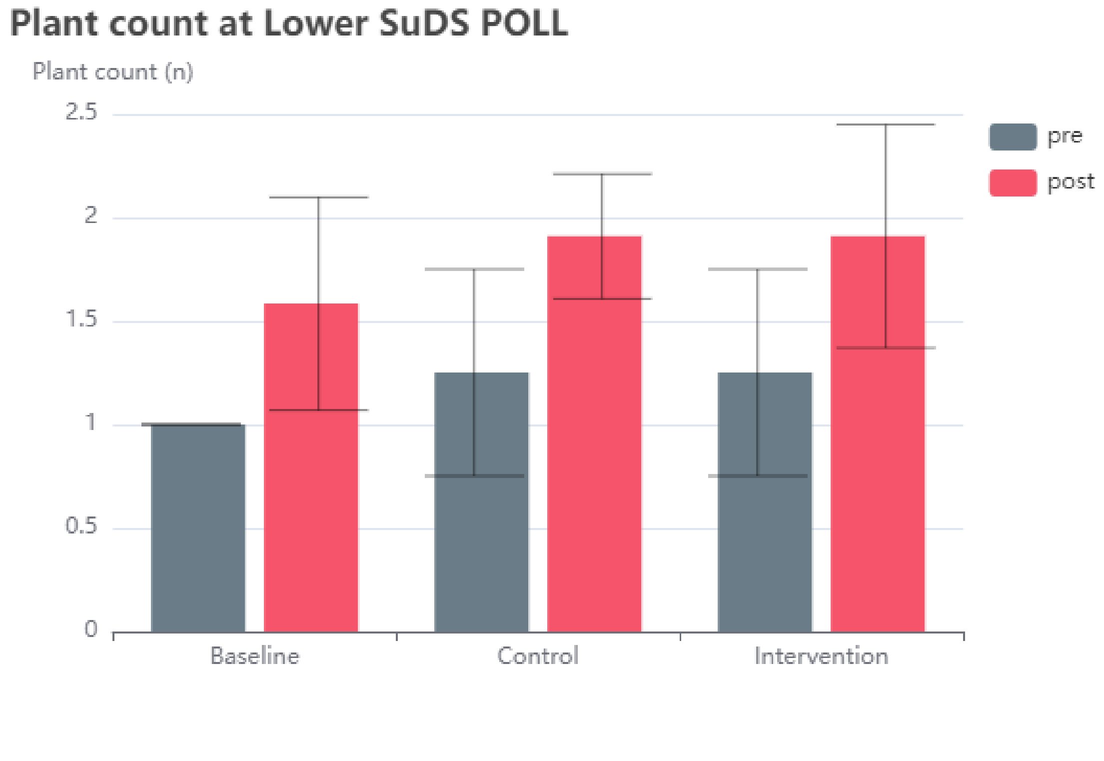
For related intervention site names, please see table below:

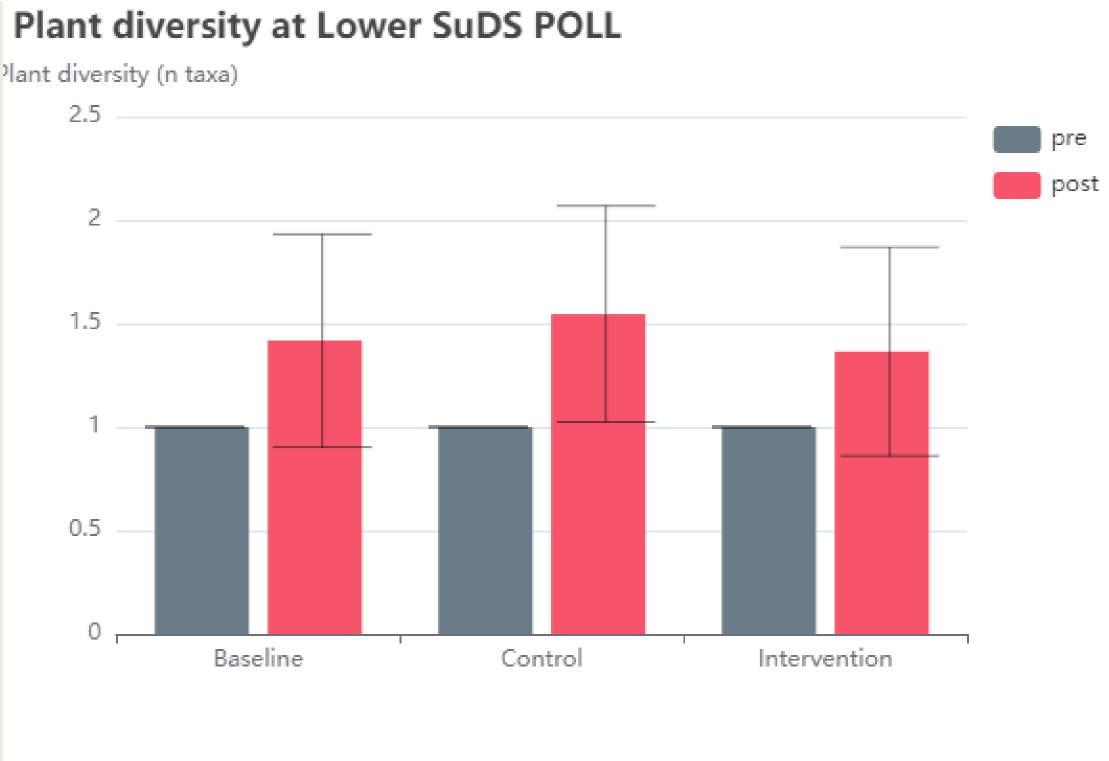
FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0411	PLANT SPECIES INCREASE	LAc1	New green cycle route	ALL	ALL	ALL
		LAc2	Green travel route	ALL	ALL	ALL
		LAc8	Rain Garden (SUDs)	Upper Pitt St RG		Upper SuDS, Lower SuDS
		LAc12	Pollinator Planting Spaces and Verges	Baltic Green Route POLL, Cornwallis St POLL, Pitt St POLL, Park Lane POLL, Baltic Hub POLL, Strand POLL, Wapping POLL		Princes Av POLL, Princes roundabt POLL, Ullet Rd POLL, Top SP Aig Dr POLL, Top SP roundabt POLL, Bott SP Aig Dr POLL, Upper SuDS POLL, Lower SuDS POLL
		LAc13	Pollinator walls/vertical	Parr St GW	St Johns GW, L1GW	
		LAc14	Pollinator roofs	RoyaL Court GR		
		LAc16	Floating gardens	Wapping FI		SPL FI

Map of monitoring locations: See CH0410

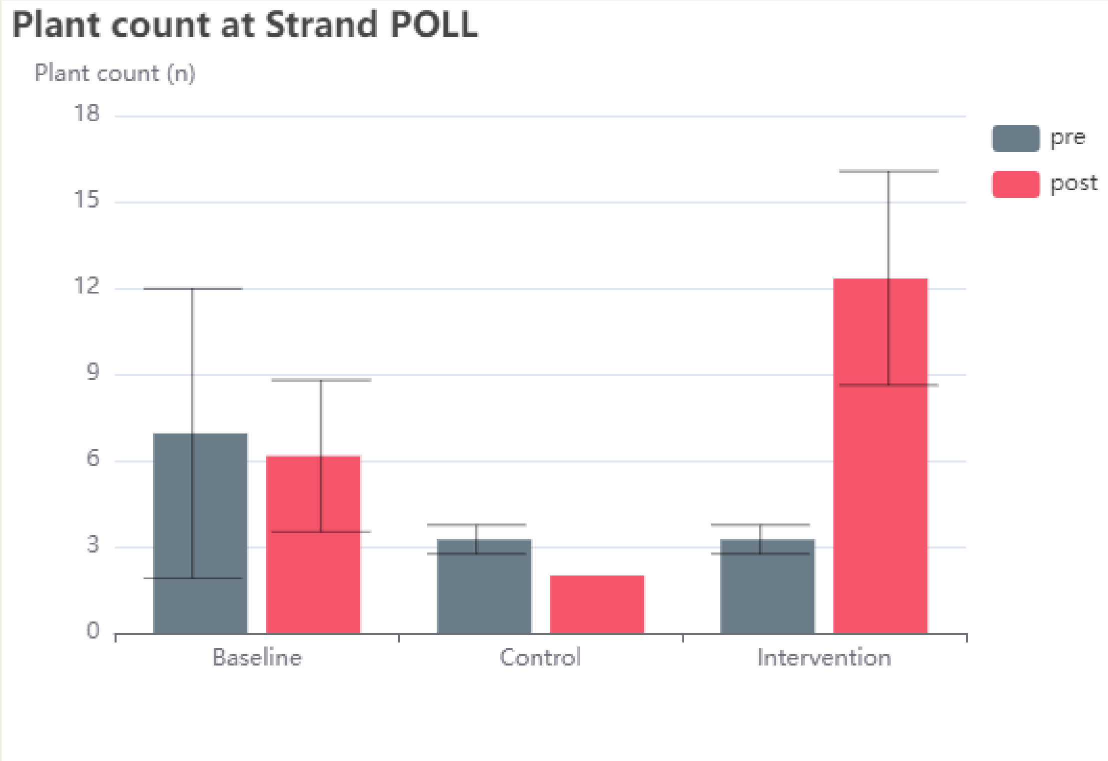
Equipment and methodology: See CH0410

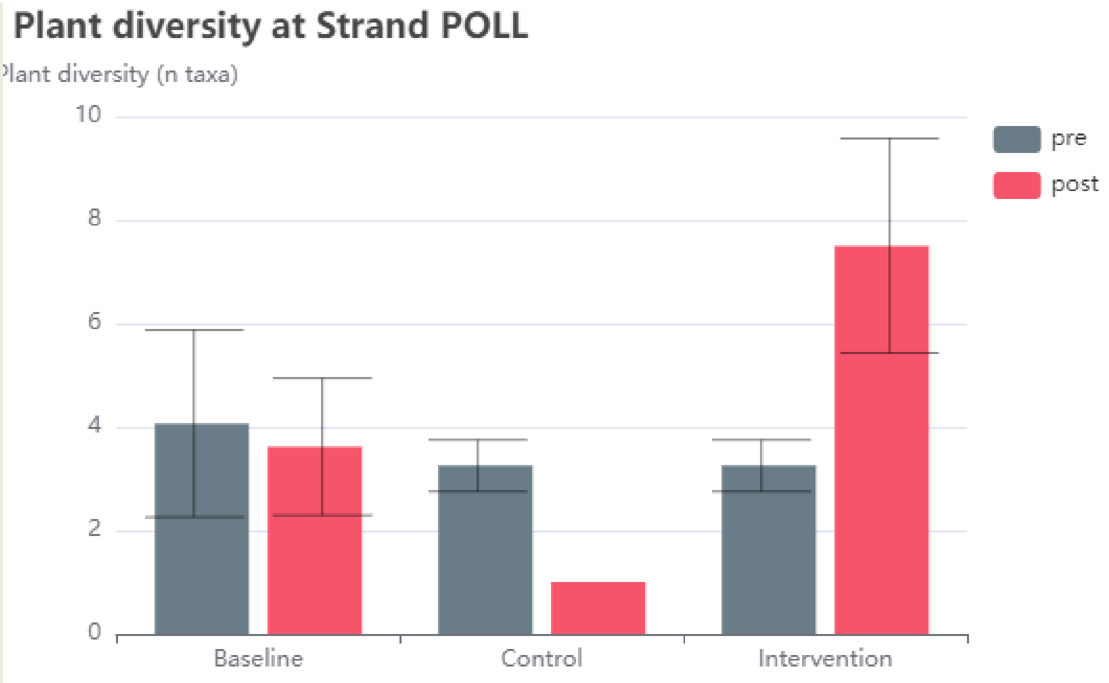
Summary plot example for pollinator verge: Sub-Demo C: Lower SuDs POLL



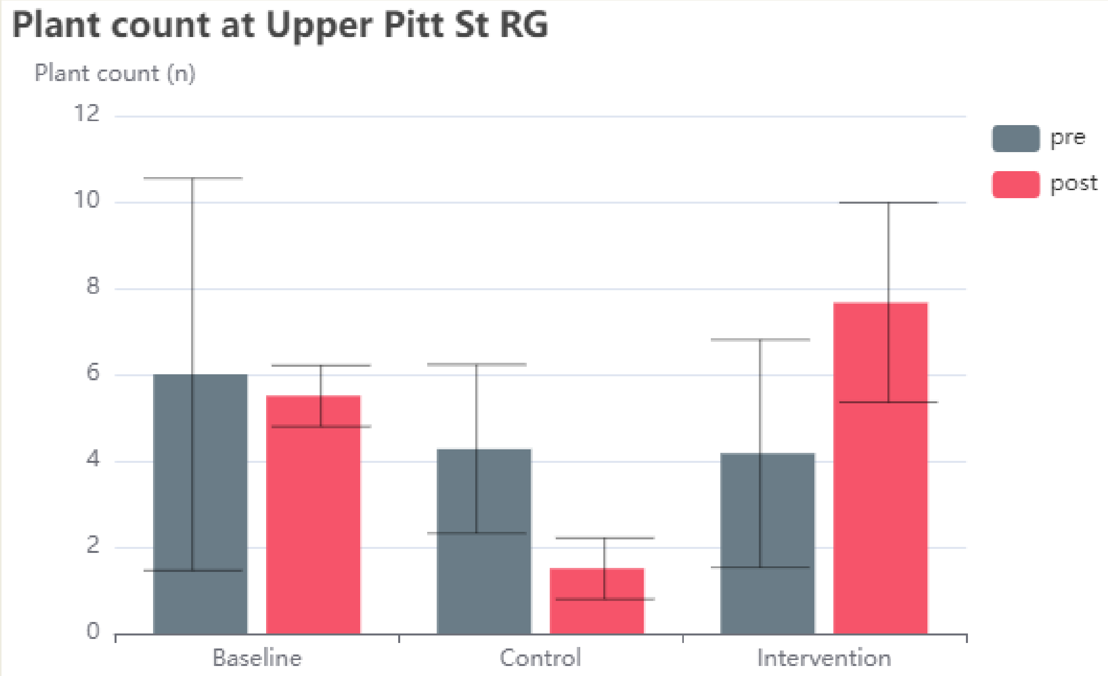


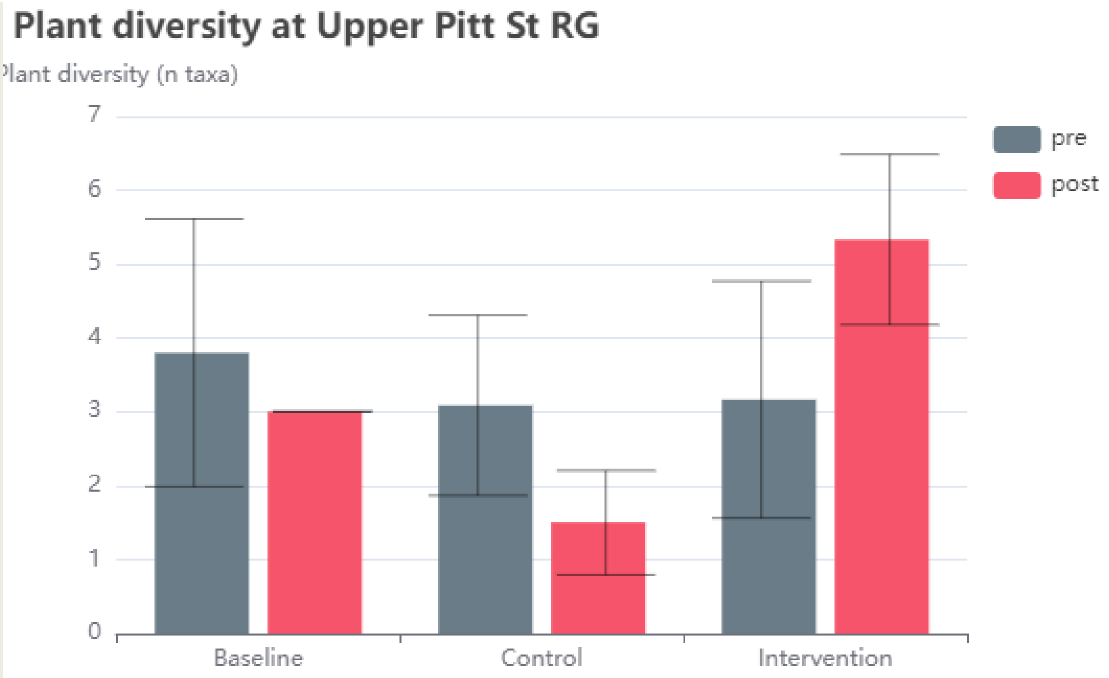
Summary plot example for pollinator verge: Sub-Demo A: Strand POLL





Summary plot example for sub demo A Rain garden:





The data showed positive changes throughout all areas, particularly for sub demo A with 118% and 73% increases in plant counts and diversity of plant families respectively. Sub demo C (34% and 20% respectively) and overall Liverpool (90% and 55% respectively) also showed increase in these counts with the Urban GreenUP project.

From the detailed breakdown, the pollinator walls showed the most important positive increase (1108% and 542% respectively) with pollinator verges (77% and 55% respectively) and Suds and rain garden (68% and 52% respectively) also important. The floating gardens again had a low number of observations, but still showed an increase in plant count (33%).

The rain garden in sub demo A was important in increasing the plant diversity (84% and 68% respectively for plant count and plant family diversity), plus the entire Lower Suds area was important at 53% and 36% respectively. The green wall percentage changes could not always be calculated, but all showed an increased number and diversity of plants, with Parr Street showing a 1108% plant count and 541% plant diversity increase. The pollinator verges were very important, particularly Strand POLL (280% and 131% respectively) and Park Lane POLL (121% and 136% respectively). Please see example plots.

Overall, all sites and areas showed an increase in plant counts and diversity of plant families.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.17.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
None	
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
None	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further data comparisons with comparative data sources such as local BioBank and iNaturalist records would be useful to understand the impact of the interventions on the plant species and diversity.

Overall, all sites and areas showed an increase in plant counts and diversity of plant families. This was particularly shown for large, planted areas.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.18 CH0413 Insectivore increase

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0413	INSECTIVORE INCREASE	CFT
CITY	*RELATED NBS*	
LIV	LAc1, LAc2, LAc8, LAc12, LAc13, LAc14, LAc16	

2.18.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: Observational transects

Quantitative monitoring data results:

Bat (Chiroptera) results for the vicinity of each intervention: Number of Bat passes (Note this is not the same as the number of bats) and maximum diversity noted:

	BAT PASSES		
Bats recorded in the vicinity of interventions	**PRE-INTERVENTION**	**POST-INTERVENTION**	**% Change**
St Johns GW			
RoyaL Court GR			
Strand Tree SuDS	10		-100.0
Parr St GW			
Sub demo A pollinator sites	1		-100.0
Wapping FI			
SPL FI	141	564	300.0
Upper SuDS	13	6	-53.8
Lower SuDS	10	15	50.0
Sub Demo C pollinator sites	1	42	4100.0

Total sub demo A	**1**		-100.0
Total sub demo B	**10**		-100.0
Total sub demo C	**165**	**627**	280.0

	BAT DIVERSITY		
Bats recorded in the vicinity of interventions	**PRE-INTERVENTION**	**POST-INTERVENTION**	**% Change**
St Johns GW			
RoyaL Court GR			
Strand Tree SuDS	1		-100.0
Parr St GW			
Sub demo A pollinator sites	1		-100.0
Wapping FI			
SPL FI	5	5	0.0
Upper SuDS	1	1	0.0
Lower SuDS	2	2	0.0
Sub Demo C pollinator sites	1	4	300.0
Total sub demo A	**1**		-100.0
Total sub demo B	**1**		-100.0
Total sub demo C	**5**	**5**	0.0

Dragonfly and damselfly (Odonata) results:

Sefton Park Floating island: Odonata abundance and diversity:

Odonata Abundance	**SP FI**		
Distance from intervention (m)	**pre**	**post**	**% Change**
0-50	13	4	-69.2
<250	9	2	-77.8
<500	65	19	-70.8

<750	55	21	-61.8
<1000	36	35	-2.8
<1250	35	39	11.4
<1500	0	10	
1500+	2	7	250.0

Odonata Diversity	**SP FI**		
Distance from intervention (m)	**pre**	**post**	**% Change**
0-50	3	1	-66.7
<250	3	1	-66.7
<500	5	1	-80.0
<750	3	3	0.0
<1000	3	3	0.0
<1250	4	4	0.0
<1500	0	2	
1500+	1	2	100.0

Upper SuDs water retention pond: Odonata abundance and diversity:

Odonata Abundance	**Upper SuDs**		
Distance from intervention (m)	**pre**	**post**	**% Change**
0-50	0	0	
<250	0	0	
<500	6	0	-100.0
<750	9	12	33.3
<1000	13	4	-69.2
<1250	59	19	-67.8
<1500	43	27	-37.2
1500+	85	75	-11.8

Odonata Diversity	**Upper SuDs**

Distance from intervention (m)	pre	post	% Change
0-50	0	0	
<250	0	0	
<500	4	0	-100.0
<750	3	2	-33.3
<1000	3	1	-66.7
<1250	5	1	-80.0
<1500	3	3	0.0
1500+	4	4	0.0

Lower SuDs water retention pond: Odonata abundance and diversity:

Odonata Abundance	**Lower SuDs**		
Distance from intervention (m)	**pre**	**post**	**% Change**
0-50	0	10	Positive
<250	0	0	
<500	0	0	
<750	0	0	
<1000	8	7	-12.5
<1250	9	2	-77.8
<1500	13	4	-69.2
1500+	185	114	-38.4

Odonata Diversity	**Lower SuDs**		
Distance from intervention (m)	**pre**	**post**	**% Change**
0-50	0	2	Positive
<250	0	0	
<500	0	0	
<750	0	0	
<1000	4	2	-50.0
<1250	3	1	-66.7
<1500	3	1	-66.7

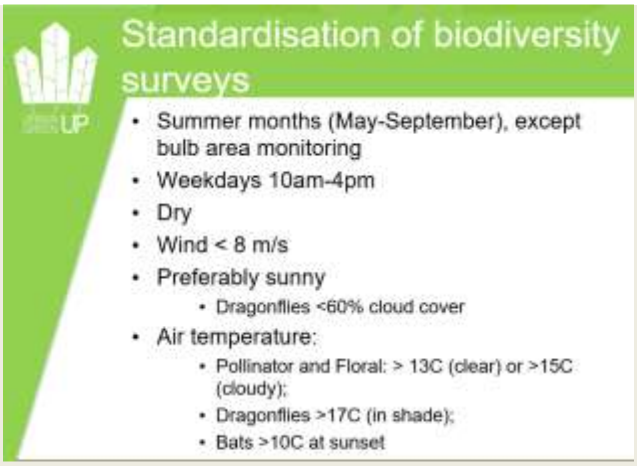
1500+	5	4	-20.0

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

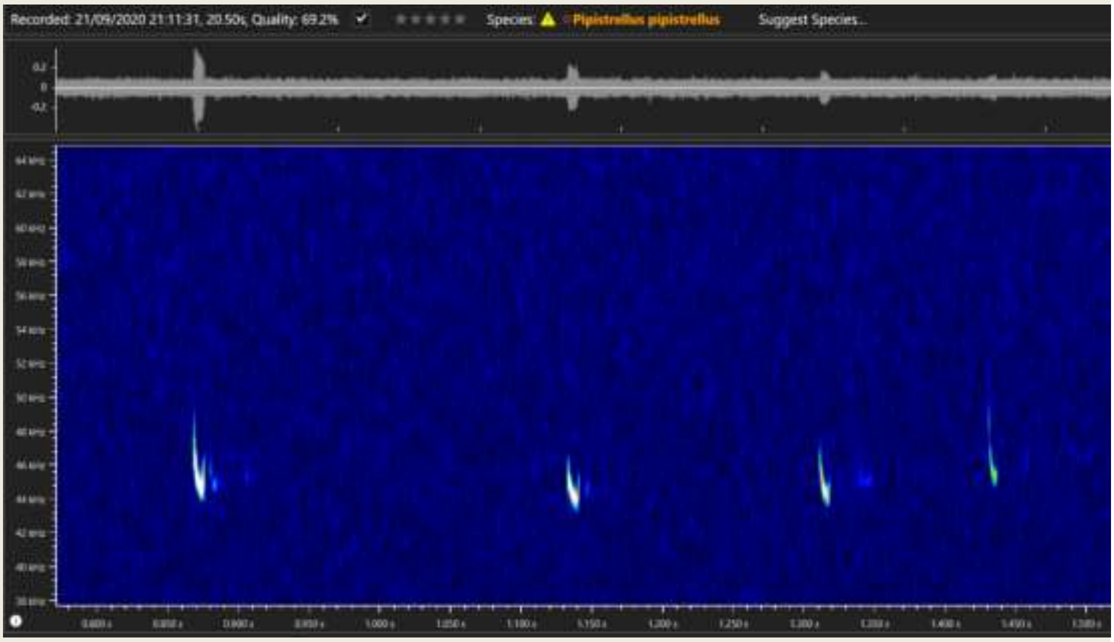
For related intervention site names, please see table below:

FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0413	INSECTIVORE INCREASE	LAc1	New green cycle route	ALL	ALL	ALL
		LAc2	Green travel route	ALL	ALL	ALL
		LAc8	Rain Garden (SUDs)	Upper Pitt St RG		Upper SuDS, Lower SuDS
		LAc12	Pollinator Planting Spaces and Verges	Baltic Green Route POLL, Cornwallis St POLL, Pitt St POLL, Park Lane POLL, Baltic Hub POLL, Strand POLL, Wapping POLL		Princes Av POLL, Princes roundabt POLL, Ullet Rd POLL, Top SP Aig Dr POLL, Top SP roundabt POLL, Bott SP Aig Dr POLL, Upper SuDS POLL, Lower SuDS POLL
		LAc13	Pollinator walls/vertical	Parr St GW	St Johns GW, L1GW	
		LAc14	Pollinator roofs		RoyaL Court GR	
		LAc16	Floating gardens	Wapping FI		SPL FI

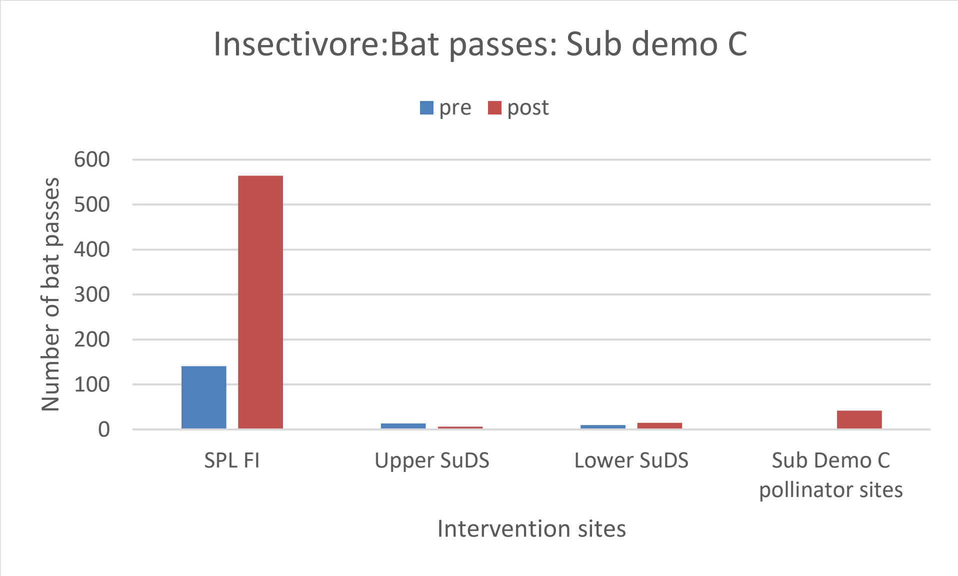
Map of monitoring locations, equipment and methodology:

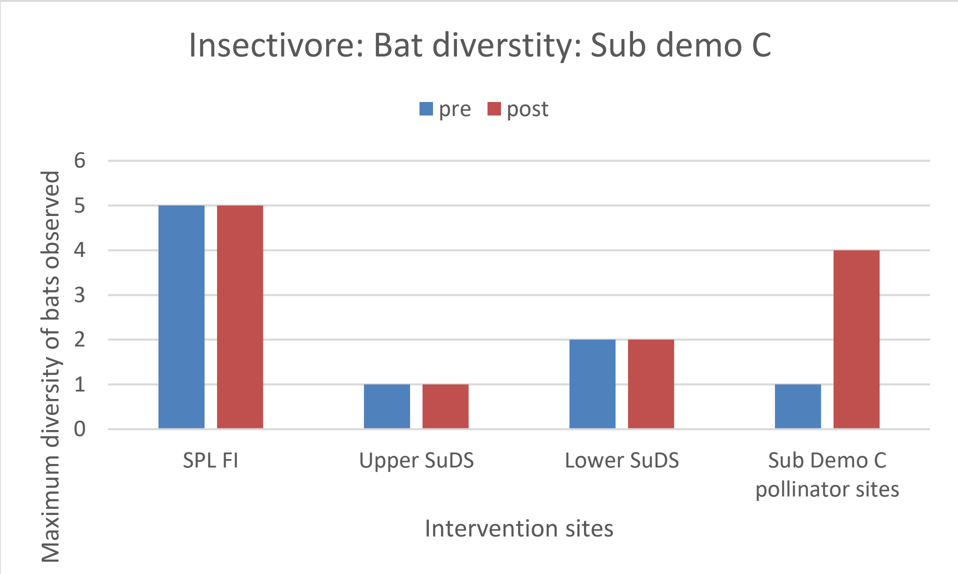


Example sonogram from bat monitoring recorded using a Batlogger M detector and sonogram produced using Batexplorer software (Elekon, Switzerland): Common Pipistrelle adjacent to Lower Suds:

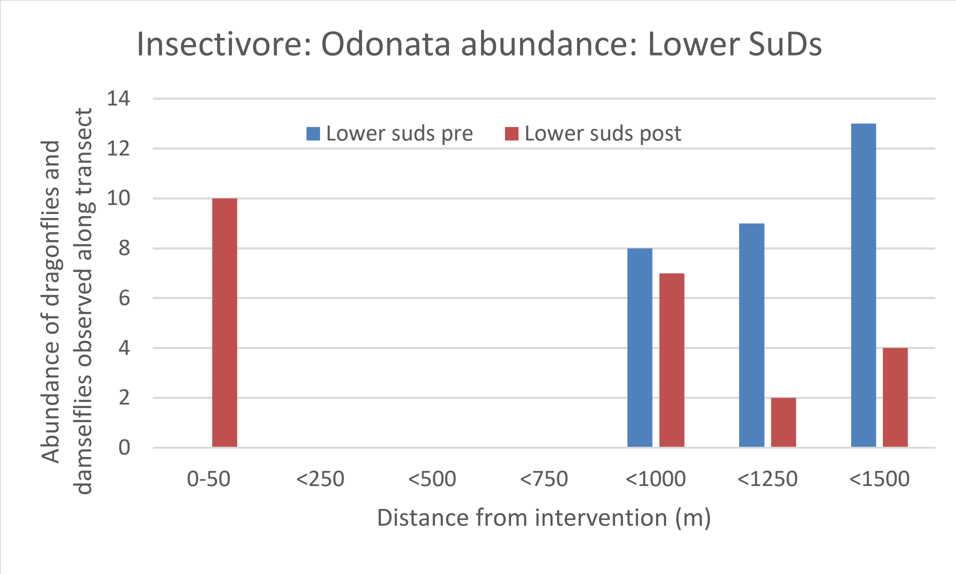


Bat data: Example summary plots: Bat passes and diversity in sub demo C:

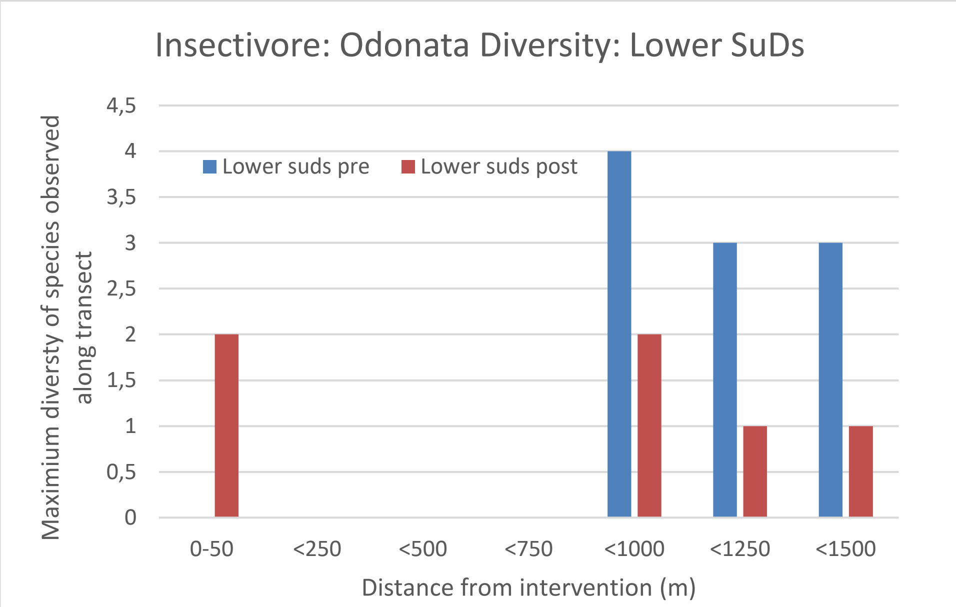




Example summary distance from intervention plot: Odonata Abundance: Lower SuDs



Example summary distance from intervention plot: Odonata Diversity: Lower SuDs



The bat data showed great variations in number of bat passes. This group varied greatly according to climatic conditions. Not many bats were observed within the more central sub demos A and B, but plenty of bats were observed in sub demo C, particularly on Sefton Park Lane adjacent to the floating island (SPL FI). Positive increases with the introduction of the interventions were observed for Sefton Park floating island, the lower SuDs water retention pond and the pollinator planting sites. The pollinator planting sites seemed to increase the diversity of the bats foraging as well. So overall, a positive effect was observed after the interventions were added, but further analyses to look a weather conditions would help to better interpret these data.

The Odonata, dragonflies and damselflies, showed great variations in their abundance and diversity of species according to the season and overall climatic conditions (historical and on the day of survey). Due to this variation, it was difficult to determine any effect from the interventions, except where a pond was added as at the Lower SuDs site. At the Lower Suds site, the dragonflies and damselflies were provided with a habitat, so the numbers increased. Even thorough binoculars it was difficult to see small damselflies on the Sefton Park floating island (SP FI), so the observations here may be less than in reality and climatic conditions may have caused the drop in observations noted at the time of survey. At the Upper SuDs site, water may have been flowing too fast to provide an adequate habitat. Hence, the results were generally inconclusive, except for a positive change where a waterbody habitat was introduced.

Overall, the insectivores appeared to show a positive change with the introduction of the Urban green up interventions.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.18.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

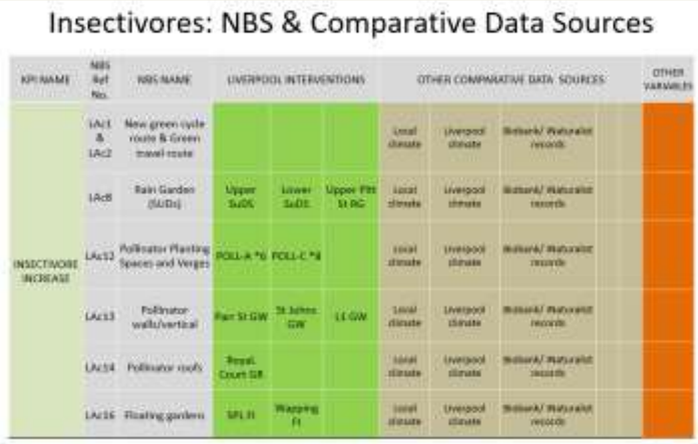
Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
None	
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
Insectivore numbers highly variable due to environmental factors. Ideally the methodology would have included more intensive surveying.	Awareness of limitation of data

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further data analyses with comparative data sources such as shown in the table below, would be useful to understand any impacts of the interventions on the diversity and abundances of the insectivores observed.


Insectivores: NBS & Comparative Data Sources

KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS			OTHER COMPARATIVE DATA SOURCES				OTHER VARIABLES
INSECTIVORE INCREASE	LAc1 & LAc2	New green cycle route & Green travel route				Local climate	Liverpool climate	Biobank/ Naturalist records		
	LAc8	Rain Garden (SUDs)	Upper SuDS	Lower SuDS	Upper Pitt St RG	Local climate	Liverpool climate	Biobank/ Naturalist records		
	LAc12	Pollinator Planting Spaces and Verges	POLL-A *6	POLL-C *8		Local climate	Liverpool climate	Biobank/ Naturalist records		
	LAc13	Pollinator walls/vertical	Parr St GW	St Johns GW	LE GW	Local climate	Liverpool climate	Biobank/ Naturalist records		
	LAc14	Pollinator roofs	Royal Court GR			Local climate	Liverpool climate	Biobank/ Naturalist records		
	LAc16	Floating gardens	SPL FI	Wapping FI		Local climate	Liverpool climate	Biobank/ Naturalist records		

As the number of insectivores observed, bats and dragonflies, varied greatly with seasonal and environmental conditions, further analyses would be helpful to distinguish patterns in the data.

Results were very variable, but positive changes with the project were seen where a pond habitat was added as for the Lower SuDs site and for the floating island habitat area in Sefton Park (for the bats).

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.19 CH0501 Deaths related to pollution and contamination

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0501	DEATHS RELATED TO POLLUTION AND CONTAMINATION	CFT
CITY	*RELATED NBS*	
LIV	All NBS	

2.19.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL

GI-VAL results:

CH0501: Deaths related to Pollution and Contamination	GI-VAL BENEFITS	Sub-Demo Areas			Overall Liverpool	BENEFIT QUANTIFICATION
Functions	Tools	A	B	C		
Provision of attractive opportunities for exercise	4.2 Reduced mortality from increased walking and cycling	0.81	0.88	26.31	26.50	lives saved per yr

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The closest indicator by the modelling analysis program GI-VAL demonstrates a reduced mortality from increased walking and cycling levels by 26.5% for overall Liverpool.

For further plots, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.19.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project. GI-VAL could not provide a precise indicator for this KPI.	Awareness of limitations of model
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
Positive change in the form of a reduced mortality resulting from increased exercise. This is used as an indicator for this KPI.
What was the impact? (positive/negative, significant/non-significant)?
Positive

2.19.3 Other comments

Optional: Any other relevant comments that you would like to include.

Unfortunately, the modelling software available could not provide a closer indicator for this KPI.

2.20 CH0502 Annual mean levels of fine PM2.5 particules

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0502	ANNUAL MEAN LEVELS OF FINE PM2.5 PARTICULES	CFT and LCC
CITY	*RELATED NBS*	
LIV	LAc1, LAc2, LAc4, LAc8, LAc12, LAc13, LAc14, LAc17	

2.20.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: Portable photometric sampler

MODELLING: GI-Val

Quantitative monitoring data results:

QUANTITATIVE DATA SUMMARY									
CH0502: PM 2.5									
Pre-Intervention				**Post-Intervention**				**% Change**	**Area**
n_obs	**n_sites**	**estimate**	**sd**	**n_obs**	**n_sites**	**estimate**	**sd**		
427	22	10.1	9.9	291	30	8.0	7.4	-20.6	**Overall Liverpool**
78	4	9.4	10.4	47	5	6.8	7.4	-28.2	**Sub-Demo A**
277	12	11.0	10.5	150	15	8.8	7.1	-20.7	**Sub-Demo B**
42	3	8.1	5.7	24	3	5.3	3.0	-35.0	**Sub-Demo C**

QUANTITATIVE DATA SUMMARY		
CH0502: PM 2.5		
NBS	**NBS Name**	**% Change**

LAc4	Urban catchment forestry	-49.3
LAc8	SuDs & Rain Garden	-62.6
LAc12	Pollinator verges and spaces	9.0
LAc13	Pollinator walls/vertical	-7.4
LAc14	Pollinator roofs	-57.3
LAc17	Green filter area	-13.8

QUANTITATIVE DATA SUMMARY										
CH0502: PM 2.5		Pre-Intervention				Post-Intervention				% Change
NBS	inter_code	n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd	
LAc4	Strand Tree SuDS	110	4	11.7	13.1	40	4	6.0	6.1	-49.3
LAc8	Upper Pitt St RG	30	2	9.9	13.9	2	2	2.0	0.0	-79.8
LAc8	Upper SuDS	18	2	9.2	5.5	22	2	5.0	3.0	-45.3
LAc12	Bott SP Aig Dr POLL	24	1	7.3	5.9	2	1	8.0	2.8	9.1
LAc12	Cornwallis St POLL	33	1	8.3	7.7	3	1	9.0	5.6	8.8
LAc13	L1 GW	30	3	5.3	2.8	70	7	8.1	8.7	52.0
LAc13	Parr St GW	15	1	11.0	7.1	42	2	6.8	7.6	-37.9
LAc13	St Johns GW	29	2	15.6	8.5	47	5	9.9	6.8	-36.3
LAc14	Royal Court GR	2	1	26.0	8.5	35	1	11.1	7.5	-57.3
LAc17	Lime St TREES	86	3	10.0	8.3	10	3	6.8	7.2	-31.9
LAc17	Stafford St TREES	50	2	8.1	6.5	18	2	8.4	7.5	4.3

GI-VAL results:

CH0502: PM2.5 trends: GI-VAL BENEFITS	Sub-Demo Areas			Overall Liverpool	BENEFIT QUANTIFICATION
Tools	A	B	C		
4.6 Reduced air pollution	0.0004	0.0017	0.0003	0.0000	t/yr of PM2.5 removed

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

For intervention site names used for the quantitative data monitoring, see table below.

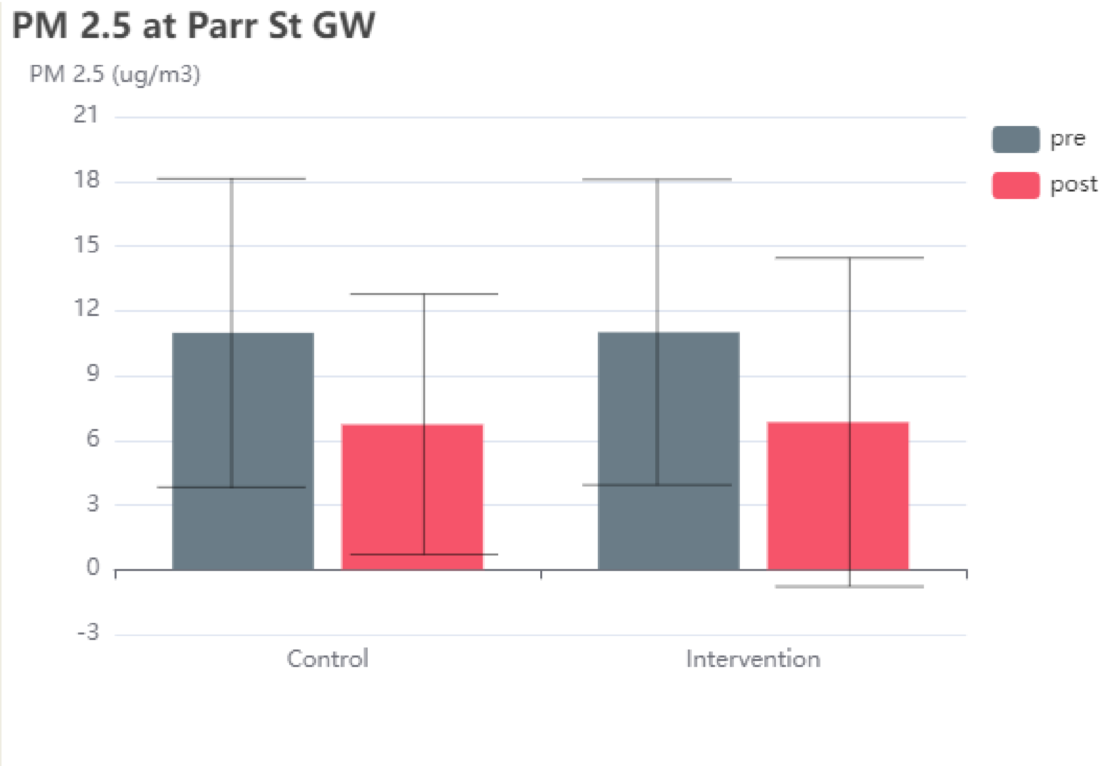
FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0502	ANNUAL MEAN LEVELS OF FINE PM2.5 PARTICULES	LAc1	New green cycle route	ALL	ALL	ALL
		LAc2	Green travel route	ALL	ALL	ALL
		LAc4	Urban Catchment forestry		Strand Tree SuDS	
		LAc8	Rain Garden (SUDs)	Upper Pitt St RG		
		LAc12	Pollinator Planting Spaces and Verges	Baltic Green Route POLL, Cornwallis St POLL, Pitt St POLL, Park Lane POLL, Baltic Hub POLL, Strand POLL, Wapping POLL		Princes Av POLL, Princes roundabt POLL, Ullet Rd POLL, Top SP Aig Dr POLL, Top SP roundabt POLL, Bott SP Aig Dr POLL, Upper SuDS POLL, Lower SuDS POLL
		LAc13	Pollinator walls/vertical	Parr St GW	St Johns GW, L1GW	
		LAc14	Pollinator roofs		RoyaL Court GR	
		LAc17	Green filter area with large urban trees		Green_Filter_TREES	

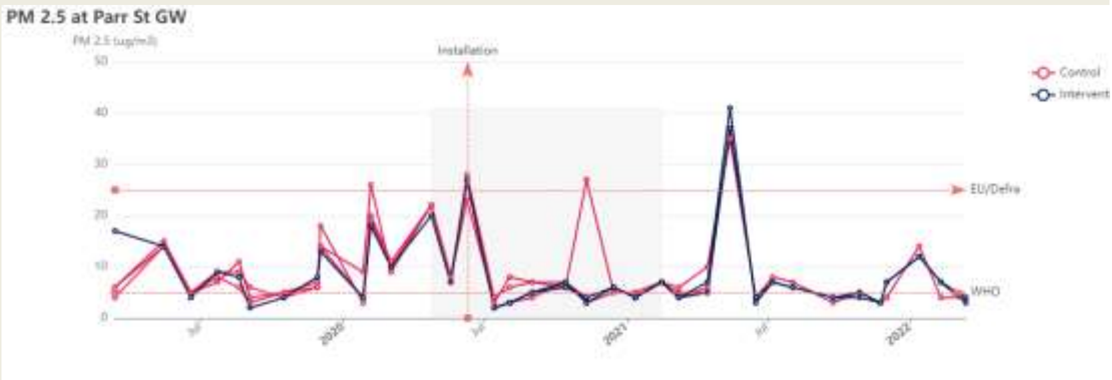
Map of monitoring locations

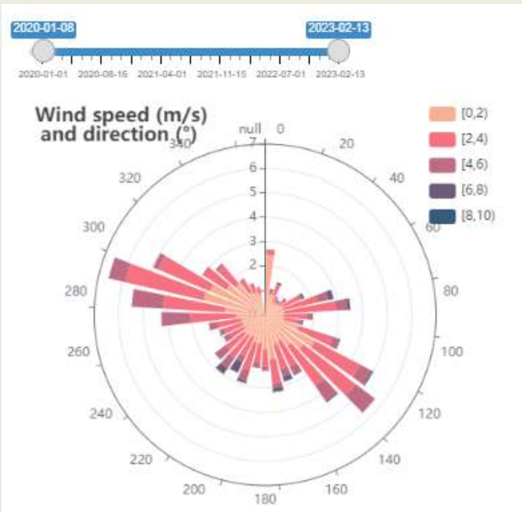
Equipment and methodology:

Summary plot example: Vertical green wall:

Box plots showing pre and post intervention at wall and control sites; Time-line showing installation of green wall (shading showing covid lockdown period); wind rose showing wind direction and speeds over the monitoring period.

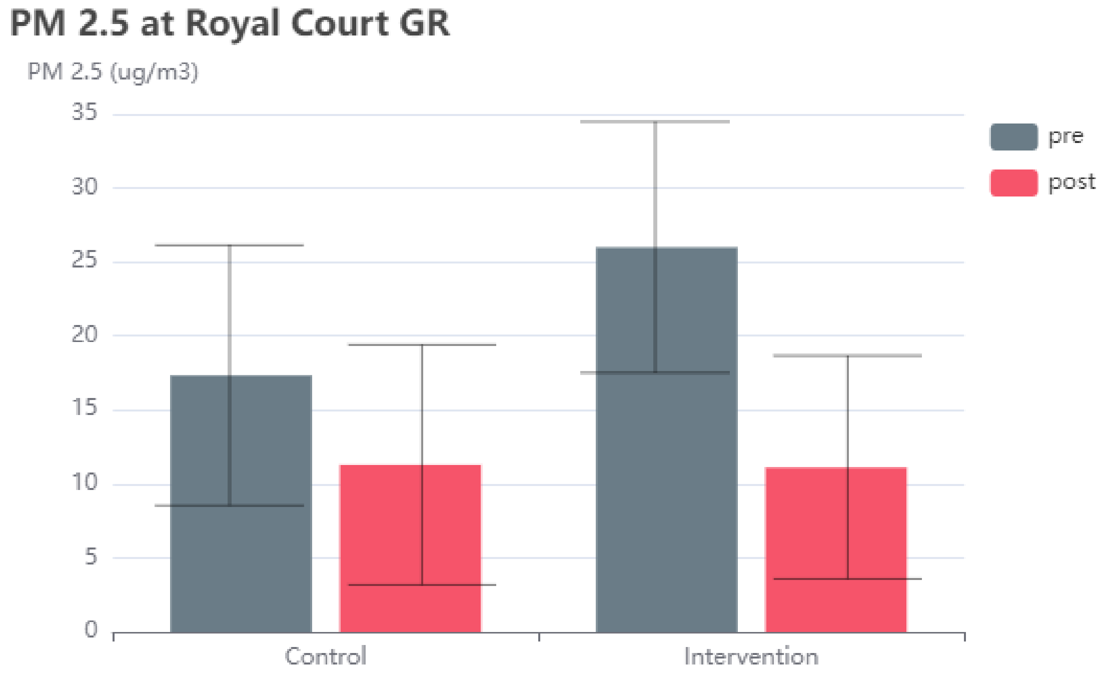

PM 2.5 at Parr St GW
PM 2.5 (ug/m3)
21
18
15
12
9
6
3
0
-3
pre
post
Control
Intervention

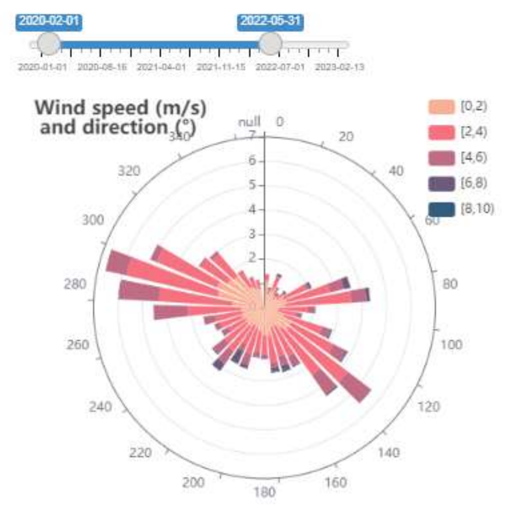

PM 2.5 at Parr St GW
Installation
EU/Defra
WHO
Control


2020-01-08
2023-02-13
Wind speed (m/s)
and direction (°)
[0,2)
[2,4)
[4,6)
[6,8)
[8,10)

Summary plot example: Pollinator roof at Royal Court:

Box plots showing pre and post intervention at wall and control sites; Time-line showing installation of green wall (shading showing covid lockdown period); wind rose showing wind direction and speeds over the relevant monitoring period.





These example summary plots show a reduction in the PM2.5 values with the installation of the interventions for both the green wall and the pollinator roof. These are as reflected in the data summary tables for these interventions (-7% and -57% respectively).

The overall data summary for the quantitative data showed clear reductions in PM2.5 particulate pollution throughout all areas of Liverpool, in particular within sub demo C at -35%. This was followed by sub demo A at -28% and sub demo B at -20%. Over all Liverpool, the change was calculated to be -20%.

When the effect of interventions were considered, the SuDs and rain garden surprisingly showed high reductions (-63%), but pollinator roofs (-57%) and the urban catchment Strand trees (-49%) were also important. The green filter trees (-14%) vertical green walls (-7%) were also important, but the pollinator verges and spaces actually showed a slight increase in pollution overall at 9%. From a further detailed comparison, the rain garden in the Baltic showed a high decrease in particulate matter at -80% change, but this was based on a low number of observations so may have been due to other external factors. The upper SuDs water retention pond also, though, showed decreased levels of particulate pollution after the interventions at -45%. The green walls varied in effectiveness as the Liverpool One green wall showed an increase (52%), but the Parr Street and St Johns green walls demonstrated decreased changes (-38% and -36% respectively). The Royal Court green roof showed a high decrease in pollution observed at -57%. Trees acting as green filters were important particularly on Lime Street (-32%), but Stafford trees were not as effective and even showed an increase of 4%. It would be interesting to see the progression as the tree canopies expand and mature.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The GI-VAL analyses showed the interventions within sub demo B reduced the PM2.5 particulate pollution the most (0.0017 t/yr), followed by sub demo A (0.0004 t/yr) then negligible results for sub demo C and overall Liverpool.

Overall, the results for the KPI monitoring and modelling demonstrated a reduction in PM2.5 particulate air pollutants.

For further plots, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.20.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
The particulate pollution was found to be enormously impacted by if the wind direction was from nearby industries, so the wind speed and direction had to be considered. Dust and debris from adjacent may have impacted on the monitoring results. Covid lockdowns had impact on behaviour but not so much on particulate pollution	Local climate recorded and awareness of limitations of data emphasized. Awareness of limitations of sampling methodology and timings of works. Awareness of timings of Covid lockdowns.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further data analyses with comparative data sources (see table below) such as wind direction would further understanding of the impact of the interventions, but the main indications from the data demonstrate reductions in PM2.5 from both the site monitoring and modelling.

KPI NAME	NBS Ref No.	NBS NAME	OTHER POSSIBLE COMPARATIVE DATA SOURCES			OTHER VARIABLES
ANNUAL MEAN LEVELS OF FINE PM2.5 PARTICULES	LAc1	New green cycle route	Local climate	Liverpool climate		COVID lockdown
	LAc2	Green travel route	Local climate	Liverpool climate		COVID lockdown
	LAc4	Urban Catchment forestry	Local climate	Liverpool climate		COVID lockdown
	LAc8	Rain Garden (SUDs)	Local climate	Liverpool climate	Detectronic Flow meter	COVID lockdown
	LAc12	Pollinator Planting Spaces and Verges	Local climate	Liverpool climate		COVID lockdown
	LAc13	Pollinator walls/vertical	Local climate	Liverpool climate		COVID lockdown
	LAc14	Pollinator roofs	Local climate	Liverpool climate		COVID lockdown
	LAc17	Green filter area with large urban trees	Local climate	Liverpool climate		COVID lockdown

Positive impact overall areas and over most interventions in reducing the air pollutant PM2.5

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.21 CH0503 Annual mean levels of fine PM10 particules

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0503	ANNUAL MEAN LEVELS OF FINE PM10 PARTICULES	CFT and LCC
CITY	*RELATED NBS*	
LIV	LAc1, LAc2, LAc4, LAc8, LAc12, LAc13, LAc14, LAc17	

2.21.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: Portable photometric sampler

Quantitative monitoring data results:

QUANTITATIVE DATA SUMMARY									
CH0503: PM 10									
Pre-Intervention				**Post-Intervention**				**% Change**	**Area**
n_obs	**n_sites**	**estimate**	**sd**	**n_obs**	**n_sites**	**estimate**	**sd**		
427	22	17.7	12.1	291	30	15.8	10.5	-11.0	**Overall Liverpool**
78	4	16.3	12.0	47	5	12.8	7.5	-21.6	**Sub-Demo A**
277	12	18.9	12.9	150	15	16.7	11.1	-11.9	**Sub-Demo B**
42	3	15.8	7.8	24	3	14.2	7.8	-9.9	**Sub-Demo C**

QUANTITATIVE DATA SUMMARY		
CH0503: PM 10		
NBS	**NBS Name**	**% Change**
LAc4	Urban catchment forestry	-36.7
LAc8	SuDs & Rain Garden	-27.7
LAc12	Pollinator verges and spaces	32.8
LAc13	Pollinator walls/vertical	-14.1
LAc14	Pollinator roofs	-49.3
LAc17	Green filter area	30.2

QUANTITATIVE DATA SUMMARY										
CH0503: PM 10		Pre-Intervention				Post-Intervention				% Change
NBS	inter_code	n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd	
LAc4	Strand Tree SuDS	110	4	19.6	14.5	40	4	12.4	9.5	-36.7
LAc8	Upper Pitt St RG	30	2	16.7	15.8	2	2	10.5	0.7	-37.1
LAc8	Upper SuDS	18	2	16.8	5.9	22	2	13.7	7.7	-18.2
LAc12	Bott SP Aig Dr POLL	24	1	15.0	9.0	2	1	19.5	9.2	30.0
LAc12	Cornwallis St POLL	33	1	14.8	8.8	3	1	20.0	7.0	35.5
LAc13	L1 GW	30	3	13.0	6.8	70	7	16.4	11.2	26.0
LAc13	Parr St GW	15	1	19.0	9.1	42	2	12.4	7.5	-34.8
LAc13	St Johns GW	29	2	24.0	11.7	47	5	16.0	8.6	-33.5
LAc14	Royal Court GR	2	1	37.5	7.8	35	1	19.0	8.9	-49.3
LAc17	Lime St TREES	86	3	18.6	12.8	10	3	21.7	15.8	16.7
LAc17	Stafford St TREES	50	2	14.5	7.4	18	2	20.8	17.4	43.7

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

For intervention site names, see table below.

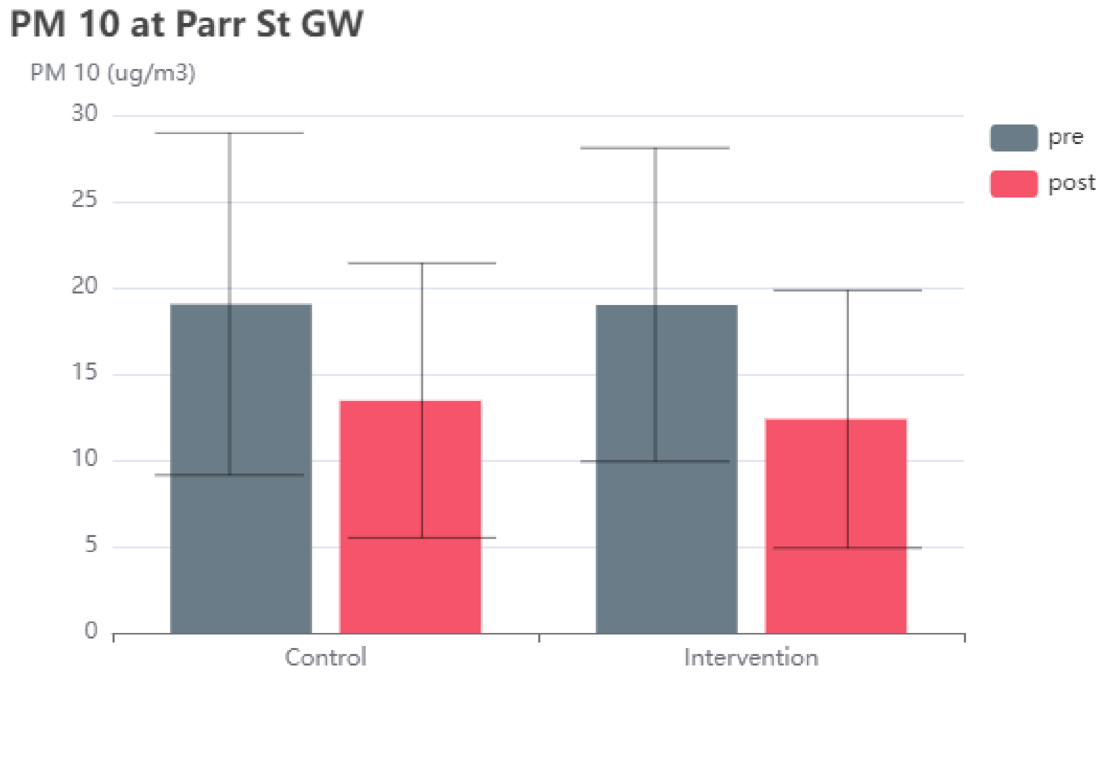
FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0503	ANNUAL MEAN LEVELS OF FINE PM10 PARTICULES	LAc1	New green cycle route	ALL	ALL	ALL
		LAc2	Green travel route	ALL	ALL	ALL
		LAc4	Urban Catchment forestry		Strand Tree SuDS	
		LAc8	Rain Garden (SUDs)	Upper Pitt St RG		
		LAc12	Pollinator Planting Spaces and Verges	Baltic Green Route POLL, Cornwallis St POLL, Pitt St POLL, Park Lane POLL, Baltic Hub POLL, Strand POLL, Wapping POLL		Princes Av POLL, Princes roundabt POLL, Ullet Rd POLL, Top SP Aig Dr POLL, Top SP roundabt POLL, Bott SP Aig Dr POLL, Upper SuDS POLL, Lower SuDS POLL
		LAc13	Pollinator walls/vertical	Parr St GW	St Johns GW, L1GW	
		LAc14	Pollinator roofs		RoyaL Court GR	
		LAc17	Green filter area with large urban trees		Green_Filter_TREES	

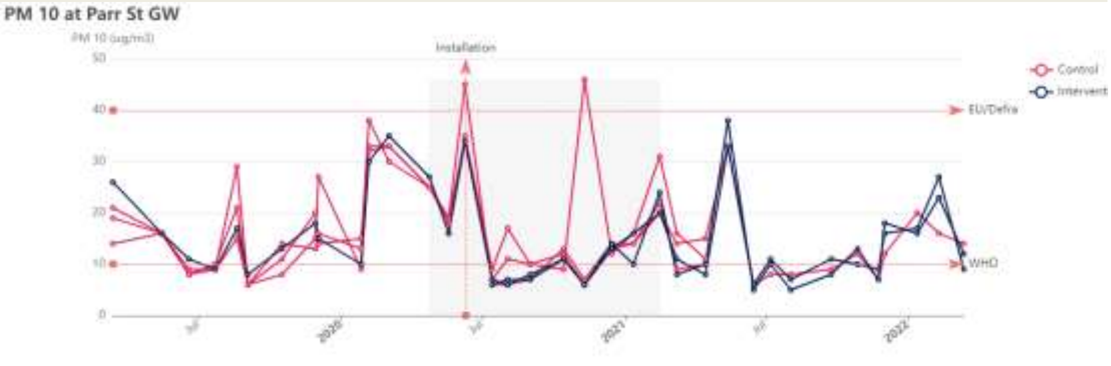
Map of monitoring locations: See CH0502

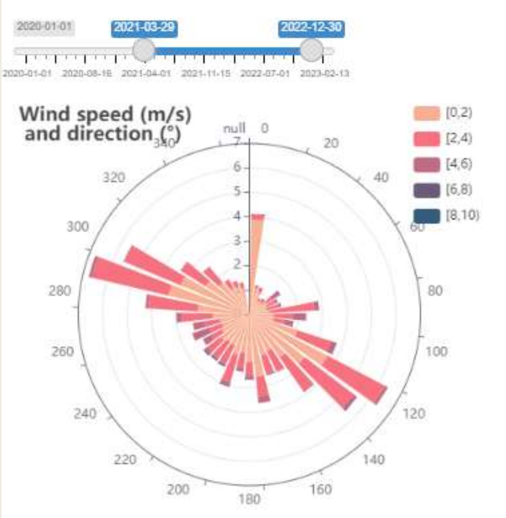
Equipment and methodology: See CH0502

Summary plot example: Vertical green wall:

Box plots showing pre and post intervention at wall and control sites; Timeline showing installation of green wall (shading showing covid lockdown period); wind rose showing wind direction and speeds over the monitoring period post intervention installation:

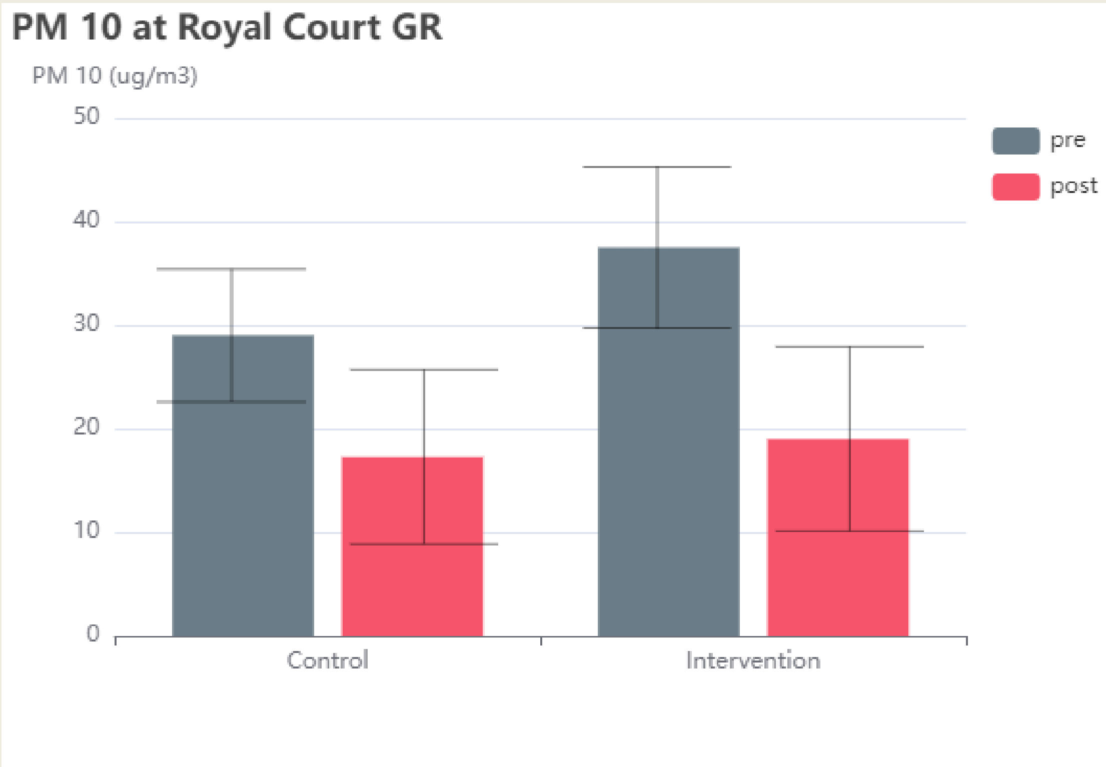


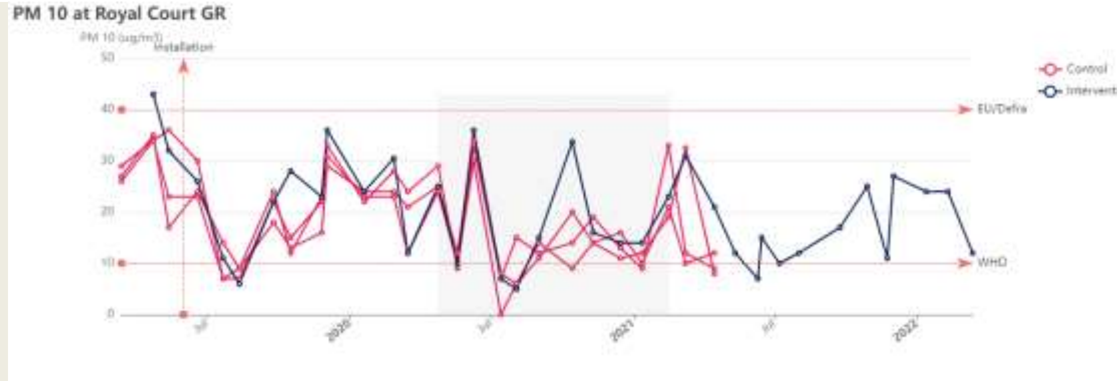


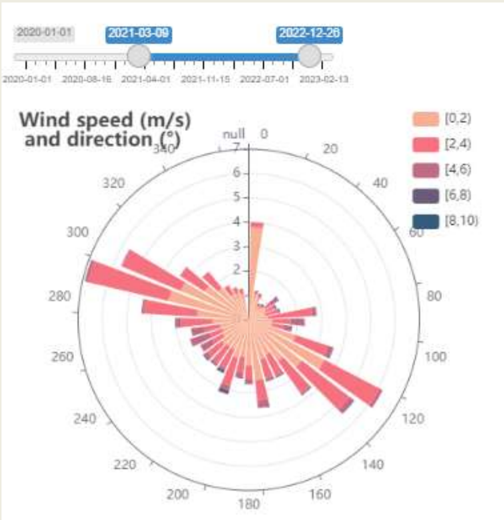


<u>Summary plot example: Pollinator roof at Royal Court:</u>

Box plots showing pre and post intervention at wall and control sites; Timeline showing installation of green wall (shading showing covid lockdown period); wind rose showing wind direction and speeds over the relevant monitoring period.







The overall data summary table for the quantitative data shows an overall decrease of PM10 particulate pollution of the duration of the Urban GreenUP project, particularly for Sub demo A at -21.6%. Sub demo B was found to be -11.9% and sub demo C was -9.9%. Overall Liverpool showed a -11% change in PM10 particulate pollution.

From the separation of the interventions, pollinator roof was found to be really important for this category at -49% reduction (see example plots), followed by the Strand tree SuDs at -37% (urban catchment forestry. The Suds and rain garden also demonstrated an important reduction at -28% change. The green walls had a better impact than for the PM2.5 particulates (see CH0502) but together were not so important a reduction (-14%) as other interventions. Both the pollinator verge planting (33%) and green filter trees (30% change throughout the Liverpool sites) showed an increase in PM10 pollutants after the interventions were introduced. Further analyses of the data with comparative data would be best to understand these increases.

When individual intervention sites were analysed, the Royal court green roof was the highest reduction at -49%. The Baltic rain garden in Upper Pitt Street showed a better reduction than the upper SuDS water retention pond site (-37% and -18% respectively). The Strand tree SuDs or urban catchment forestry showed a reduction (-37%) when the green filter tree sites, 'Lime St TREES' and 'Stafford St TREES' (17% and 44%) demonstrated an increase in pollution. Both pollinator sites in the analysis showed an increase in pollution as well for this factor (Bott SP Aig Dr POLL and Cornwallis St POLL at 30% and 36% respectively). For the green walls, the

Liverpool One green wall showed an increase (as for PM2.5) of 26%, but the Parr St and St Johns green walls demonstrated a reduction (see example plot) of both -34%.

Except for some pollinator planting and green filter trees, overall all areas and overall Liverpool there was found to be a reduction in PM10 particulate pollution over the duration of the Urban GreenUP project.

For further plots, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.21.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

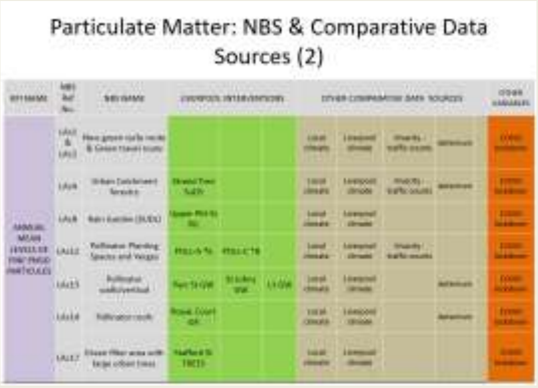
Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
Dust and debris from adjacent works and Covid lockdowns may have impacted on the monitoring results. The particulate pollution was found to be enormously impacted by if the wind direction	Awareness of limitations of sampling methodology and covid lockdown periods. Awareness of need to run analyses with wind speed and direction.

was from nearby industries, so the wind speed and direction had to be considered.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further data comparations with comparative data sources (as shown in table below) would increase understanding of the impact of the interventions on this pollutant. Many increases in pollution may also be caused by nearby work dust, proximity to nearby roads with increased vehicular traffic levels, so further analyses would be useful to carry out.


Particulate Matter: NBS & Comparative Data Sources (2)

For the overall data summary for the sub demo areas and for Liverpool as a whole, a reduction in PM10 pollutants were observed, so a positive change over the course of the Urban GreenUP project.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.22 CH0504 NOx trends

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0504	NOx TRENDS	CFT and LCC
CITY	*RELATED NBS*	
LIV	LAc1, LAc2, LAc4, LAc12, LAc13, LAc14, LAc17	

2.22.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: Diffusion tube data

MODELLING: GI-Val

Quantitative monitoring data results:

QUANTITATIVE DATA SUMMARY									
CH0504: NO2									
Pre-Intervention				Post-Intervention				% Change	Area
n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd		
782	31	35.9	11.7	420	30	30.5	9.6	-15.2	**Overall Liverpool**
85	5	30.6	6.8	112	5	25.6	5.0	-16.3	**Sub-Demo A**
289	11	44.1	11.6	143	10	36.4	10.6	-17.5	**Sub-Demo B**
319	12	29.2	7.9	148	12	27.4	7.6	-6.1	**Sub-Demo C**

QUANTITATIVE DATA SUMMARY		
CH0504: NO2		
NBS	**NBS Name**	**% Change**
LAc4	Urban catchment forestry	-13.7
LAc8	SuDs & Rain Garden	-19.8
LAc12	Pollinator verges and spaces	-7.9
LAc13	Pollinator walls/vertical	-10.6
LAc14	Pollinator roofs	-26.2
LAc17	Green filter area	-9.7

QUANTITATIVE DATA SUMMARY										
CH0504: NO2		Pre-Intervention				Post-Intervention				% Change
NBS	inter_code	n_obs	n_sites	estimate	sd	n_obs	n_sites	estimate	sd	

LAc4	Strand Tree SuDS	87	4	40.1	9.3	57	4	34.6	8.7	-13.7
LAc8	Upper SuDS	29	2	39.3	11.9	44	2	31.5	9.2	-19.8
LAc1 2	Top SP Aig Dr POLL	101	3	29.1	5.6	20	3	26.5	5.8	-8.7
LAc1 2	Top SP roundabt POLL	34	1	23.0	5.7	7	1	21.7	5.7	-5.9
LAc1 2	Ullet Rd POLL	105	4	26.6	6.5	57	4	24.2	5.9	-9.1
LAc1 2	Bott SP Aig Dr POLL	50	2	33.3	5.9	20	2	30.7	4.0	-8.0
LAc1 3	Parr St GW	85	5	30.6	6.8	112	5	25.6	5.0	-16.3
LAc1 3	St Johns GW	29	2	39.0	12.9	36	2	32.7	11.2	-16.2
LAc1 3	L1 GW	89	3	38.8	8.7	17	3	39.1	8.3	0.7
LAc1 4	Royal Court GR	4	1	54.7	8.0	32	1	40.4	12.3	-26.2
LAc1 7	Lime St TREES	169	6	46.7	11.7	18	5	42.2	7.7	-9.7

GI-VAL results:

CH0504: NO2 trends: GI-VAL BENEFITS	**Sub-Demo Areas**			**Overall Liverpool**	**BENEFIT QUANTIFICATION**
Tools	**A**	**B**	**C**		
4.6 Reduced air pollution	0.0001	0.0006	0.0001	0.0008	t/yr of NO2 removed

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The GI-VAL analyses indicated that the interventions overall Liverpool reduced the air pollutant NO2 the most at 0.0008t/yr, with sub demo B showing the most reduced levels of NO2 (0.0006 t/yr) out of the sub demo areas.

For intervention site names used in the quantitative data, see table below.

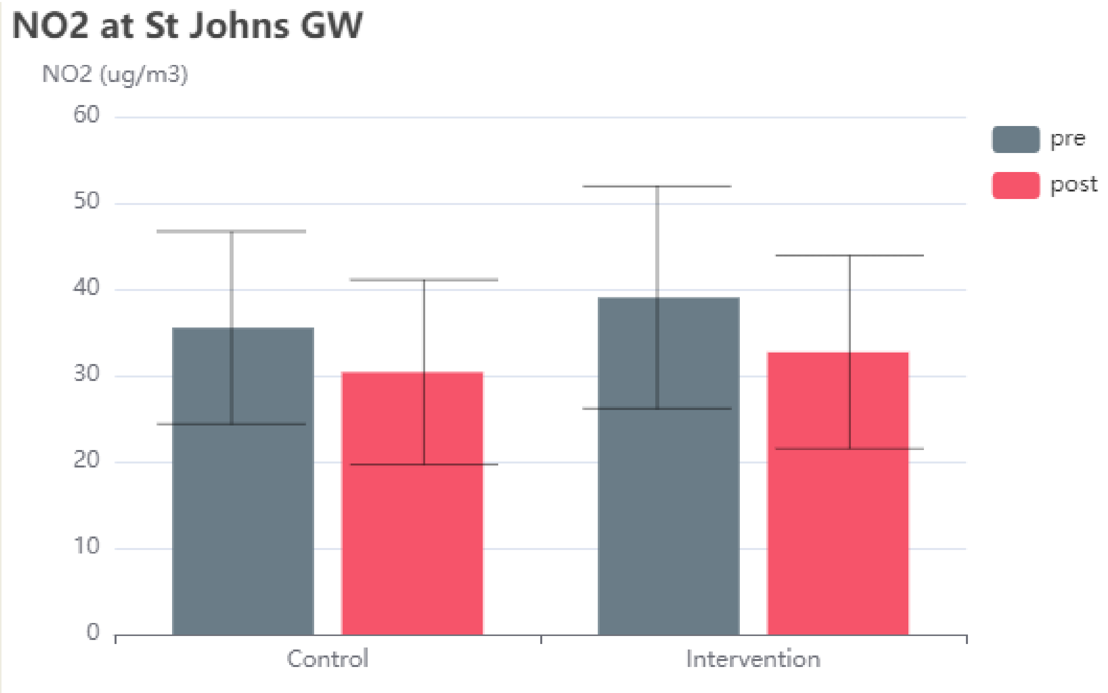
FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0504	NOx TRENDS	LAc1	New green cycle route	ALL	ALL	ALL
		LAc2	Green travel route	ALL	ALL	ALL
		LAc4	Urban Catchment forestry		Strand Tree SuDS	
		LAc12	Pollinator Planting Spaces and Verges	Baltic Green Route POLL, Cornwallis St POLL, Pitt St POLL, Park Lane POLL, Baltic Hub POLL, Strand POLL, Wapping POLL		Princes Av POLL, Princes roundabt POLL, Ullet Rd POLL, Top SP Aig Dr POLL, Top SP roundabt POLL, Bott SP Aig Dr POLL, Upper SuDS POLL, Lower SuDS POLL
		LAc13	Pollinator walls/vertical	Parr St GW	St Johns GW, L1 GW	
		LAc14	Pollinator roofs		RoyaL Court GR	
		LAc17	Green filter area with large urban trees		Green_Filter_TREES	

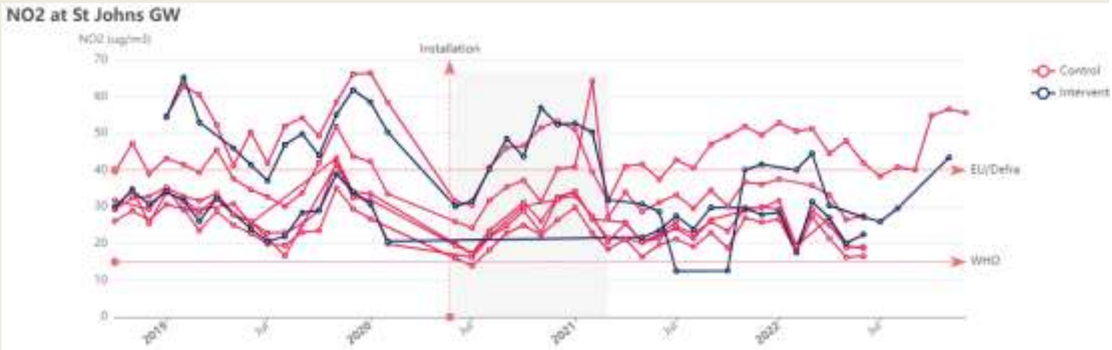
Map of monitoring locations: See CH0502

Equipment and methodology:

<u>Summary plot example: St Johns Green wall</u>

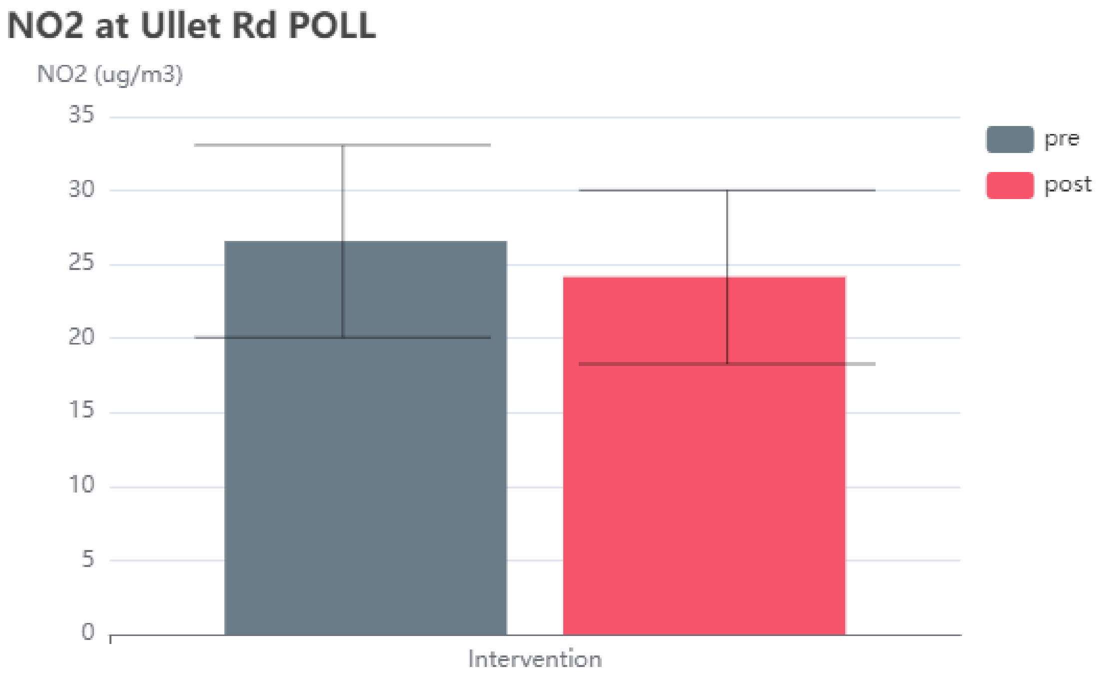
Box plots showing pre and post intervention at wall and control sites; Timeline showing installation of green wall (shading showing covid lockdown period);

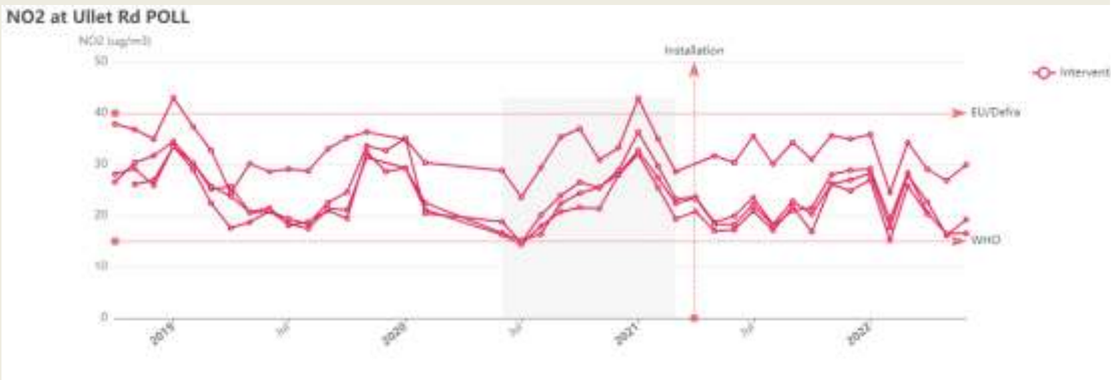




<u>Summary plot example: Ullet road pollinator and tree planting site</u>

Box plots showing pre and post intervention at wall and control sites; Time-line showing installation of green wall (shading showing covid lockdown period);





The overall data summary showed a reduction in Nitrogen dioxide (NO2) over the duration of the Urban GreenUP project, particularly for sub demos A and B (116.5% and -17.5% respectively). Overall Liverpool showed a -15.2% change in NO2 levels.

With respect to interventions, pollinator roof was most important (-26%) followed by the Suds and rain garden (-19.8% overall), in this case the Upper SuDs site in sub demo C (-20%). The Urban catchment forestry site (Strand tree SuDs at -13.7%), and green walls (-10.6%) also showed important reductions. An example plot is shown for the St Johns green wall site. The Green filter area trees (on Lime Street) and the pollinator verges also demonstrated reductions in Nitrogen dioxide (-9.7% and -7.9% respectively).

A further detailed comparison of the intervention sites within the data summaries showed within the pollinator verge sites that the Aigburth Drive plantings at the top and base of Sefton Park demonstrated -9% and -8% reductions respectively, but that the Ullet road planting (Ullet Rd POLL) had the most effect at -9% (see plot shown). The smallest reduction was for the roundabout at the top of Sefton Park at -6%. These planting areas comprised tree planting in addition to wildflower planting, which may have affected the reduction of this pollutant. For the green wall sites, the Liverpool One site showed a small increase of NO2 at 1%, but both the Parr Street and St Johns green walls showed -16% change in NO2 levels.

Overall reductions in NO2 were observed and calculated for all intervention sites, all areas and overall Liverpool.

For further plots, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.22.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

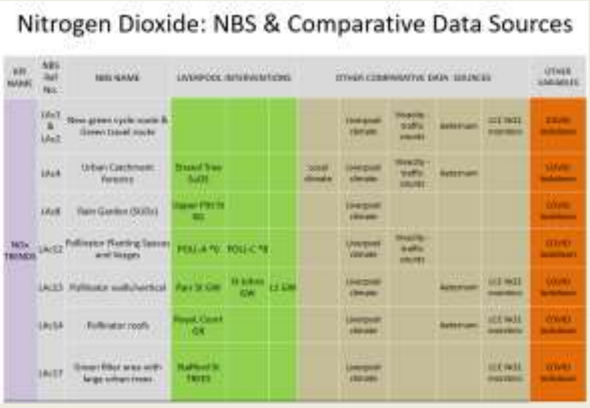
Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
Some, due to lab shutdown in Covid lockdown.	Awareness of data limitations

Covid Lockdowns also caused changes in travel behaviour, so may have impacted on the amount of pollutant recorded.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further data comparations with comparative data sources (as in table below) would further understanding of the actual impact of the interventions on this pollutant.



Positive NO2 reductions over all Liverpool and particularly for sub demos A and B were shown for both the data summaries and modelled GI-VAL data.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.23 CH0505 SOx trends

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0505	Sox TRENDS	CFT and LCC
CITY	*RELATED NBS*	
LIV	LAc1, LAc2, LAc17	

2.23.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: Diffusion tube data [STOPPED EARLY]: Advised to stop data collection due to negligible results

MODELLING: GI-Val

GI-VAL results:

CH0505: SO_2 trends: GI-VAL BENEFITS	Sub-Demo Areas			Overall Liverpool	BENEFIT QUANTIFICATION
Tools	A	B	C		
4.6 Reduced air pollution	0.0000	0.0001	0.0000	0.0001	t/yr of SO_2 removed

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

GI-Val results showed that the interventions had an overall reduction of SO_2 pollution, particularly in Sub demo B at 0.0001 t/yr

The quantitative data showed very low results for Sulphur dioxide, so monitoring stopped very early on in the project.

For further plots, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.23.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or	Awareness of limitations of model

encourage, depending upon the type of project.	
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
None	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Very little quantitative data were available due to being advised to stop early. Data collection stopped well before any interventions were installed.

SO2 reduction shown by GI-VAL for all the interventions over all Liverpool and for sub demo B.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.24 CH0508 Run-off mitigation/ mitigation through cooling and sequestration

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0508	RUN-OFF MITIGATION/ MITIGATION THROUGH COOLING AND SEQUESTRATION	CFT with LJMU
CITY	*RELATED NBS*	

LIV	All NBS

2.24.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL

N-Crat model not possible/inconclusive

GI-VAL results:

CH0508: Mitigation through cooling and sequestration	**GI-VAL BENEFITS**		**Sub-Demo Areas**			**Overall Liverpool**	
Functions	**Tools**	**GVA value**	**A**	**B**	**C**		**BENEFIT MONETISATION**
Shelter from wind	1.1 Reduced building energy consumption for heating	**GVA value**	15049.7	0.0	0.0	0.0	£
Cooling through shading and evapo-transpiration	1.5 Reduced building energy consumption for cooling	**GVA value**	211.6	670.7	0.0	882.4	£
		Total Climate Change benefit monetisation:	15261.3	670.7	0.0	**882.4**	£

CH0508: Mitigation through cooling and sequestration	**GI-VAL BENEFITS**		**Sub-Demo Areas**			**Overall Liverpool**	
Functions	**Tools**	**Other economic value**	**A**	**B**	**C**		**BENEFIT MONETISATION**
Shelter from wind	1.2 Avoided carbon emissions from building energy saving for heating	**Other economic value**	255.7	0.0	0.0	0.0	£

Cooling through shading and evapo-transpiration	1.6 Avoided carbon emissions from building energy saving for cooling	**Other economic value**	6.1	19.3	0.0	25.4	£
Carbon storage and sequestration	1.7 Carbon sequestered by trees	**Other economic value**	164.6	632.0	115.4	942.5	£
Carbon storage and sequestration	1.8 Carbon sequestered through other land use change	**Other economic value**	7207.6	7207.6	33389.2	33389.2	£
		Total Climate Change benefit monetisation :	7634.0	7858.9	33504.6	**34357.1**	£

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project. Non- significant values were obtained for benefit monetisations for avoiding damage from wind and storms, reduction of urban heat island effect. Some output could only be gained for one of GVA value or 'Other Economic value'. The simplified table is as shown above.

The GI-VAL analyses for the impact of the interventions found positive Climate change benefit monetisations throughout where analyses were possible: a total of £882 'GVA' and £34357 'other economic value' for overall Liverpool. Sub demo A produced the highest GVA value benefit for reduced building energy consumption for heating (£15050), but sub demo C produced the highest benefit for the 'other economic value' factor 'carbon sequestered through other land use change' at £33389. Overall Liverpool showed the highest benefit amount for Carbon sequestered by trees at £943.

The factor 'Shelter from the wind' assessing reduced building and carbon emissions for heating consumption was best for Sub demo A at £256, but in terms of cooling energy consumption, sub demo B and overall Liverpool were the most important (£19.3 and £25 respectively). In terms of sub demo areas, for carbon sequestration by trees, sub demo B interventions had the most impact at £632 (also see CH0104 Carbon sequestration), but in terms of other land use change, carbon sequestration savings were most important for sub demo C (and overall Liverpool) at £33389.

For further plots, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.24.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project. N-Crat modelling software was found to produce inconclusive results for the scale of interventions	Awareness of limitations of models
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Positive effect of all interventions in all sub demo areas and overall Liverpool were found for the Climate Change benefit monetisations.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.25 CH0509 Energy savings

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0509	ENERGY SAVINGS	CFT with LJMU
CITY	*RELATED NBS*	
LIV	All NBS	

2.25.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL

Also see data in CH0508-Mitigation through cooling and sequestration

GI-VAL results:

CH0509: Energy Savings: GI-VAL BENEFITS		**Sub-Demo Areas**			**Overall Liverpool**	
Tools	**GVA value**	**A**	**B**	**C**		**BENEFIT MONETISATION**
7.3 Savings from reduced absenteeism from work	**GVA value**	199686.8	199686.8	56713.1	56713.1	£

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

GI-VAL analyses show high GVA values for all sub demo areas and overall Liverpool, particularly for sub demo A and B areas (£199686.8 and £199686.8 respectively), for savings from reduced absenteeism from work. Other positive monetised benefits can be seen in CH0508.

For further plots, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.25.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Positive monetisation benefits can be seen for all areas with GI-VAL.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.26 CH0510 Increase in property value

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0510	INCREASE IN PROPERTY VALUE	UOL/UOM
CITY	*RELATED NBS*	
LIV	All NBS	

2.26.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL

SOCIO-ECONOMIC : Data in CH1004-Land and Property price change.

GI-VAL results:

CH0510: Increase in property value	GI-VAL BENEFITS		Sub-Demo Areas			Overall Liverpool	
Functions	Tools	Other economic value	A	B	C		BENEFIT MONETISATION
Catalyst for community cohesion and pride	3.1 Willingness to pay for a view of urban green space	Other economic value	426551.2	1258325.9	1389427.7	1024768.2	£
Catalyst for community cohesion and pride	3.2 Increase in volunteering	Other economic value	n.a.	n.a.	n.a.	n.a.	£

	GI-VAL BENEFITS	**Total Place & Communities benefit monetisation**	426551.2	1258325.9	1389427.7	**1024768.2**	£
Setting for higher value residential and commercial properties	5.1 Residential land and property values uplift	**Land and property value**	10647693.3	19492758.4	10565155.7	12236330.1	£
Land management	11.2 Employment supported by land management	**Land and property value**	n.a.	n.a.	n.a.	n.a.	£

Socio-economic data: please see report 3 (SE-REPORT_3_WP5-KPI CH1004_Housing_prices_NBS-Report) and see CH1004.

House Prices	Otterspool	Sefton Park	Baltic Triangle
2008 (baseline average price)	£215,053.57	£155,730.86	£163,713.17
2019 (pre-installation) reported crimes	£230,229.13	£218,412.50	£130,652.08
2020 (post-installation) reported crimes	£248429.67	£223,722.25	£139,276.29
% change (2019-2020)	+7.9%	+7.0%	+6.8%
% change 2008-2020	+15.5%	+50%	-15%

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The GI-VAL modelling produced positive monetary benefits for all areas for a willingness to pay for a view of urban green space (sub demo C the most important at £1389427.7), and land and property value increases for residential land (sub demo B the most important at £19492758.4).

Socio-economic data: please see report 3 (SE-REPORT_3_WP5-KPI CH1004_Housing_prices_NBS-Report).

For further plots, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.26.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project. Land values unable to be accessed in the same way as property value/ sales.	Awareness of limitation of model Awareness of limitations of data available
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

A positive monetized benefit of all the interventions added to each area was calculated using GI-VAL.

Socio-economic data: please see report 3 (SE-REPORT_3_WP5-KPI CH1004_Housing_prices_NBS-Report) and see CH1004. This report found that it is not possible for demonstrate that the Urban GreenUP interventions led to any increases in property prices.

Hence the KPI can only have an inconclusive result.

What was the impact? (positive/negative, significant/non-significant)?

Inconclusive

2.27 CH0511 Value of air quality improvements

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0511	(GI VAL TO CALCULATE THE) VALUE OF AIR QUALITY IMPROVEMENTS	CFT with LJMU
CITY	*RELATED NBS*	
LIV	All NBS	

2.27.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: EcoServR, GI-VAL;

Also refer to CH0513-Total monetary value of urban forests including air quality

N-Crat model not possible/inconclusive

EcoServR results:

EcoServR: CH0511: Air quality improvements		**% Change**
sub demo A	Air.purification	3.1
sub demo B	Air.purification	1.6
sub demo C	Air.purification	-0.1
Overall Liverpool	Air.purification	0.0

EcoServR: CH0511: Air quality improvements		
NBS	**NBS Name**	**% Change**
lac4	Urban catchment forestry	

lac5	shade trees	1.4
lac6	cooling trees	8.4
lac8	SuDs & Rain Garden	-1.6
lac12	Pollinator verges and spaces	10.5
lac13	Pollinator walls/vertical	15.0
lac14	Pollinator roofs	31.2
lac16	Floating gardens	12175.5
lac17	Green filter area	16.3

EcoServR: CH0511: Air quality improvements		
Pollinator walls/vertical	**radius (m)**	**% Change**
L1 GW	20	0.0
Parr St GW	20	
St Johns GW	20	
L1 GW	100	0.0
Parr St GW	100	5.5
St Johns GW	100	54.5

EcoServR: CH0511: Air quality improvements		
SuDs & Rain Garden	**radius (m)**	**% Change**
Upper Pitt St RG	20	5.5
Upper SuDS	20	-8.1
Lower SuDS	20	-4.0
Upper Pitt St RG	100	4.6
Upper SuDS	100	-5.2
Lower SuDS	100	-2.6

EcoServR: CH0511: Air quality improvements			
NBS	**NBS Name**	**radius (m)**	**% Change**

lac4	Urban catchment forestry	20	
lac5	shade trees	20	1.7
lac6	cooling trees	20	10.0
lac17	Green filter area	20	21.7
lac4	Urban catchment forestry	100	
lac5	shade trees	100	1.1
lac6	cooling trees	100	6.8
lac17	Green filter area	100	11.0

EcoServR: CH0511: Air quality improvements		
Floating gardens	**radius (m)**	**% Change**
SPL FI	20	0.2
Wapping FI	20	
SPL FI	100	0.1
Wapping FI	100	36526.2

EcoServR: CH0511: Air quality improvements			
Sub Demo Area	**Pollinator verges and spaces**	**radius (m)**	**% Change**
A	Baltic Hub POLL	20	0.6
A	Baltic POLL	20	17.4
A	Cornwallis St POLL	20	12.1
A	Park Lane POLL	20	0.0
A	Pitt St POLL	20	2.9
A	Strand POLL	20	13.3
A	Wapping POLL	20	
C	Bott SP Aig Dr POLL	20	1.5
C	Lower SuDS POLL	20	-3.7
C	Princes Av POLL	20	6.8
C	Princes roundabt POLL	20	2.7
C	Top SP Aig Dr POLL	20	2.0
C	Ullet Rd POLL	20	2.5

C	Upper SuDS POLL	20	-7.4
A	Baltic Hub POLL	100	1.8
A	Baltic POLL	100	8.6
A	Cornwallis St POLL	100	9.3
A	Park Lane POLL	100	0.1
A	Pitt St POLL	100	2.9
A	Strand POLL	100	31.3
A	Wapping POLL	100	177.1
C	Bott SP Aig Dr POLL	100	0.6
C	Lower SuDS POLL	100	-2.2
C	Princes Av POLL	100	4.1
C	Princes roundabt POLL	100	1.9
C	Top SP Aig Dr POLL	100	1.0
C	Ullet Rd POLL	100	1.0
C	Upper SuDS POLL	100	-4.8

GI-VAL results:

CH0511: Value AQ improvements: GI-VAL BENEFITS		**Sub-Demo Areas**			**Overall Liverpool**		**Sub-Demo Areas**			**Overall Liverpool**	
Tools	**GVA value**	**A**	**B**	**C**		**Other economic value**	**A**	**B**	**C**		**BENEFIT MONETISATION**
4.6 Reduced air pollution	**GVA value**	956.6	3672.5	670.6	5476.89	**Other economic value**	n.a.	n.a.	n.a.	n.a.	£

For further plots, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The EcoServR model assessed the air purification mitigation by vegetation in the following way. Vegetation can trap particulate matter and other airborne pollutants and therefore improve air quality locally. Using the aspect, the model assigned relative scores (0-100) to habitat types from the natural capital baseline based on their relative capacity to trap pollutants and improve air quality. Tall, dense vegetation (especially evergreen) scored the highest. Therefore, the best habitats for this service were woodland (especially coniferous), with scrubland and other semi-natural habitats scoring lower. Built-up areas were considered to have a score of 0. Because the benefits that a habitat provides may be felt a certain distance away from the habitat itself, focal statistics summed the scores at A) a short (20 m) and B) local (100 m) range. The two were then combined (summed) to produce the final capacity map. Patches smaller than 100 m2 were removed as they are unlikely to provide the service to any meaningful extent. Raw units do not represent a biophysical value. A rescaled (0-100) version was provided where 100 is the highest capacity in the area mapped.

EcoServR model found a positive reduction in air pollution for all areas, in particular sub demo A (3.1%) and sub demo B (1.6%), but except for sub demo C (-0.1%). EcoServR does not take account of the addition of SuDs systems and so penalised the loss of woodland * and the loss of other habitat for the SuDs in Otterspool Woods. In additions, the scores are so low at Wapping floating island that the large percentage change is not very meaningful.

From a more detailed breakdown of the effect of the interventions by the EcoServR model, floating gardens showed an extremely high percentage change of 12176% Further investigation into how the model applies the habitat codes is needed to further understand this high percentage change. The SuDs and rain garden category produced a negative change*. Positive changes were found for the pollinator sites: pollinator roofs (31.2%), pollinator walls (15%), and pollinator verges (10.5%), as well as for the tree interventions: green filter area(16.3%), shade trees (1.4%), and cooling trees (8.4%).

For the green walls, not all percentage changes could be calculated, but St Johns wall showed a 55% change, Parr Street a 6% positive change. With regards to the Suds and rain garden, the SuDs (Upper and Lower) showed a negative result as expected in EcoServR*, but the rain garden showed the most important improvement at 5.5% at 20m or 4.6% at 100m radius. As expected, the green filter area trees showed the most important result within the tree-based interventions (21.7% at 20m, 11.0% at 100m), but all showed a positive change. Within the floating gardens category, both showed a positive change, with an extreme change for Wapping dock as previously mentioned. For the pollinator verges, the Wapping dock pollinator site (Wapping POLL) showed the best positive change at a 100m radius (177%), followed by Strand POLL (13% at 20m, 31% at 100m), Baltic POLL (the pollinator pillars at 17% at 20m, 9% at 100m) and Cornwallis POLL (12% at 20m, 9% at 100m). The remainder all generally showed positive results.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The GI-VAL analyses found the positive monetary savings from reduced air pollution for all areas, in particular sub demo B (£3672.5), but also for Sub demo A, C and overall Liverpool (£956.6, £670.6 and £5476.89 respectively).

2.27.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project. *EcoServR does not take drainage systems or SuDs into account and penalizes any loss of woodland. N-Crat modelling software was found to produce inconclusive results for the scale of interventions	Awareness of limitations of models
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Positive percentage changes in air purification were found for all areas (except sub demo C due to model characteristics) and positive monetary impacts found for reduced air pollution using GI-VAL

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.28 CH0512 Value of air pollution reduction

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0512	VALUE OF AIR POLLUTION REDUCTION	CFT with LJMU
CITY	*RELATED NBS*	
LIV	All NBS	

2.28.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELS: GI-Val: No data possible as expertise left project

N-Crat model not possible/inconclusive

Please see other KPIS: CH0513 -Total monetary value of urban forests including air quality (Unit €/m2) and CH0511 Value of air quality improvements (unit €)

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

n/a

2.28.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Lack of expertise to upgrade model. N-Crat modelling software was found to produce inconclusive results for the scale of interventions	KPI unable to be calculated. Awareness of model limitations.
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
Unknown as KPI impossible to assess due to lack of necessary models and expertise.

What was the impact? (positive/negative, significant/non-significant)?
Unknown

2.29 CH0513 Total monetary value of urban forests including air quality

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0513	TOTAL MONETARY VALUE OF URBAN FORESTS INCLUDING AIR QUALITY	CFT with LJMU
CITY	*RELATED NBS*	
LIV	All NBS	

2.29.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL

Also refer to CH0511-Value of air quality improvements

N-Crat model not possible/inconclusive

GI-VAL results:

CH0513: Value urban forests	GI-VAL BENEFITS		Sub-Demo Areas			Overall Liverpool	
Functions	**Tools**	**Other economic value**	**A**	**B**	**C**		**BENEFIT MONETISATION**
Provision of attractive opportunities for exercise	4.2 Reduced mortality from increased walking and cycling	**Other economic value**	18304628	18713431	597015437	599573041	£
Tourism attraction	8.1 Tourism expenditure	**GVA value**	9979926	9979926	9979926	9979926	£
Tourism attraction	8.2 Employment supported by tourism	**GVA value**	10329224	10329224	10329224	10329224	£
Provision of recreation opportunities	9.1 Recreational value for use by local population	**Other economic value**	1985590	1985590	1985590	1985590	£
Provision of recreation opportunities	10.1 Willingness to pay for protection or enhancement of biodiversity	**Other economic value**	0	2	99	72	£

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The GI-VAL model found monetary benefits for green spaces such as for increased active travel, tourism expenditure and employment, recreational use and willingness to pay for protection of biodiversity. These were found for all areas and overall Liverpool. Of particular importance were sub demo C and overall Liverpool for active travel (£597,015,437 and £599,573,041 respectively).

For further plots, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.29.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project. N-Crat modelling software was found to produce inconclusive results for the scale of interventions	Awareness of limitation of models
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Positive monetary benefits found for related factors and for the value of the project interventions for all sub demo areas and overall Liverpool.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.30 CH0602 Benefits from interventions

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0602	BENEFITS FROM INTERVENTIONS	UOL/UOM
CITY	*RELATED NBS*	
LIV	All NBS	

2.30.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL

SOCIO-ECONOMIC: See other KPIs and combined report on KPI CH1005 New Business, CH1002 Job Creation, CH0602 Benefits of NBS Interventions and CH0703 Social Learning

GI-VAL results:

CH0602: Benefits from Interventions	**GI-VAL BENEFITS**	**Sub-Demo Areas**			**Overall Liverpool**	**BENEFIT QUANTIFICATION**
Functions	**Tools**	**A**	**B**	**C**		
Provision of recreation opportunities	10.1 Willingness to pay for protection or enhancement of biodiversity	0.00	0.00	0.16	0.16	Ha of land w/ biodiversity value added

Socio-Economic data: Please see Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The GI-VAL results indicate an increase of land possible to increase biodiversity and an increase in willingness to pay for the protection and enhancement of this land. This is particularly shown for sub demo C at 0.16 Ha of land with biodiversity value added. Overall Liverpool also showed 0.16 Ha of land had been added for this output.

Socio-Economic data: Please see Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning).

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.30.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed

Impacts on number of face-to-face surveys due to Covid restrictions	Online interviews and postal surveys became the focus of the Socio-economic investigations

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Yes, a positive impact of the benefits from the addition of the interventions.

Socio-Economic data: Please see Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning): Perceptions of NBS/greenspace quantity, quality, and accessibility in the city centre among interviewees were negative. There are concerns over a lack of inter-connectivity between spaces and the impact this has on the mental and physical health of city centre dwellers. There is also concern regarding NBS/greenspace inequities in the city as a whole, with the South possessing more high-quality spaces than the North..

Conflicting indications were found, so this KPI is assumed to be inconclusive.

What was the impact? (positive/negative, significant/non-significant)?

Inconclusive

2.31 CH0703 Social learning

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0703	SOCIAL LEARNING	UOL/UOM
CITY	*RELATED NBS*	
LIV	All NBS	

2.31.1 Results and Discussion

Table of results (summary, from Task 5.4)

NON-TECHNICAL: Nature4Health (N4H), Webinar audience numbers

SOCIO-ECONOMIC: Data within other KPIS. Also refer to report 'Analysis of NBS in Liverpool' which assesses CH0403-Green Space Accessibility, CH0702 Citizen Participation, CH0703 Social Learning, CH0705 Engagement with NBS and CH0904 Health Quality Perception. See also other KPIs and combined report on KPI CH1005 New Business, CH1002 Job Creation, CH0602 Benefits of NBS Interventions and CH0703 Social Learning.

Non-technical: Nature for Health data:

CH0703-Social Learning: Nature for Health Non-Technical					
Mental Well-being WEMWBS scores**	**Total number of participants**	**Before**	**After**	**Change in points**	**% change**
Community Forest Trust (2018) Nature4Health: Impact Report	1936	47.6	53.8	6.2	13
St. Margaret's, Toxteth	16	42.9	53.8	10.9	25.5
St. Michaels in the City	11	46.5	51.9	5.4	11.5
Totals adjacent to UGU NBS	**27**	**44.7**	**52.9**	**8.2**	**18.2**
**Warwick-Edinburgh Mental Wellbeing Scale: https://warwick.ac.uk/fac/sci/med/research/platform/wemwbs/					

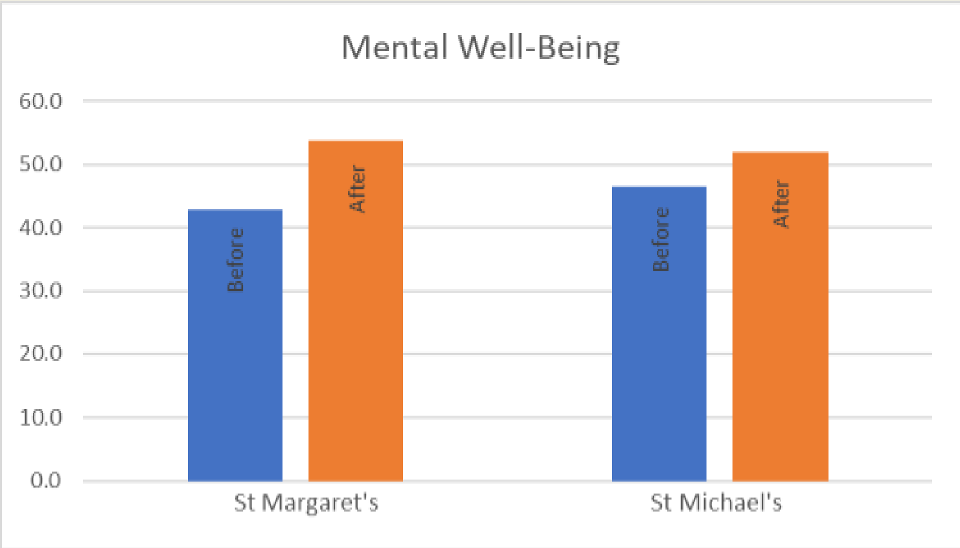
Non-technical: Event participant numbers for Liverpool

Urban GreenUP Liverpool partner meetings and events								
Sum of Size of audience								
Year	**Conference**	**Meeting**	**Fairs**	**Visit (one to one meeting)**	**Workshop**	**Public lecture**	**Other**	**TOTALS**
2017	660	130	0	2	120	0	0	**912**
2018	550	121	200	0	562	0	0	**1433**
2019	820	185	500	11	244	0	0	**1760**
2020	50	84	0	0	100	0	0	**234**
2021	196	1	0	0	124	165	220	**706**
2022	0	85	0	0	0	80	0	**165**
TOTALS	**2276**	**606**	**700**	**13**	**1150**	**245**	**220**	**5210**

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final) and Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The Non-technical data for Nature for Health comprised results from participant surveys during a twelve-week horticultural therapy course targeting 'hard to reach' people from areas of need. This course aimed to improve mental and physical wellbeing through gardening and growing food. More information can be found in the 2018 Community Forest Trust Nature4Health impact report.



The Nature for Health participants in horticultural therapy reported an increased sense of mental well-being during the course.

The non-technical data from event audience numbers were calculated from any events or webinars based in Liverpool. These data showed that these events reached at least 5000 participants.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final) and Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning).

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.31.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*

n/a	
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
Impacts on number of face-to-face surveys due to Covid restrictions	Online interviews and postal surveys became the focus of the Socio-economic investigations

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Positive impact of learning through horticultural therapy on mental well-being. The participant numbers showed a reach for the project of at least 5000 participants.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final) and Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning). Also see CH0702. An insight from report 4 is: Many interviewees believe that urban greening has a beneficial impact on business rates, and the mental wellbeing of workers, visitors, and urban dwellers alike. Those involved in the implementation of specific NBS interventions illustrated that the public response to their implementation has been more positive than what had been perhaps expected. This suggest that community buy-in for projects already exists. However, there are concerns amongst local people over the degree of impact small-scale interventions can have upon large-scale urban sustainability issues. By reducing urban greening interventions to solution providers, some interviewees warned that this simultaneously risks oversimplifying the complexity of sustainability issues and overselling the transformative power of nature.

Overall there were positive indications for this KPI.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.32 CH0702 Citizen perception

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0702	CITIZEN PERCEPTION	UOL/UOM
CITY	*RELATED NBS*	
LIV	All NBS	

2.32.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL

NON-TECHNICAL: Nature4Health

SOCIO-ECONOMIC: Also relates to CH0705. Also refer to report 'Analysis of NBS in Liverpool' which assesses CH0403-Green Space Accessibility, CH0702 Citizen Participation, CH0703 Social Learning, CH0705 Engagement with NBS and CH0904 Health Quality Perception.

GI-VAL results:

CH0702: Citizen Perception: GI-VAL BENEFITS	Sub-Demo Areas			Overall Liverpool	BENEFIT QUANTIFICATION	
Tools	A	B	C			
7.3 Savings from reduced absenteeism from work	122.83	122.83	34.88	34.88	Min	work days los avoided per yr
7.3 Savings from reduced absenteeism from work	655.08	655.08	186.05	186.05	Max	work days los avoided per yr

Non-technical Nature for Health results:

CH0702-Citizen Perception: Nature for Health Non-Technical					
Question: "Connected to nature?"	Total number of participants	Before	After	Change in points	% change
St. Margaret's, Toxteth	24	3.0	4.2	1.2	40.8
St. Michaels in the City	7	3.7	4.4	0.7	19.2
Totals adjacent to UGU NBS	31	3.3	4.3	1.0	**28.8**

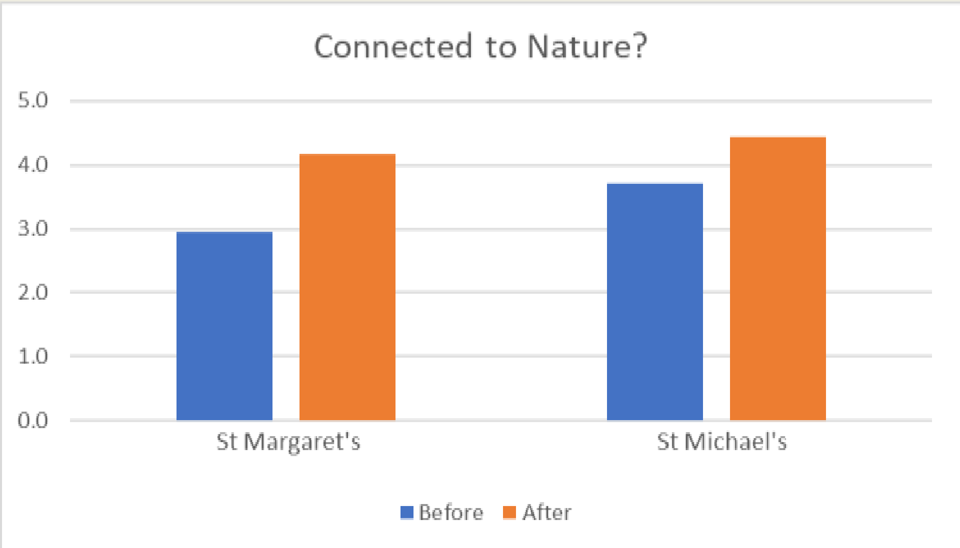
Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final)

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The GI-VAL modelled analyses showed a benefit in that there were saving due to reduced absenteeism from work due to the impact of the project interventions.

The Non-technical data for Nature for Health comprised results from participant surveys during a twelve-week horticultural therapy course targeting 'hard to reach' people from areas of need. This course aimed to improve mental and physical wellbeing through gardening and growing food. More information can be found in the 2018 Community Forest Trust Nature4Health impact report.



The Nature for Health data from horticultural therapy participants reported an increase in connection to Nature during the course. The sites chosen were adjacent to Urban GreenUP sites and were assumed to reflect on these interventions in a positive light.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final)

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.32.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
Impacts on number of face-to-face surveys due to Covid restrictions	Online interviews and postal surveys became the focus of the Socio-economic investigations

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Positive impact on reduced absenteeism from work and on connection to Nature.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final): Responses to what impact greenspace/NBS can have on social issues were generally more positive than on environmental issues. The issue that garnered the largest 'neutral/no impact' selection was social inequality: 34% of responses in Sefton Park and 37% in Otterspool.

Hence, all data indicated a positive perception.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.33 CH0705 Engagement with nbs

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0705	ENGAGEMENT WITH NBS	UOL/UOM
CITY	*RELATED NBS*	
LIV	All NBS	

2.33.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL

NON-TECHNICAL: BIOAPP-Lancashire Wildlife Report, Nature4Health:

SOCIO-ECONOMIC: Refer to report 'Analysis of NBS in Liverpool' which assesses CH0403-Green Space Accessibility, CH0702 Citizen Participation, CH0703 Social Learning, CH0705 Engagement with NBS and CH0904 Health Quality Perception.

GI-VAL results:

CH0705: Engagement with NBS	**GI-VAL BENEFITS**	**Sub-Demo Areas**			**Overall Liverpool**	**BENEFI QUANTIFICA**
Functions	**Tools**	**A**	**B**	**C**		
Tourism attraction	8.1 Tourism expenditure	100000	100000	100000	100000	Visitor days
Provision of recreation opportunities	9.1 Recreational value for use by local population	500000	500000	500000	500000	Local users

Non-technical Nature for Health results:

CH0702-Citizen Perception: Nature for Health Non-Technical					
Question: "Connected to nature?"	**Total number of participants**	**Before**	**After**	**Change in points**	**% change**
St. Margaret's, Toxteth	24	3.0	4.2	1.2	40.8
St. Michaels in the City	7	3.7	4.4	0.7	19.2
Totals adjacent to UGU NBS	31	3.3	4.3	1.0	**28.8**

Non-technical BioApp iNaturalist results:

Year 1

Indicator	Expected	Actual	Comments
Number of people engaged in City Nature Challenge 2020	Engagement of 200 people	180 people engaged	national coronavirus lockdown impacted on number of people who participated
Number of iNaturalist observations collected during City Nature Challenge 2020	Collect 1000 observations	5954 observations	
Number of species recorded on iNaturalist during City Nature Challenge 2020		975 species recorded	
Number of observations collected on iNaturalist Baltic Triangle project	Collect 1500 observations	269 observations	Coronavirus lockdown prevented project officer being employed, therefore promotion of the project has been limited and no events were run
Number of species recorded on iNaturalist Baltic Triangle project	Identify 150 species on the green corridors	128 species record	
Number of webinars delivered	2	0	no webinars delivered due to staff being furloughed
Number of people engaged in webinars	500	0	As above

Year 2:

Indicator	Expected	**Actual**	Comments

Number of people engaged in City Nature Challenge 2021	Engagement of 400 people	111 observers 381 identifiers	Target exceeded
Number of iNaturalist observations collected during City Nature Challenge 2021	Collect 7000 observations	8,901 observations	Target exceeded
Number of species recorded on iNaturalist during City Nature Challenge 2021	1000	941 species	
Number of observations collected on iNaturalist Baltic Triangle project	Collect 1500 observations	829	Limited opportunities for events unt end of national restrictions at the end c 2021 impacted number of observations
Number of species recorded on iNaturalist Baltic Triangle project	200	271	Target exceeded
Number of iNaturalist events	30	25	- 7 x Facebook videos (for CNC, iNatur project) - 12 x Self-guided challenges posted (f City Nature Challenge, 30 Days Wild, Wildlife competition) - 6 x Wildlife walks
Number of people engaged in iNaturalist events	-	553 (online) 12 (in person) = 565	Online figures calculated thı comments, 'reactions' to the post and s to other sites. Lack of engagement with the w competition for primary school chil Consistent promotion efforts made social media, press releases, radio inter email and telephone contact with sch offer of assemblies;
Number of webinars delivered	4	2	- City Nature Challenge webinar (21/0 - Recording wildlife in Liverpool City C (26/05)
Number of people engaged in webinars	750	80	41 for City Nature Challenge webinar (2 39 for Recording wildlife in LCC we (26/05)

Bioapp Media Activity:

Timetable	Media/Activity	Sites

April	1 x Webinar event promoted and hosted on the LWT 'What's On' page	LWT website Facebook
April	1 x Blog post promoting the Urban GreenUP project and wildlife recording around the intervention sites.	LWT website
April – May	4 x Social media videos promoting the intervention sites (location) and wildlife recording for City Nature Challenge.	Facebook
April	1 x Post/advert on permanent web page for the art trail	Art-dot website
April	1 x Webinar event promoted and hosted on the LWT 'What's On' page	LWT website Facebook
April – May	4 x Social media posts promoting webinar and showcasing 'what's been found in the Baltic Triangle'.	Facebook
May	1 x Blog post on Farm Urban's website promoting the Urban GreenUP intervention sites, wildlife recording and upcoming webinar (May 26th)	Farm Urban website
May	1 x Press release advertising the Baltic Bingo Wildlife Competition for Years 4-6, including information on the Urban GreenUP project and intervention sites.	Press release
May	1 x Webpage advertising the Baltic Bingo Wildlife Competition and wildlife recording across Liverpool City Centre for the Urban GreenUP project.	LWT website
May	1 x radio interview advertising the Baltic Bingo Wildlife Competition and wildlife recording across Liverpool City Centre for the Urban GreenUP project.	BBC Radio Merseyside
June	8 x Social media posts promoting the focus sites (including art trial, insects found in the BT for national insect week) and the Baltic Bingo Wildlife Competition. Promotional content will tie into 30 Days Wild to increase engagement.	Facebook
June	1 x Article in Lapwing (ed. Summer 2021) about Urban GreenUp project and wildlife recording.	Magazine article
July	6 x Events (wildlife walks) promoted and hosted on the LWT 'What's On' page. Social media template sent to wide range of contacts to promote the events via newsletters, social media posts, website content and word of mouth.	LWT website Facebook
July	5 x Social media posts promoting the Urban GreenUP project and use of iNaturalist at focus sites.	Facebook
July	Facebook live broadcast ('iNaturalist Q&A) answering questions about iNaturalist submitted by the public.	Facebook

August	2 x Social media posts promoting Baltic Triangle Record & Ramble walks,	Faceb
August	1 x Press release detailing wildlife recording findings in the Baltic Triangle since the start of the year.	Press
August	1 x Blog post promoting the Urban GreenUP wildlife recording project – developments since March when promotion began.	LWT v

For further bioapp information, please see Lancashire Wildlife Trust report.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final)

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The GI-VAL modelling analyses show 100000 visitor days, and 500000 local users may have passed close to the interventions, so an assumed positive benefit to Liverpool from the addition of the interventions is made.

The Non-technical data for Nature for Health comprised results from participant surveys during a twelve-week horticultural therapy course targeting 'hard to reach' people from areas of need. This course aimed to improve mental and physical wellbeing through gardening and growing food. More information can be found in the 2018 Community Forest Trust Nature4Health impact report.

The non-technical data for the bioapp, iNaturalist, were data from event audience numbers and observations made using the app.

The non-technical data (see CH0702 Citizen Perception) show an increase in connection with Nature. Other non-technical data regarding the use of the bioapp, iNaturalist demonstrate a successful increase in numbers of users, awareness of the app and knowledge of the biodiversity (16%) in the Sub-demo A Baltic area.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final).

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.33.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
Impacts on number of face-to-face surveys due to Covid restrictions for the Socio-economic data. In addition, events and activities to promote the bioapp, iNaturalist, were really restricted due to Covid restrictions and staff furlough.	Online interviews and postal surveys became the focus of the Socio-economic investigations. Bioapp were organized where possible and social media/ webinars used to promote the use of the iNaturalist app.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Assumed positive benefit from increase in visitor and local user numbers, even though a true number of people who look at or interact with the interventions could not be determined. Successful increase in awareness and use of the bioapp, iNaturalist, plus the knowledge of the biodiversity of the Baltic area increased by 16%. Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final) and other related KPIs.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.34 CH0801 Crime reduction

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0801	CRIME REDUCTION	UOL with LCC

CITY	*RELATED NBS*
LIV	All NBS

2.34.1 Results and Discussion

Table of results (summary, from Task 5.4)

SOCIO-ECONOMIC

Socio-economic data: please see report 2 (SE-REPORT_2_WP5-KPI CH0801 - Crime Reduction_Report).

Crime	Otterspool	Sefton Park	Baltic Triangle
2019 (pre-installation) reported crimes	259	184	557
2020 (post-installation) reported crimes	235	170	464
% change (increase/decrease reported crimes)	-9%	-8%	-17%

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Socio-economic data: please see report 2 (SE-REPORT_2_WP5-KPI CH0801 - Crime Reduction_Report).

Overall a decrease in crime rates occurred with sub demos C and A, but please see report for detailed analysis.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.34.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
n/a	
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Socio-economic data: please see report 2 (SE-REPORT_2_WP5-KPI CH0801 - Crime Reduction_Report): Overall, it is not possible to state that NBS interventions in the three study areas led to decreases in the numbers of reported crimes. Although, the data highlights a general decrease in the reporting of crimes from 2019 to 2020 the impact of Covid-19, the micro-scale of the interventions, as well as the breadth of interventions cannot be deemed to have significantly lower crime. Moreover, to make such claims would require explicit qualitative/contextual data to validate such claims. This does not though question the role that well-managed, well designed, light with good sightlines, and well used NBS have on reducing crime, as noted in the literature. For the three intervention areas examined for URBAN GreenUP claims regarding links between crime reduction and NBS interventions cannot be substantiated.

What was the impact? (positive/negative, significant/non-significant)?

Inconclusive

2.35 CH0902 Walking area increase

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0902	WALKING AREA INCREASE	UOL/UOM with LCC
CITY	*RELATED NBS*	
LIV	LAc1, LAc2, LAc5, LAc6, LAc12, LAc25, LAc26	

2.35.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: VIVACITY sensor data

NON-TECHNICAL: Nature4Health

Quantitative monitoring data results:

QUANTITATIVE DATA SUMMARY									
CH0902: Walking									
Pre-Intervention				**Post-Intervention**				**% Change**	**Area**
n_obs	**n_sites**	**estimate**	**sd**	**n_obs**	**n_sites**	**estimate**	**sd**		
4492	4	739.9	495.3	2519	3	842.4	501.9	13.9	**Overall Liverpool**

Non-technical Nature for Health results:

CH0703-Social Learning: Nature for Health Non-Technical					
Mental Well-being WEMWBS scores**	**Total number of participants**	**Before**	**After**	**Change in points**	**% change**
Community Forest Trust (2018) Nature4Health: Impact Report	1936	47.6	53.8	6.2	13
St. Margaret's, Toxteth	16	42.9	53.8	10.9	25.5
St. Michaels in the City	11	46.5	51.9	5.4	11.5
Totals adjacent to UGU NBS	**27**	**44.7**	**52.9**	**8.2**	**18.2**
**Warwick-Edinburgh Mental Wellbeing Scale: https://warwick.ac.uk/fac/sci/med/research/platform/wemwbs/					

CH0902-Walking Area Increase: Nature for Health Non-Technical									
		IPAQ 5				IPAQ 6			
IPAQ*-Walking Activity	**Total number of participants**	**Before**	**After**	**Difference**	**% change**	**Before**	**After**	**Difference**	**% change**
		days	**days**	**days**		**mins per day**	**mins per day**	**mins per day**	
Community Forest Trust (2018) Nature4Health: Impact Report	1936					63	85.5		36
St. Margaret's, Toxteth	21	5.0	5.6	0.6	11.4	80.4	102.9	22.4	27.9
St. Michaels in the City	11	5.5	6.5	1.0	18.3	115.4	122.0	6.5	5.7
Totals adjacent to UGU NBS	**32**	**5.2**	**6.0**	**0.8**	**15.0**	**97.9**	**112.4**	**14.5**	**14.8**

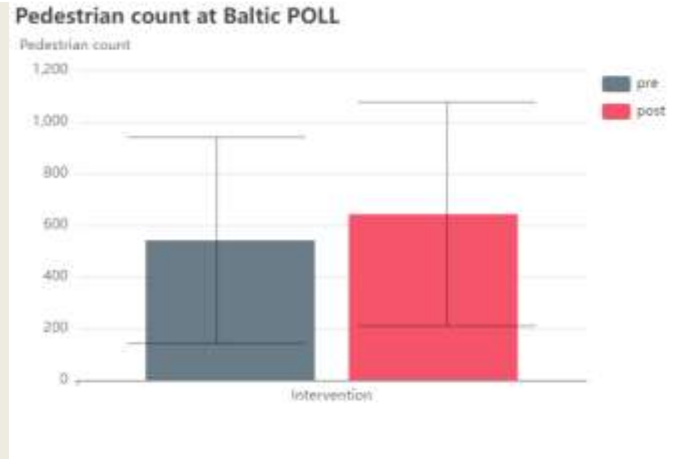
Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

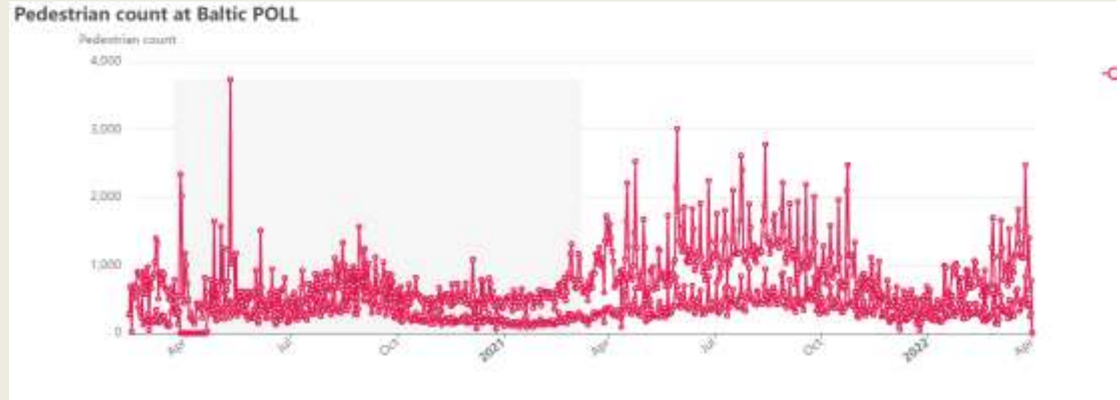
The related interventions are in the table below:

FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0902	WALKING AREA INCREASE	LAc1	New green cycle route	ALL	ALL	ALL
		LAc2	Green travel route	ALL	ALL	ALL
		LAc5	Shade trees	Shade_TREES	Shade_TREES	Shade_TREES
		LAc6	Cooling trees	Cooling_TREES	Cooling_TREES	
		LAc25	GI for Physical health	ALL	ALL	ALL
		LAc26	GI for Mental health	ALL	ALL	ALL

Map of monitoring locations

Equipment and methodology: Vivacity traffic sensor:



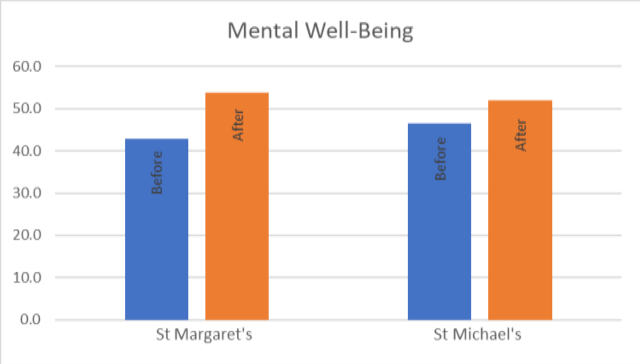


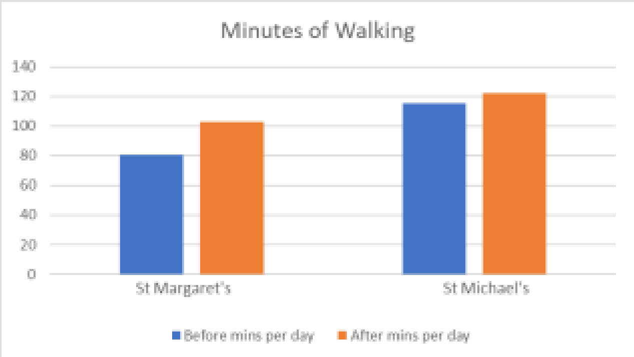
The timeline for the Vivacity data (example plot from the Baltic sub demo A Green Route) shows the depression in numbers with lockdown (grey background) and seasonal effects. The box plot demonstrates a slight increase after the interventions were added for pedestrians. Further analyses may help to determine if any particular interventions made a difference to the walking levels.

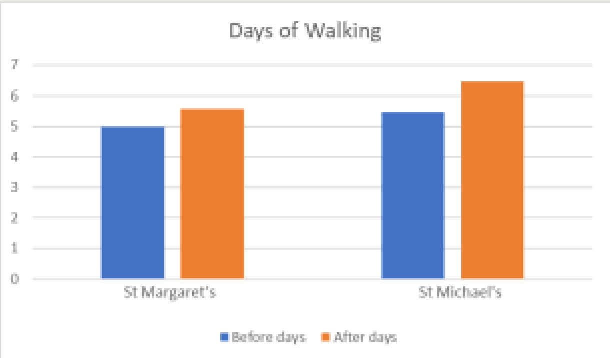
The overall data summary data for Liverpool from the Vivacity sensor data demonstrates a positive increase in walking levels of 13.9%.

The Non-technical data for Nature for Health comprised results from participant surveys during a twelve-week horticultural therapy course targeting 'hard to reach' people from areas of need. This course aimed to improve mental and physical wellbeing through gardening and growing food. More information can be found in the 2018 Community Forest Trust Nature4Health impact report.

The Non-technical data shows a positive increase in mental wellbeing of 18% from being associated with horticultural therapy undertaken at sites adjacent to Urban GreenUP interventions.







The walking data from the Nature for Health programme demonstrate an increase in walking for both days(15 days) and minutes per day (increase of 15 minutes per day for both sites adjacent to Urban GreenUP interventions.

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.35.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Sensor locations did not always transect the entire street corridor or road junctions or were not able to be located close to the interventions.	Awareness of limitations of data in counting actual numbers of pedestrians actually passing interventions or along designated green routes.
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
Covid lockdowns severely temporarily reduced walking levels	Awareness of timings of lockdowns when assessing the data.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further analyses to assess the impact of Covid lockdown periods, seasonality and climate would be useful to increase understanding of the impact of the Urban GreenUP project on activity levels.

Positive in terms of quantitative Vivacity sensor data and in terms of non-technical participant surveys.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.36 CH0903 Cycling area increase

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0903	CYCLING AREA INCREASE	UOL/UOM with LCC
CITY	*RELATED NBS*	

LIV	LAc1, LAc2, LAc5, LAc6, LAc12, LAc25, LAc26

2.36.1 Results and Discussion

Table of results (summary, from Task 5.4)

QUANTITATIVE: VIVACITY sensor data: SEE CH0902

NON-TECHNICAL: Nature4Health (data in CH0703-Social Learning)

Quantitative monitoring data results:

QUANTITATIVE DATA SUMMARY									
CH0903: Cycling									
Pre-Intervention				**Post-Intervention**				**% Change**	**Area**
n_obs	**n_sites**	**estimate**	**sd**	**n_obs**	**n_sites**	**estimate**	**sd**		
4492	4	105.7	118.0	2519	3	99.7	96.9	-5.6	**Overall Liverpool**

Non-technical Nature for Health results:

CH0903-Cycling Area Increase: Nature for Health Non-Technical									
		IPAQ 1				**IPAQ 2**			
IPAQ*-Cycling activity	**Total number of participants**	**Before**	**After**	**Difference**	**% change**	**Before**	**After**	**Difference**	**% change**
		days	**days**	**days**		**mins per day**	**mins per day**	**mins per day**	
Community Forest Trust (2018) Nature4Health: Impact Report	1936					8.4	9.4		12.0
St. Margaret's, Toxteth	13	1.1	1.8	0.8	71.4	53.1	85.4	32.3	60.9
St. Michaels in the City	10	1.1	2.1	1.0	90.9	27.0	36.0	9.0	33.3
Totals adjacent to UGU NBS	**23**	**1.1**	**2.0**	**0.9**	**81.3**	**40.0**	**60.7**	**20.7**	**51.6**
		IPAQ 3				**IPAQ 4**			
		Before	**After**	**Difference**	**% change**	**Before**	**After**	**Difference**	**% change**
		days	**days**	**days**		**mins per day**	**mins per day**	**mins per day**	

Community Forest Trust (2018) Nature4Health: Impact Report	1936					20.5	27.7		35.0
St. Margaret's, Toxteth	13	2.0	3.5	1.4	69.8	133.8	125.8	-8.1	-6.0
St. Michaels in the City	10	2.1	2.0	-0.1	-4.8	33.0	66.0	33.0	100.0
Totals adjacent to UGU NBS	**23**	**2.1**	**2.7**	**0.7**	**32.0**	**83.4**	**95.9**	**12.5**	**14.9**

CH0903-Cycling Area Increase: Nature for Health Non-Technical				
	IPAQ1&3	**% change**	**IPAQ2&4**	**% change**
		days		**mins per day**
Totals adjacent to UGU NBS		56.6		33.3

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

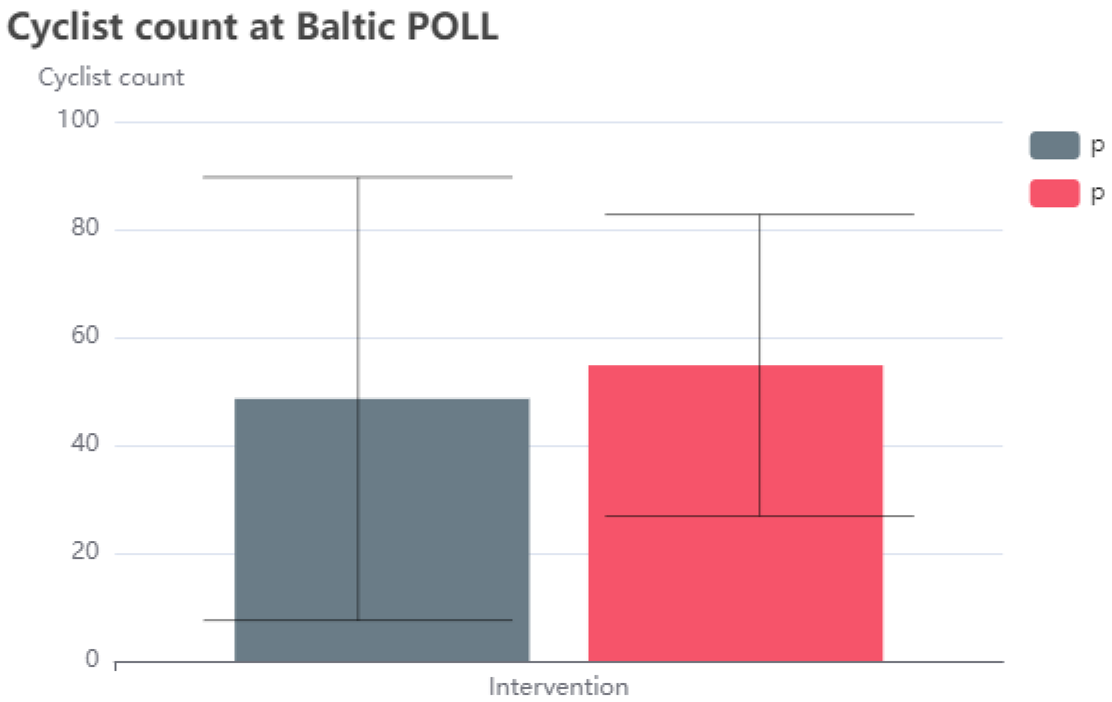
The related interventions are in the table below:

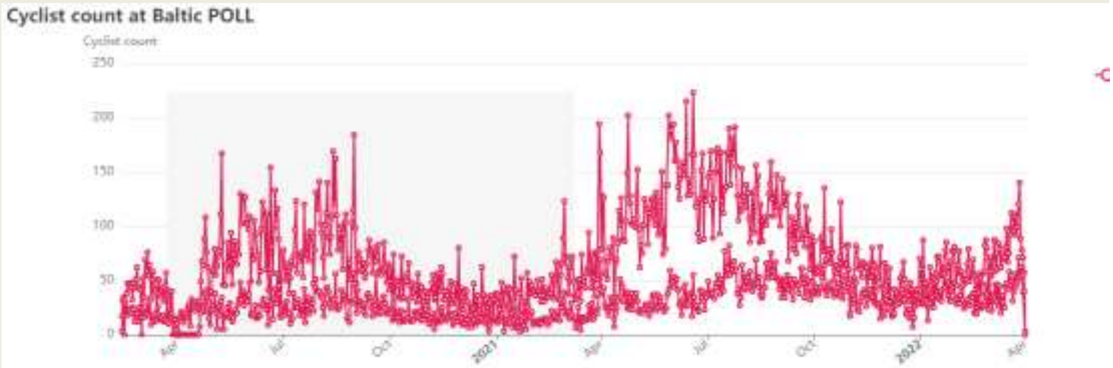
FINAL KPI CODE	KPI NAME	NBS Ref No.	NBS NAME	LIVERPOOL INTERVENTIONS: Sub-demo A	LIVERPOOL INTERVENTIONS: Sub-demo B	LIVERPOOL INTERVENTIONS: Sub-demo C
CH0903	CYCLING AREA INCREASE	LAc1	New green cycle route	ALL	ALL	ALL
		LAc2	Green travel route	ALL	ALL	ALL
		LAc5	Shade trees	Shade_TREES	Shade_TREES	Shade_TREES
		LAc6	Cooling trees	Cooling_TREES	Cooling_TREES	
		LAc25	GI for Physical health	ALL	ALL	ALL
		LAc26	GI for Mental health	ALL	ALL	ALL

Map of monitoring locations: See CH0902

Equipment and methodology: See CH0902

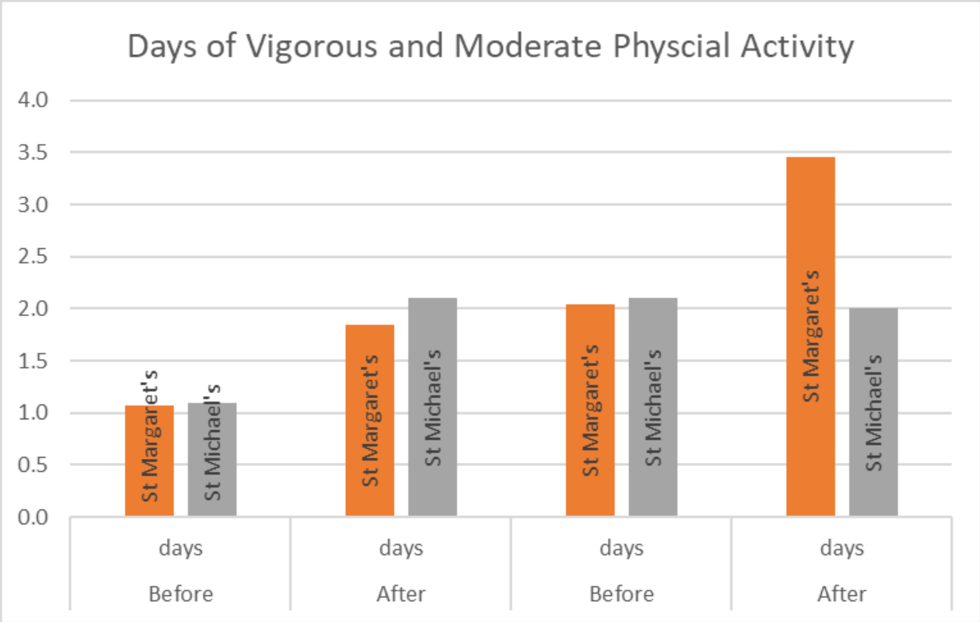
The overall data summary data for Liverpool from the Vivacity sensor data demonstrates a slight negative effect on cycling levels of -5.6% from the addition of the Urban GreenUP interventions.

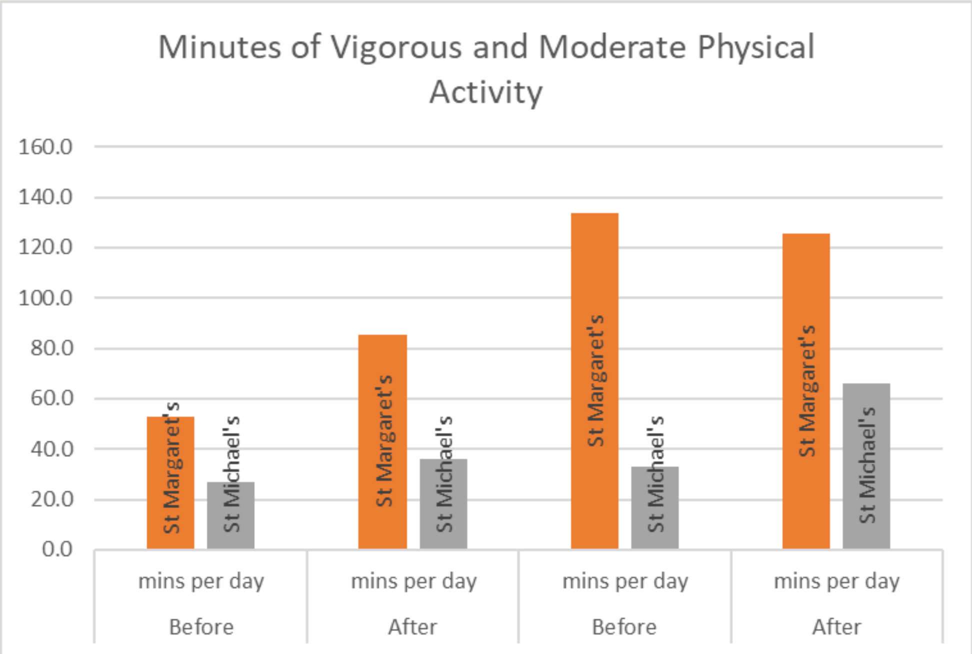




The timeline for the Vivacity data (example plot from the Baltic sub demo A Green Route) shows the depression in numbers with lockdown (grey background) and seasonal effects. The box plot demonstrates a slight increase after the interventions were added for people cycling. Further analyses may help to determine if any interventions made a difference to the cycling levels.

The Non-technical data for Nature for Health comprised results from participant surveys during a twelve-week horticultural therapy course targeting 'hard to reach' people from areas of need. This course aimed to improve mental and physical wellbeing through gardening and growing food. More information can be found in the 2018 Community Forest Trust Nature4Health impact report.





The non-technical participant surveys demonstrated and increase of cycling levels in terms of day (56.6%) and minutes per day (33.3%). This effect was more noticeable for the St Margaret's site (adjacent to Princes Ave pollinator planting and cycle way improvements) than for the St Martins site (adjacent to Baltic sites such as the rain garden).

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.36.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Sensor locations did not always transect the entire street corridor or road junctions, or were not able to be located close to the interventions	Awareness of limitations of data in counting actual numbers of people cycling who actually passing interventions or travelled along designated green routes
Economical barriers	How they have been addressed
None	
Social barriers	How they have been addressed
None	
Environmental (including COVID)	How they have been addressed
Covid lockdowns severely temporarily reduced cycling levels	Awareness of timings of lockdowns when assessing the data.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Further analyses to assess the impact of Covid lockdown periods, seasonality and climate would be useful to increase understanding of the impact of the Urban GreenUP project on activity levels.

Negative in terms of quantitative Vivacity sensor data, but positive and in terms of non-technical participant surveys

What was the impact? (positive/negative, significant/non-significant)?

Inconclusive

2.37 CH0904 Health quality perception

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0904	HEALTH QUALITY PERCEPTION	UOL/UOM

CITY	*RELATED NBS*
LIV	All NBS

2.37.1 Results and Discussion

Table of results (summary, from Task 5.4)

SOCIO-ECONOMIC: Refer to report 'Analysis of NBS in Liverpool' which assesses CH0403-Green Space Accessibility, CH0702 Citizen Participation, CH0703 Social Learning, CH0705 Engagement with NBS and CH0904 Health Quality Perception.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final)

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final)

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.37.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
n/a	

Economical barriers	How they have been addressed

n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
Impacts on number of face-to-face surveys due to Covid restrictions	Online interviews and postal surveys became the focus of the Socio-economic investigations

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Socio-Economic data: Please see report 1 'Analysis of NBS in Liverpool' (SE-REPORT_1_WP5-KPI CH0403-CH0904-CH0702-CH0703-CH0705-Final): People in both sites strongly hold that greenspace/NBS has a positive impact on both mental and physical health. On greenspace/NBS impact on mental health, 77% of respondents in Sefton Park and 70% in Otterspool selected 'very positive impact', whilst 68% of respondents in Sefton Park and 70% in Otterspool selected the same option regarding physical health. With these perceptions in mind, it is perhaps unsurprising that people in both sites believe that greenspace/NBS has a highly positive impact on quality of life. 67% of responses in Sefton Park and 69% in Otterspool were for 'very positive impact'.

Hence, a positive impact was found.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.38 CH1002 Job creation

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH1002	JOB CREATION	UOL/UOM

CITY	*RELATED NBS*
LIV	All NBS

2.38.1 Results and Discussion

Table of results (summary, from Task 5.4)

MODELLING: GI-VAL

SOCIO-ECONOMIC: See also other KPIs and combined report on KPI CH1005 New Business, CH1002 Job Creation, CH0602 Benefits of NBS Interventions and CH0703 Social Learning

GI-VAL results:

CH1002: Job Creation	GI-VAL BENEFITS		Sub-Demo Areas			Overall Liverpool	BENEFIT QUANTIFICATION
Functions	Tools		A	B	C		
Tourism attraction	8.2 Employment supported by tourism		60	60	60	60	FTE jobs
Land management	11.2 Employment supported by land management		2	2	2	2	FTE jobs

Socio-Economic data: Please see Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The GI-VAL toolkit used standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits were assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.

The Gi-VAL modelling produced a positive increase in employment due to tourism and land management associated with the Urban GreenUP project. For all areas and overall Liverpool, these were calculated as 60 jobs connected with tourism and 2 jobs within land management.

Socio-Economic data: Please see Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning).

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.38.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
The GI-VAL toolkit uses standard valuation techniques to assess the potential benefits provided by green infrastructure within a defined project area. These benefits are assessed in terms of the functions that the green infrastructure may perform, support or encourage, depending upon the type of project.	Awareness of limitations of model
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Positive impact on employment levels according to the modelling analyses.

Socio-Economic data: Please see Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning) and see CH1005.

Overall, positive indications were found.

What was the impact? (positive/negative, significant/non-significant)?

Positive

2.39 CH1004 Land and property price change

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH1004	LAND AND PROPERTY PRICE CHANGE	UOL/UOM
CITY	*RELATED NBS*	
LIV	All NBS	

2.39.1 Results and Discussion

Table of results (summary, from Task 5.4)

SOCIO-ECONOMIC: See also CH0510-Increase in Property value. Land values unable to be accessed in the same way as property value/ sales.

Socio-economic data: please see report 3 (SE-REPORT_3_WP5-KPI CH1004_Housing_prices_NBS-Report).

House Prices	Otterspool	Sefton Park	Baltic Triangle
2008 (baseline average price)	£215,053.57	£155,730.86	£163,713.17
2019 (pre-installation) reported crimes	£230,229.13	£218,412.50	£130,652.08
2020 (post-installation) reported crimes	£248429.67	£223,722.25	£139,276.29
% change (2019-2020)	+7.9%	+7.0%	+6.8%
% change 2008-2020	+15.5%	+50%	-15%

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Socio-economic data: please see report 3 (SE-REPORT_3_WP5-KPI CH1004_Housing_prices_NBS-Report).

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.39.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
. Land values unable to be accessed in the same way as property value/ sales.	Awareness of limitations of data.
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Socio-economic data: please see report 3 (SE-REPORT_3_WP5-KPI CH1004_Housing_prices_NBS-Report): The overall conclusion from the analysis presented above is that it is not possible to statistically state that the URBAN GreenUP interventions have led to increases in property prices. Although evidence exists linking increased house

prices to NBS/greenspace these point to larger interventions and/or interventions in areas of limited greenspace/NBS as being moist influential. In two of the three research areas the existing greenspace baseline in terms of parks, trees, and access to water features is high and therefore the evidence does not suggest an additional uplift in house prices associated with the micro-scale URBAN GreenUP NBS interventions. Moreover, although proximity (and by association accessibility) is noted as being key variables in understanding house prices when the majority of an area is located within a 10-minute and/or 500m radius of a high-quality greenspace/NBS it is difficult to isolate the added value of micro-scale NBS interventions. Hence, for the result was inconclusive for this KPI.
What was the impact? (positive/negative, significant/non-significant)?
Inconclusive

2.40 CH1005 New businesses

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH1005	NEW BUSINESSES	UOL/UOM
CITY	*RELATED NBS*	
LIV	All NBS	

2.40.1 Results and Discussion

Table of results (summary, from Task 5.4)
SOCIO-ECONOMIC: See also other KPIs and combined report on KPI CH1005 New Business, CH1002 Job Creation, CH0602 Benefits of NBS Interventions and CH0703 Social Learning Socio-Economic data: Please see Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning).
Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Socio-Economic data: Please see Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning).

For further plots and reports, please see portal: https://ecoservr.shinyapps.io/UrbanGreenUP: Username: ugu; Password: Baltic

2.40.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
n/a	
Economical barriers	How they have been addressed
n/a	
Social barriers	How they have been addressed
n/a	
Environmental (including COVID)	How they have been addressed
n/a	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Socio-Economic data: Please see Report 4 (SE-REPORT_4_WP5-KPI CH1005 New Business_CH1002 Job Creation_CH0602 Benefits of NBS Intervention_CH0702 Social Learning): 2. Many interviewees believe that urban greening has a beneficial impact on business rates, and the mental wellbeing of workers, visitors, and urban dwellers alike.

Overall a small positive indication was found.

What was the impact? (positive/negative, significant/non-significant)?

Postitive

3 Izmir

3.1 CH0102 Ton CO2 Carbon removed ha per year

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0102	Ton CO_2 Carbon removed ha per year	EGE Landscape
CITY	*RELATED NBS*	
IZM	Green shady structure, urban carbon sink, green parklets and new green corridor	

3.1.1 Results and Discussion

Table of results (summary, from Task 5.4)

Carbon sequestration capacity of trees and shrubs per year in hectare was estimated based on I-tree Eco v6 and canopy cover value. For baseline and monitoring calculations of carbon sequestration potentials of vegetation, structural data of plants was collected from the field.

The carbon sequestration potential of plant cover in ha/year in Peynircioğlu increased up to 190 % in the 1st monitoring and 217 % in the 2nd monitoring period compared to baseline value (Table 1).

The carbon sequestration potential of plants in Sasalı enhanced up to 183 % (Table 2).

	Baseline	1st monitoring	2nd monitoring
Carbon sequestration (C t/ha year)	3,78	10,98	11,99

Table 1: Carbon sequestered by vegetation in Peynircioğlu.

	Baseline	1st monitoring
Carbon sequestration (C t/ha year)	8,4	23,77

Table 2: Carbon sequestered by vegetation in Sasalı.

Figure 2: Plants in Peynircioğlu (left) and Sasalı (right).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Increasing number of trees and expanding canopy cover in Peynircioğlu enhanced carbon sequestration ecosystem service in the site (Figure 2).

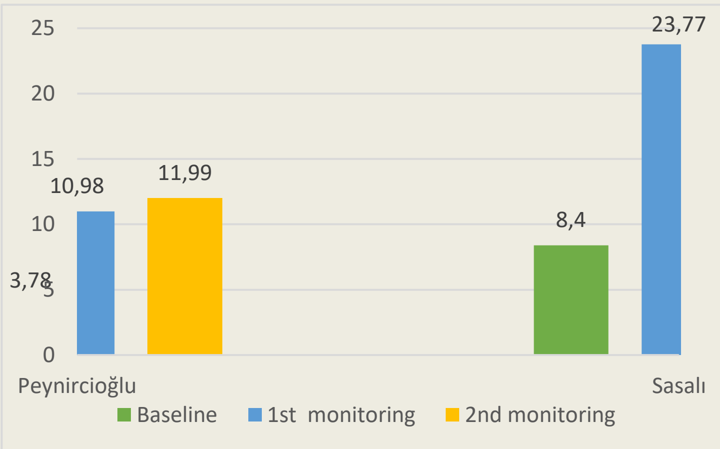


Figure 2: Carbon sequestered by vegetation in Peynircioğlu and Sasalı.

Oriental plane *(Platanus orientalis*), Turkey oak (Quercus cerris), Mediterranean cypress (*Cupressus sempervirens*) and Cherry plum (*Prunus cerasifera*) had high contribution for carbon sequestration.

In Sasalı; planting climate-resilient high numbers of native tree and shrub species provide contribution to carbon sequestration in ha/year (Figure 2). Based on monitoring outcomes, Eucalyptus trees (*Eucalyptus cameldulensis*), Strawberry tree (*Arbutus unedo*) and Goat willow (*Salix caprea*) support carbon sequestration in the site.

3.1.2 Conclusions and recommendations

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No barriers detected.	
Economical barriers	How they have been addressed
No barriers detected.	
Social barriers	How they have been addressed
No barriers detected.	
Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Since increasing concentration of atmospheric carbon is the main reason for climate change, removal of carbon from the atmosphere greatly contributes to climate change and climate mitigation. There is a significant impact based on the outcomes of monitoring. This impact increases over time.

What was the impact? (positive/negative, significant/non-significant)?

Planting new trees and increasing tree cover create a significant impact on C sequestration in the area of the Urban Carbon Sink. The contribution to the “Challenge 1: Climate mitigation & adaptation" is positive in the values. The planting of trees in the city will contribute more to carbon sequestration in the mid and long terms.

3.2 CH0103 Carbon stored by vegetation

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0103	CARBON STORED BY VEGETATION	EGE Landscape
CITY	*RELATED NBS*	
IZM	Green shady structure, urban carbon sink, green parklets and new	

	green corridor

3.2.1 Results and Discussion

Table of results (summary, from Task 5.4)

Carbon storage capacity of trees and shrubs was estimated based on their biomass by using I-tree Eco v6. For baseline and monitoring calculations of carbon storage potentials of vegetation structural data of plants were collected from the field observations.

Carbon storage capacity of plant cover in Peynircioğlu increased up to 35 % in the 1st monitoring and 87 % in the 2nd monitoring period compared to baseline value (Table 1).

Before implementation trees in Sasalı estimated to store 107,7 carbon ton/year. After implementation as a result of removing many large trees from the site, this number reduced 50 % (Table 2).

	Baseline	1st monitoring	2nd monitoring
Number of plant species	306	3966	3936
Carbon storage (metric ton)	281,1	380,8	526,3

Table 1: Carbon stored by vegetation in Peynircioğlu.

	Baseline	1st monitoring
Number of plant species	299	3936
Carbon storage (metric ton)	107,7	53,6

Table 2: Carbon stored by vegetation in Sasalı.


Figure 1: Vegetation of Peynircioğlu (left) and Sasalı (right).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Monitoring results showed that carbon storage function of plants in Peynircioğlu increased more than 80 % (Figure 2). Oriental plane *(Platanus orientalis*), Turkey oak (*Quercus cerris*), Mediterranean cypress (*Cupressus sempervirens*), Cherry plum (*Prunus cerasifera*) had high contribution for carbon storage. Considering that the plants used are quite young, the carbon storage amount of these plants will increase over time.

The calculated decline for carbon storage potential of plants in Sasalı is related to tree cover reduction after the implementation (Figure 2). Based on monitoring outcomes, Eucalyptus trees (*Eucalyptus cameldulensis*), Strawberry tree (*Arbutus unedo*) and Goat willow (*Salix caprea*) greatly support carbon storage.

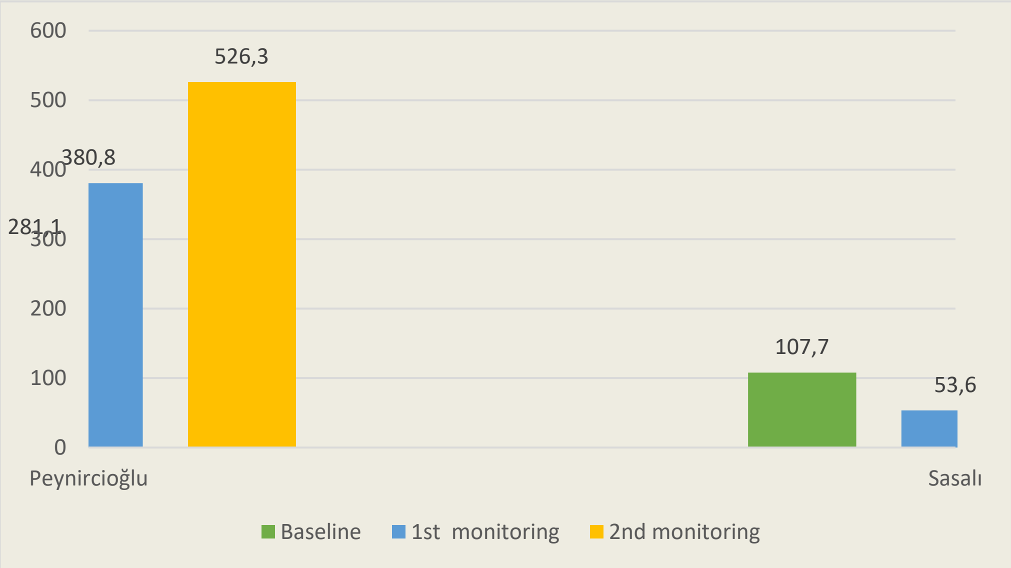


Figure 2: Carbon stored by plants in Peynircioğlu and Sasalı.

3.2.2 Conclusions and recommendations

Proper maintenance measures are required to keep the plants growing and healthy in order to increase the amount of carbon stored over time. Large canopy trees are highly recommended to keep a large canopy cover.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No barriers detected.	

Economical barriers	How they have been addressed
No barriers detected.	

Social barriers	How they have been addressed
No barriers detected.	

Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Since increasing concentration of atmospheric carbon is the main reason for climate change, Increased carbon storage capacity of urban green would have a very important impact on climate mitigation and adaptation challenges.

What was the impact? (positive/negative, significant/non-significant)?

Implementations in Peynircioğlu obviously impacted climate change challenge very positively. That positive impact is expected to increase over time.

Sasali on the other hand, stayed on the negative side with its the decreased number of large trees. But, that negative impact would turn into positive one as the trees grow and expand by volumetric.

3.3 CH0104 Carbon sequestration by vegetation

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0104	CARBON SEQUESTRATION BY VEGETATION	EGE Landscape
CITY	*RELATED NBS*	
IZM	Green shady structure, urban carbon sink, green parklets and new green corridor	

3.3.1 Results and Discussion

Table of results (summary, from Task 5.4)

Carbon sequestration capacity of trees and shrubs were estimated based on their biomass by using I-tree Eco v6. For baseline and monitoring calculations of carbon sequestration potentials of vegetation, structural data of plants was collected from the field. Every tree was measured based on required data. Having a large amount of biomass was the here.

The carbon sequestration of plant cover in Peynircioğlu increased up to 632 % in the 1st monitoring and 675 % in the 2nd monitoring period compared to baseline value (Table 1). This is a very significant increase that also indicates a very sharp increase in the biomass of Peynircioğlu.

The carbon sequestration potential of plants in Sasalı enhanced up to 186 % (Table 2).

	Baseline	1st monitoring	2nd monitoring
Number of plant species	306	3966	3936
Carbon sequestered (ton/year)	1,85	11,7	12,49

Table 1: Carbon sequestration by vegetation for Peynircioğlu.

	Baseline	1st monitoring
Number of plant species	299	3936
Carbon removed (ton/ year)	2.48	4.62

Table 2: Carbon sequestration by vegetation for Sasalı.

Figure 2: Plants in Peynircioğlu (left) and Sasalı (right).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Renaturing Peynircioğlu stream and expanding the park along the stream (blue) corridor include planting new big trees. Increasing number of trees greatly enhanced carbon sequestration ecosystem service in the site (Figure 2). Oriental plane *(Platanus orientalis*), Turkey oak (Quercus cerris), Mediterranean cypress (*Cupressus sempervirens*) and Cherry plum (*Prunus cerasifera*) had high contribution for carbon sequestration.

In the implementation in Sasalı; some of large eucalyptus trees, which are not among the natural species of the region, have been removed from the area, climate-resilient native species have been replaced and a bio-swale was created to facilitate the infiltration of stormwater into the ground (Figure 2). Based on monitoring outcomes, Eucalyptus trees (*Eucalyptus cameldulensis*), Strawberry tree (*Arbutus unedo*) and Goat willow (*Salix caprea*) support carbon ssequestration in the site.

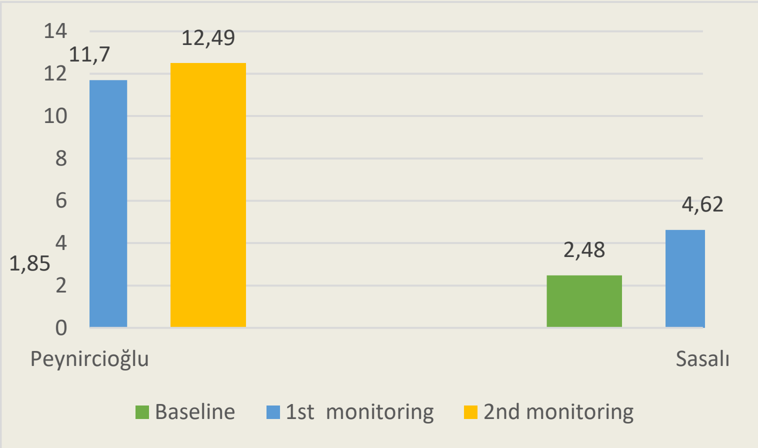


Figure 2: Carbon sequestration by plants in Peynircioğlu and Sasalı.

3.3.2 Conclusions and recommendations

Proper maintenance measures are required to keep the plants growing and healthy in order to increase the amount of carbon sequestered over time. Large biomass is highly recommended to fix a large amount of carbon. Increasing biomass and keep it that way should be one of the main goals in both areas.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No barriers detected.	
Economical barriers	How they have been addressed
No barriers detected.	
Social barriers	How they have been addressed

No barriers detected.	
Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Carbon sequestration by plants greatly contributes to climate mitigation and climate mitigation by fixing carbon into biomass. Since increasing concentration of atmospheric carbon is the main reason for climate change, Increased carbon sequestration capacity of urban green would have a very significant impact on climate mitigation and adaptation challenges.

What was the impact? (positive/negative, significant/non-significant)?

In both cases (Peynircioğlu and Sasalı), impacts are definitely positive. Implementations in Peynircioğlu impacted climate change challenge very positively. Moreover, that positive impact is expected to increase over time by increasing biomass. Sasalı showed a positive performance in sequestration as well.

3.4 CH0105- CH0106 Temperature decrease- temperature reduction (projection)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0105- CH0106	TEMPERATURE DECREASE- TEMPERATURE REDUCTION (PROJECTION)	IZT-EGE-BIT
CITY	*RELATED NBS*	
IZM	Green shady structures, green covering shelters, cool pavements, shade and cooling trees, parklets.	

3.4.1 Results and Discussion

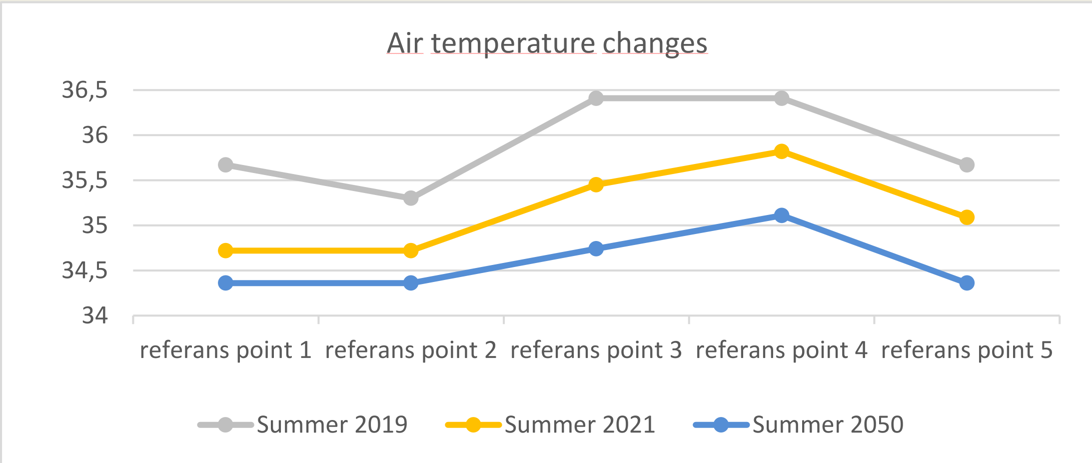
Table of results (summary, from Task 5.4)

Envi-Met, which is used in the study, is a program that simulates the built environment and uses the principles of fluid dynamics and thermodynamics to calculate surface-air-plant, thermal interactions and air quality in urban structures and open spaces (Koerniawan, 2015). In the study where the microclimate was calculated, mobile measurements were made based on reference points. The reference points were determined according to different material types and sun-shade conditions. Therefore, the changes in the microclimate of the area after the applications were easily calculated.

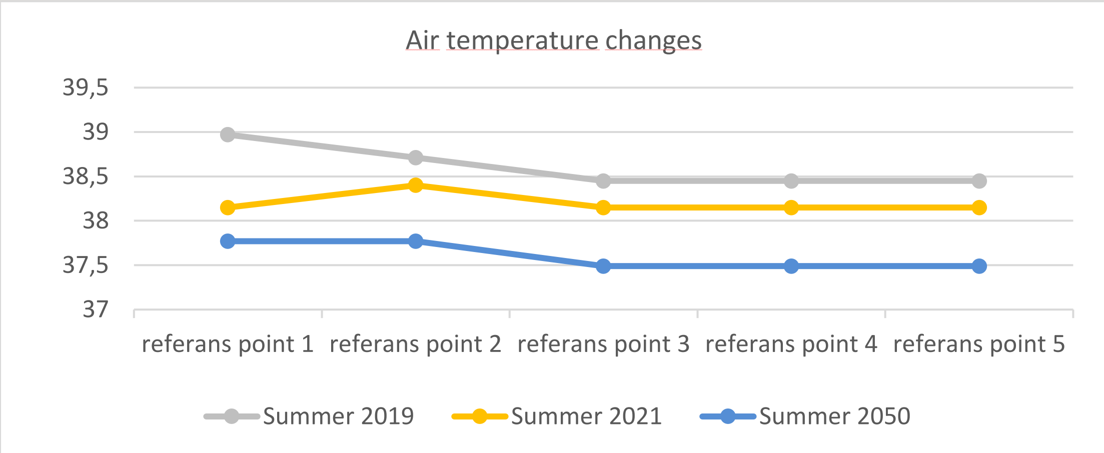
In the study, data on climate parameters were collected from fixed and mobile stations. Data on mobile measurements were first collected in 2019 before implementation. The measurements were then repeated on high-temperature days in the summer of 2020 and 2021. Finally, the future simulations of 2050, which was determined as the date when the planted plants will reach mature form, were calculated.

The monitoring and calculations are made for Girne Avenue, Sasali Wildlife and Vilayetler Evi Car Park Areas where IAc3 arboreal areas implementations are made.

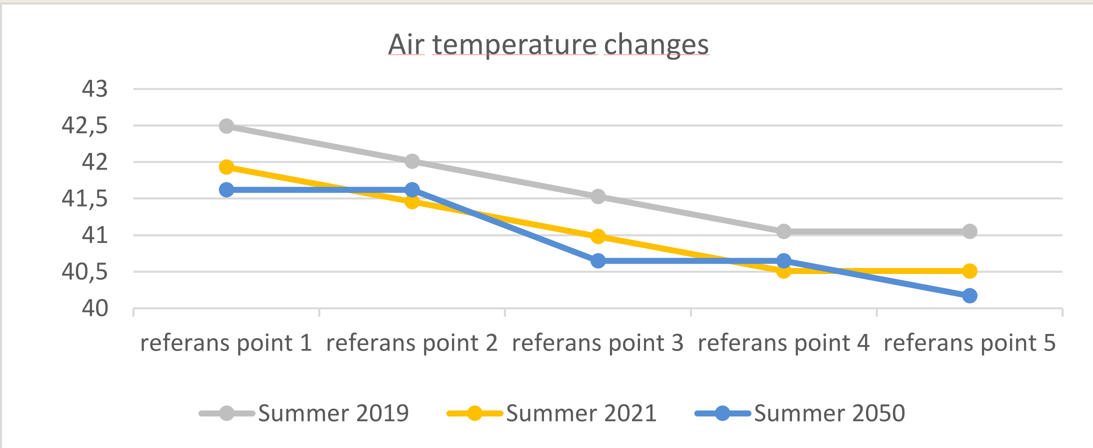
GİRNE AVENUE		1	2	3	4	5	max	Min
2019	Air temperature	35.30-35.67	34.93-35.30	36.04-36.41	36.04-36.41	35.30-35.67	38.25	34.56
2021	Air temperature	34.72-35.09	34.72-35.09	35.45-35-82	35.82-36.19	35.09-35.45	38.03	34.35
2050	Air temperature	34.36-34.74	34.36-34.74	34.74-35.11	35.11-35.48	34.36-34.74	37.72	33.99



SASALI WİLDLİFE PARK CAR PARK		1	2	3	4	5	max	min
2019	Air temperature	38.71-38.97	38.45-38.71	38.19-38.45	38.19-38.45	37.92-38.45	40.55	37.92
2021	Air temperature	38.15-38.40	38.40-38.65	38.15-38.40	38.15-38.40	38.15-38.40	40.43	37.89
2050	Air temperature	37.77-38.05	37.77-38.05	37.49-37.77	37.49-37.77	37.49-37.77	40.00	37.21



VİLAYETLER EVİ CAR PARK		1	2	3	4	5	max	Min
2019	Air temperature	42.01-42.49	41.53-42.01	41.05-41.53	40.57-41.05	40.57-41.05	44.41	39.61
2021	Air temperature	41.93-42.40	41.46-41.93	40.98-41.46	40.51-40.98	40.51-40.98	44.30	39.56
2050	Air temperature	41.62-42.10	41.62-42.10	40.65-41.14	40.65-41.14	40.17-40.65	44.04	39.20



Considering the baseline air temperature data in demo areas in different urban areas; The highest temperature values of 2019 at 13.00 were measured at 44.41 ^{0}C in the car park of the

Vilayetler Evi. The lowest value in terms of maximum temperatures was measured at 38.25 ^{0}C on Girne Street. The reason for the lower temperatures measured in this area is thought to be due to the shadow and canyon effect created by the buildings.

As can be seen in the tables, a small positive change was observed in all demo areas in the post-implementation measurements (2020-2021). But significant changes were calculated in the future simulation of 2050 by using Envi-met software.

3.4.2 Conclusions and recommendations.

Regarding the monitorization process

Technical barriers	*How they have been addressed*
No barriers detected	
Economical barriers	How they have been addressed
Social barriers	How they have been addressed
Environmental (including COVID)	How they have been addressed
The ivies planted in the car parks for shading have not yet covered the entire structure. Therefore, significant changes in the monitoring data could not be measured.	We expect the ivies to cover a wider area, then we will observe the impact of the interventions on the air temperature data.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Since the planted trees, ivies have not grown within the project period. During the beginning of the pandemic proper maintenance could not be done. The plants are in better condition now which also proves that the long term effects will be much higher than already calculated.

What was the impact? (positive/negative, significant/non-significant)?

Positive.

As can be seen in the tables and graphics above, a positive change, albeit small, was calculated in the post-application measurements in terms of air temperatures. Also, similar to the thermal comfort data, the most significant changes were calculated in the simulations of the future projection, 2050.

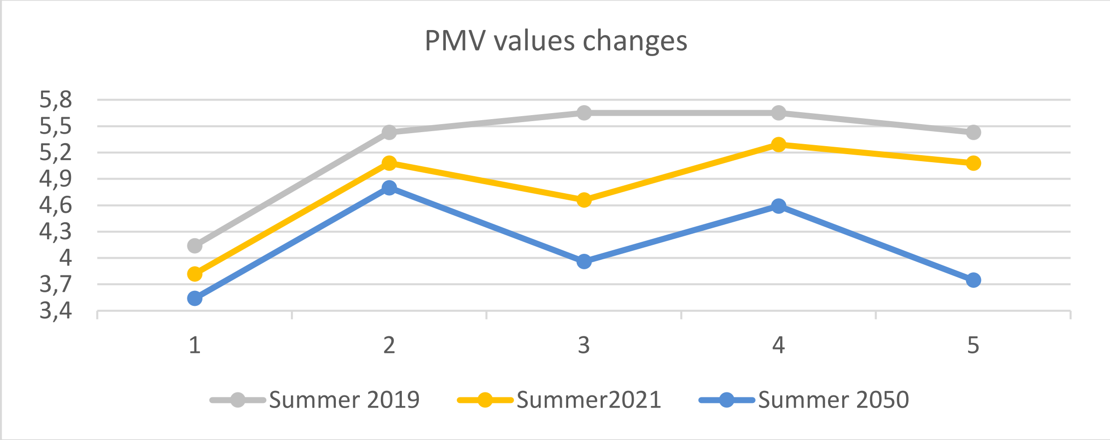
3.5 CH0107 Measures of human comfort

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0107	MEASURES OF HUMAN COMFORT	IZT-EGE
CITY	*RELATED NBS*	
IZM	Green shady structures, green covering shelters, shade and cooling trees, cool and green pavements.	

3.5.1 Results and Discussion

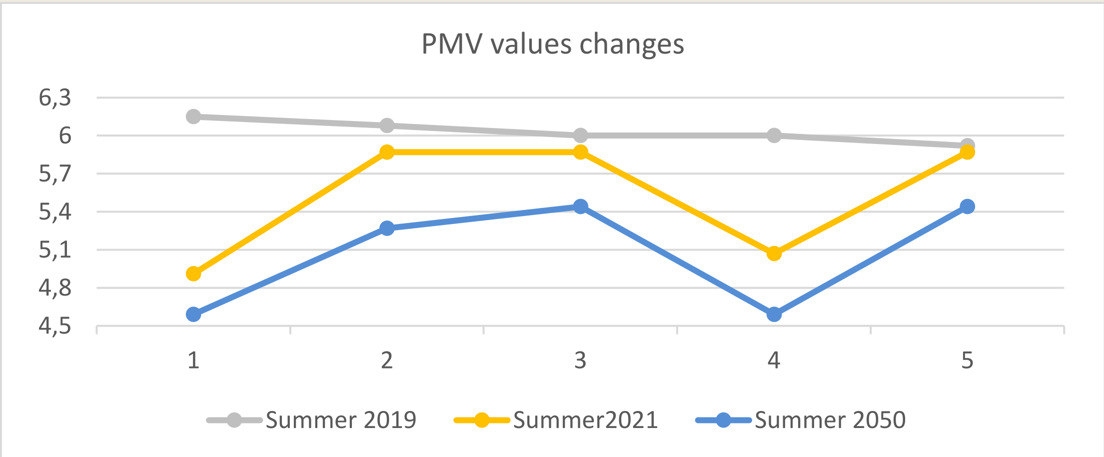
In the study, data on climate parameters were collected from fixed and mobile stations from Girne Avenue, Sasalı Wildlife and Vilayetler Evi Car Parks. Then, the thermal comfort values of the demo areas were calculated with the envi-met software. Calculations are based on the hottest days of the year.

GİRNE AVENUE		1	2	3	4	5	max	min
2019	PMV	3.92-4.14	5.22-5.43	5.43-5.65	5.43-5.65	5.22-5.43	6.08	3.92
	TMRT	52.87-55.21	71.57-73.91	71.57-73.91	71.57-73.91	71.57-73.91	76.25	52.87
2021	PMV	3.82-4.03	5.08-5.29	4.66-4.87	5.29-5.50	5.08-5.29	5.92	3.82
	TMRT	50.60-52.99	69.75-72.15	60.18-62.57	69.75-72.15	69.75-72.15	74.54	50.60
2050	PMV	3.54-3.75	4.80-5.01	3.96-4.17	4.59-4.80	3.75-3.96	5.65	3.54
	TMRT	47.31-49.78	67.11-69.58	54.73-57.21	67.11-69.58	52.26-54.73	72.06	47.31

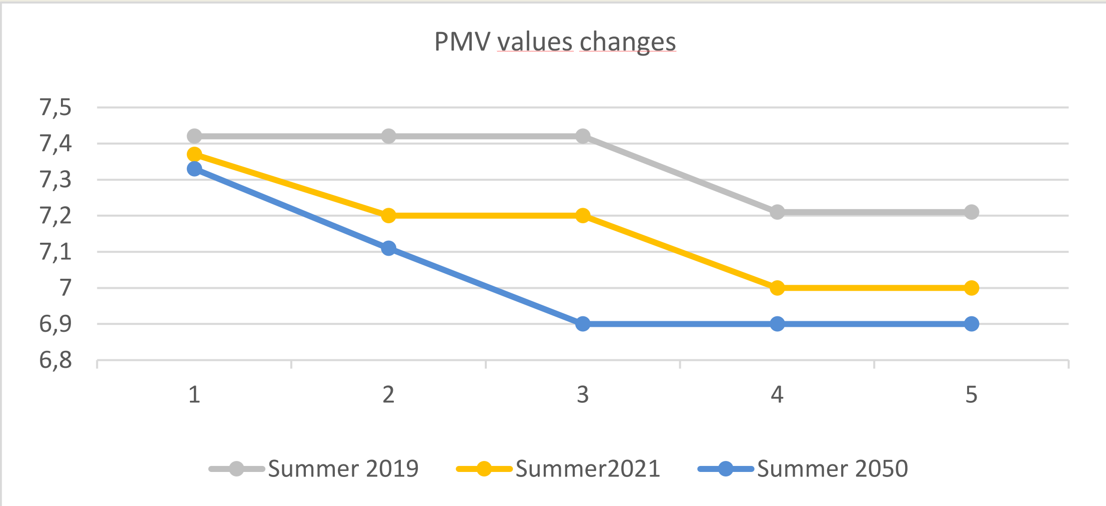


(The resulting maps have not been added.)

SASALI WİLDLİFE PARK CAR PARK		1	2	3	4	5	max	min
2019	PMV	6.08-6.15	6.00-6.08	5.92-6.00	5.92-6.00	5.85-5.92	6.62	5.85
	TMRT	82.94-83.94	82.94-83.94	82.94-83.94	82.94-83.94	82.94-83.94	82.94	82.94
2021	PMV	4.91-5.07	5.87-6.04	5.87-6.04	5.07-5.23	5.87-6.04	6.52	4.91
	TMRT	64-76-66.52	80.67-82.44	80.67-82.44	68.29-70.06	80.67-82.44	82.44	64.76
2050	PMV	4.59-4.76	5.27-5.44	5.44-5.61	4.59-4.76	5.44-5.61	6.30	4.59
	TMRT	62.78-64.58	77.11-78.90	78.90-80.69	62.78-64.58	78.90-80.69	80.69	62.78



VİLAYETLER EVİ CAR PARK		1	2	3	4	5	max	min
2019	PMV	7.21-7.42	7.21-7.42	7.21-7.42	7.00-7.21	7.00-7.21	7.85	5.72
	TMRT	82.42-84.29	82.42-84.29	82.42-84.29	82.42-84.29	82.42-84.29	84.29	65.65
2021	PMV	7.37-7.54	7.20-7.37	7.20-7.37	7.00-7.20	7.00-7.20	7.84	6.10
	TMRT	82.05-83.57	82.05-83.57	82.05-83.57	82.05-83.57	82.05-83.57	84.39	65.32
2050	PMV	7.33-7.54	7.11-7.33	7.11-7.33	6.90-7.11	6.90-7.11	7.75	5.61
	TMRT	80.69-82.64	80.69-82.64	82.64-84.59	80.69-82.64	80.69-82.64	84.59	65.12



According to the baseline measurements (2019) in the city of Izmir, where summer temperatures are quite high, all demo areas are under extreme heat stress. This calculation is based on Matrazakis' index of psychological stress.

As can be seen in the graphics, there is a decrease in PMV values in the calculations just after the application (2021) in all demo areas. In addition, the biggest change is seen in future simulations of 2050 created via Envi-met software.

3.5.2 Conclusions and recommendations.

Regarding the monitorization process

Technical barriers	*How they have been addressed*
At the beginning of the pandemic the maintenance could not be properly done right after the implementations which might have affected the growth of the plants.	

Economical barriers	How they have been addressed
No barriers detected.	

Social barriers	How they have been addressed
No barriers detected.	

Environmental (including COVID)	How they have been addressed
The ivies planted in the car parks for shading have not yet covered the entire structure. Therefore, significant changes in the monitoring data could not be measured.	We expect the ivies to cover a wider area, then we will observe the impact of the interventions on the air temperature data.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
Yes.

What was the impact? (positive/negative, significant/non-significant)?
As can be seen in the tables and graphs above, there are small positive changes between the 2019 measurements, which are baseline measurements, and the monitoring (2021) measurements. However, the most obvious differences were observed in the simulations of the future projection, 2050.

3.6 CH0108 Heatwave risk

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0108	HEATWAVE RISK	IZT

CITY	*RELATED NBS*
IZM	Horizontal green interventions, green covering shelter, green roof, green shady structures, tree related actions

3.6.1 Results and Discussion

Heatwave risks are described as 3 days of combined tropical nights (>20°C) and 3 hot days (>35°C).

Interventions applied to demo sites are installing green shady structures and replacing concrete pavements with permeable ones (Fig.1-2).

Air temperature data obtained from the meteorological stations at demo sites (Vilayetler Evi and Sasalı Natural Life Park) and number of tropical nights and hot days are determined monthly for summer season (June-August). Data for 2020 are obtained from meteoblue.com because of the lockdown during the Covid-19 pandemic.

(a) (b)

Figure 1. Vilayetler Evi Parking Lot (a) 2020, (b) 2022.

(a) (b)

Figure 2. Sasalı Natural Life Park Parking Lot (a) 2020, (b) 2022.

Table 2 and 3 present number of days with heatwave risk and encountered maximum air temperatures for daytime and night time. Highest temperatures (around 40°C) are recorded in July and August in both 2020 and 2021.

Table 1. Heatwave occurrences and maximum air temperatures at Vilayetler Evi.

Vilayetler Evi												
Months	June				July				August			
Year	2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022
Daytime												
No. of days	2	1	2	1	15	8	5	5	13	9	4	3
Max. air temp. (°C)	40.6	38.0	39.8	37.0	40.0	42.3	41.5	40.0	38.0	42.9	41.1	38.0
Night time												
No. of days	9	9	10	10	10	10	10	10	10	10	10	10
Max. air temp. (°C)	33.6	33.3	34.9	31.0	35.6	34.5	36.9	35.0	33.7	34.6	36.3	34.0
Total (Daytime + night time)	11	10	12	11	25	18	15	15	23	19	14	13

Table 2. Heatwave occurrences and maximum air temperatures at Sasalı Natural Life Park.

Sasalı Natural Life Park												
Months	June				July				August			
Year	2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022
Daytime												
No. of days	1	0	2	0	0	2	5	1	4	1	4	0
Max. air temp. (°C)	38.3	35.5	39.9	34.0	36.3	39.0	41.2	37.0	39.0	37.9	40.7	36.0
Night time												
No. of days	10	9	8	10	10	10	10	10	10	10	10	10

Max. air temp. (°C)	31.9	29.3	33.5	32.0	31.0	31.7	34.6	33.0	31.0	31.1	34.5	33.0
Total (Daytime + night time)	11	9	10	10	10	12	15	11	14	11	14	10

Total number of days with heatwave risk is combined from Table 1 and 2, and listed in Table 3 for both demo sites. Decrease in heatwave risk for Vilayetler Evi (urban area) compared with 2019 (ex-ante) is 20.3%, 30.5% and 33.9% for 2020,2021 and 2022, respectively. In Sasalı Natural Life Park (rural area), while decrease in heatwave risk is 8.6% and 11.4% for 2020 and 2022, an 11.4% increase is encountered in 2021. As can be seen from the Table 2, temperatures are quite high in 2021 summer compared with other years.

Table 3. Comparison of demo sites.

Year	Vilayetler Evi		Sasalı	
	No. of days	**No. of days change based on 2019 (%)**	**No. of days**	**No. of days change based on 2019 (%)**
Ex-ante (2019)	59	-	35	-
Ex-post (2020)	47	-20.3	32	-8.6
Ex-post (2021)	41	-30.5	39	+11.4
Ex-post (2022)	39	-33.9	31	-11.4

3.6.2 Conclusions and recommendations

It is worth to note that decrease in heatwave occurrences at Vilayetler Evi (dense urban area) is 3 times higher than Sasalı Natural Life Park (rural area) for 2019 (ex-ante) and 2022 (ex-post). This result emphasizes the powerful impact of NBS implementations on decreasing temperatures in urban areas over the rural areas. Maximum air temperatures in urban area are approximately 2°C higher than the rural area at daytime and as high as 4.6°C at night time. This is an indication of urban heat island effect.

Regarding the monitorization process

Technical barriers	*How they have been addressed*
No barriers detected.	

Economical barriers	How they have been addressed

No barriers detected.	
Social barriers	How they have been addressed
No barriers detected.	
Environmental (including COVID)	How they have been addressed
Monitoring has been delayed for a period due to COVID in 2020.	When the restrictions loosened in 2021 it was possible to do the monitoring. 2020 data for the locations were obtained from meteoblue.com

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
Yes, there is a positive impact on the number of heatwave occurrences and encountered maximum daytime and night time maximum air temperatures.
What was the impact? (positive/negative, significant/non-significant)?
Positive impact is observed on both demo sites even though the ivies planted for green shady structures have not covered the whole structure yet. Comparing the number of heatwave occurrences at demo sites for 2019 (ex-ante) and 2022 (ex-post) summer seasons, a 33.9% and 11.4% decrease encountered for Vilayetler Evi and Sasalı Natural Life Park, respectively (Table 3). When the structures are fully covered, the impact is expected to improve.

3.7 CH0109 Energy saving from reduced building consumption

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0109	Energy saving from reduced building consumption	IZT
CITY	*RELATED NBS*	
IZMIR	Green shady structures, green covering shelters, cool pavements, shade and cooling trees	

3.7.1 Results and Discussion

NBSs in Izmir do not have any building level interventions such as green roof and green façade. Green shady structures and permeable pavements are implemented in parking lots which has no connection with buildings. Therefore, energy and carbon savings from reduced building energy consumption is obtained using a dynamic building energy performance software, TRNSYS.

Vilayetler Evi parking lot demo site is located in a densely populated urban area. Therefore, a sample residential building which represents the buildings around the demo site is modelled using TRNSYS software. Then, energy demand of the building is obtained using measured temperatures (from CH0105) at the demo site.

The difference between energy demand values of pre- and post-intervention presents energy savings.

The buildings around Vilayetler Evi demo site is mostly consist of 5-floor apartments. A sample building is modelled in TRNSYS software as given in Fig. 1.

Figure 1. 3D model of the considered building.

The main characteristics of the building envelope are given in Table 1. Overall heat transfer coefficients (U) were determined based on "TS825-Thermal Insulation Requirements" standard. Indoor set point temperature is chosen as 22°C for both winter and summer.

Table 1. Main characteristics of the building envelope.

Envelope	Layers	Thickness (m)	U (W/m^2K)
External walls	Plaster, brick, insulation	0.41	0.238
Roof	Plaster, brick, insulation	0.24	0.236

Floor	Concrete, gypsum mortar, insulation	0.23	0.341

The mobile measurements in Vilayetler Evi parking lot was first taken in 2019 (ex-ante). Ex-post measurements have been taken on high-temperature days in the summer of 2020 and 2021. Green shady structures have not yet been covered by the ivies. Therefore, temperature decrease was encountered as around 1°C in 2021. The scenario for "the whole structure is fully covered" is simulated and a temperature decrease in shade is obtained as average 2°C (CH0105).

Using 2°C temperature drop, heating and cooling energy demand of the modelled building is calculated by the software. The buildings are heated by natural gas and cooling is provided by air-conditioners. Assuming an energy efficiency of 80% for natural gas heaters and a COP of 3 for air-conditioners, energy consumption of the building is calculated. Then, electricity consumption is converted to primary energy consumption using a conversion factor of 1.788 [1] and the results are given in Table 2.

Table 2. Annual primary heating, cooling and total energy consumption of the building (for 2°C temperature drop).

	Primary Energy Consumption		
	Heating (kWh/year)	**Cooling (kWh/year)**	**Total (kWh/year)**
Ex-ante	8473,40	52731,87	61205.27
Ex-post	8711,68	51705.80	60417,48
Change in energy consumption (%)	↑ 2.81	↓ 1.95	↓ 1.29

[1] https://webdosya.csb.gov.tr/db/meslekihizmetler/icerikler/elektrik-enerjisinin-birincil-enerji-ve-sera-gazi-salimi-katsayilari-agustos-2022den-sonra-20220825085911.pdf

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Table 2 indicates that for 2°C temperature drop, heating energy consumption increases by 2.81%, while cooling energy consumption decreases by 1.95%. The decrease in overall primary energy consumption is encountered as 1.29% since cooling energy consumption is approximately 3.5 times higher than heating energy consumption.

If the plants shed the leaves in winter, no temperature decrease would be encountered. That means no change in increase in energy consumption and CO_2 emissions.

In this study, we only concentrated on air temperature change. Relative humidity, solar irradiance and wind speed are the other parameters effect energy consumption of a buildings. Therefore, other parameters along with temperature should be taken into account to obtain more precise results.

3.7.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
No barriers detected.	

Economical barriers	How they have been addressed
No barriers detected.	

Social barriers	How they have been addressed
No barriers detected.	

Environmental (including COVID)	How they have been addressed
The ivies planted in the parking lots for shading have not yet covered the entire structure. Therefore, significant changes in the monitoring data could not be measured.	Modelling is used to predict the air temperature change in case the ivies to cover whole structure.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Since NBSs in demo sites do not have any building level interventions such as green roof and green façade. These interventions decrease overall heat transfer coefficient of the buildings which corresponds to a decrease in energy consumption. On the other hand, green shady structures and permeable pavements are implemented in the Izmir demo sites have no direct connection with buildings as green roofs and façades.

The projection of temperature drop measured/simulated in Vilayetler Evi demo site to the surrounding buildings at a large extend is only possible increasing the NBSs such as green shady structures, green covering shelters, cool pavements, shade and cooling trees.

Therefore, the impact cannot be evaluated as significant.

What was the impact? (positive/negative, significant/non-significant)?

Non-significant.

3.7.3 Other comments

3.8 CH0110 Carbon savings from reduced building energy consumption

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0110	Carbon savings from reduced building energy consumption	IZT
CITY	*RELATED NBS*	
IZMIR	Green shady structures, green covering shelters, cool pavements, shade and cooling trees	

3.8.1 Results and Discussion

Table of results

Primary energy consumption values taken from CH0109 are converted to amount of greenhouse gas emission using conversion factors, which are 0.202 tCO_2/MWh for natural gas and 0.484 tCO_2/MWh for electricity [1].

The amount of greenhouse gas emissions in kgCO2 is calculated and given in Table 1.

Table 1. Amount of annual greenhouse gas emissions of the building based on primary energy consumption.

	Greenhouse gas emissions ($kgCO_2$)		
	Heating	**Cooling**	**Total**
Ex-ante	1711.63	25522.22	27233.85
Ex-post	1759.76	25025.61	26785.37

Change in energy consumption (%)	↑ 2.81	↓ 1.95	↓ 1.65

[1] https://webdosya.csb.gov.tr/db/meslekihizmetler/icerikler/elektrik-enerjisinin-birincil-enerji-ve-sera-gazi-salimi-katsayilari-agustos-2022den-sonra-20220825085911.pdf

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

A 2.81% increase in CO_2 emissions is encountered based on increased energy consumption caused by a 2°C temperature reduction for natural gas heating. On the other hand, in cooling season the decrease in outdoor temperature resulted as a 1.95% decrease in CO_2 emissions. When the annual CO_2 emissions are evaluated, a 1.65% decrease is encountered.

If the plants shed the leaves in winter, no temperature decrease would be encountered. That means no change in increase in energy consumption and CO_2 emissions.

In this study, we only concentrated on air temperature change. Relative humidity, solar irradiance and wind speed are the other parameters effect energy consumption of a buildings. Therefore, other parameters along with temperature should be taken into account to obtain more precise results on energy and carbon savings.

3.8.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
No barriers detected.	

Economical barriers	How they have been addressed
No barriers detected.	

Social barriers	How they have been addressed

No barriers detected.	
Environmental (including COVID)	How they have been addressed
The ivies planted in the parking lots for shading have not yet covered the entire structure. Therefore, significant changes in the monitoring data could not be measured.	Modelling is used to predict the air temperature change in case the ivies to cover whole structure.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

As indicated in CH0109, NBSs in demo sites do not have any building level interventions such as green roof and green façade. Green shady structures and permeable pavements are implemented in the Izmir demo sites have no direct connection with buildings as green roofs and façades.

Temperature drop calculations for Vilayetler Evi demo site gave a 1.29% decrease in total primary energy consumption of the sample building. The projection of temperature decrease to the surrounding buildings at a large extend is only possible increasing the NBSs such as green shady structures, green covering shelters, cool pavements, shade and cooling trees.

Therefore, the impact on energy saving cannot be evaluated as significant. Simultaneously, carbon saving is also considered as insignificant.

What was the impact? (positive/negative, significant/non-significant)?

Non-significant.

3.9 CH0112 Global warning potential

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0112	GLOBAL WARNING POTENTIAL	EGE Soil
CITY	*RELATED NBS*	
IZM		

3.9.1 Results and Discussion

Table of results (summary, from Task 5.4)

The application of biochar to the soils appears to be one of the ways of atmospheric CO2 sequestration. In this process, carbon is separated from its rapid ecological cycle and participates in a much slower and more stable biochar cycle (Lehmann, 2007). The construction of a strategic pathway to utilize pyrolysis technology and biochar use in agriculture have been realised with potential and feasible utilization techniques.

Figure 1: Measurements

Table 1: Measurement dates

Treatment	Date
1st field experiment was conducted.	23.12.2020
1st GHGs measurement	30.12.2020
2nd GHGs measurement	06.01.2021
3rd GHGs measurement	20.01.2021
4th GHGs measurement	24.02.2021
Top dressing	13.03.2021
5th GHGs measurement	25.03.2021
6th GHGs measurement	21.04.2021
7th GHGs measurement	19.05.2021
8th GHGs measurement	16.06.2021
Harvest	17.06.2021

The sewage sludge used in the experiment was from the Çiğli Wastewater Treatment Plant of İzmir Metropolitan Municipality of Turkey, stabilized in anaerobic conditions and converted to granules of 90% dryness. Stabilized sewage sludge (SSS) and sewage sludge biochar (SSB) were incorporated into the experimental soil at a rate of 25 Mg ha^{-1} to the 0-15 cm soil depth. After incorporation, wheat seeds (250 kg ha^{-1}) were sown by hand and basal chemical fertilizer (500 kg ha^{-1}) were applied as a 15-15-15 fertilizer. The 15-15-15 fertilizer is defined by the NPK ratio (15-15-15), which means it has equal parts of Nitrogen, Phosphorous, and Potassium. Urea fertilizer applied as top-dressing (200 kg urea ha^{-1}).

The polyvinyl chloride (PVC) rings (20 cm diameter 10 cm high; 3410 cm^3) were inserted into the ground to a depth of 5 cm. Greenhouse gas (GHG) sampling occurred at specified time intervals (weekly for the first month, biweekly for the second month, and monthly thereafter, after organic materials incorporating) over 176 days. GASERA ONE PULSE (Photoacoustic Analyzer for measurement of CH_4, N_2O and CO_2) were used for the GHGs measurement.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

While the lowest methane value was 36.4 ppm for SSB treatment, the highest value occurred in SSS+CF soils (45.1 ppm). Although the methane emission of biochar-treated soils was closest to that of atmospheric air, methane emission of biochar-treated soils decreased below that in atmospheric air 4 months after the biochar was incorporated into the soil. The combined application of chemical fertilizers and biochar (SSB+CF) also showed low methane emissions.

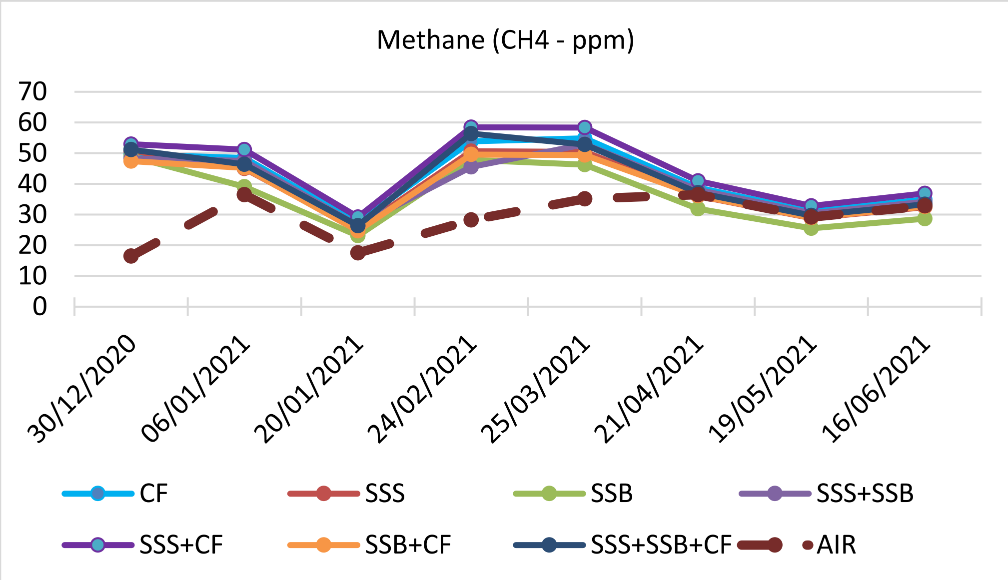


Figure 2: Methane change

In our field experiment in which 25 t/ha of organic material was applied, it was determined that the CO_2 concentration released to the atmosphere increased due to SSS applications. The sewage sludge, which is ready for agricultural use by the anaerobic stabilization method, caused an average of 26% more C-emissions than the biochar application.

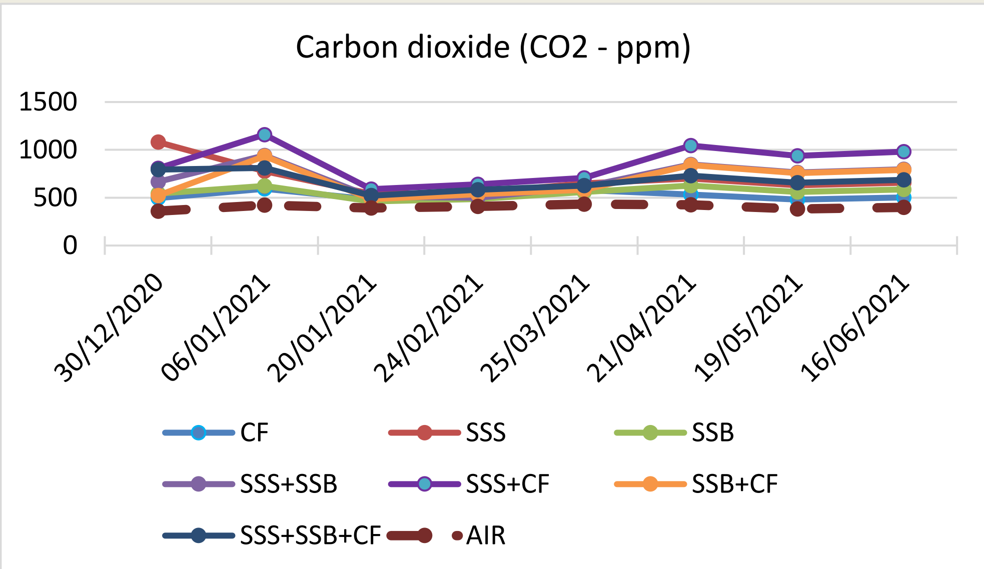


Figure 3: Carbon dioxide change (CO2 – ppm)

Since the physical conditions of the soil have a great effect on the N_2O release from the soil, we were able to reduce the N_2O emissions by 28% with biochar applications. The emission, which was 1120 ppb in SSS soils, decreased to 875 ppb due to SSB applications.

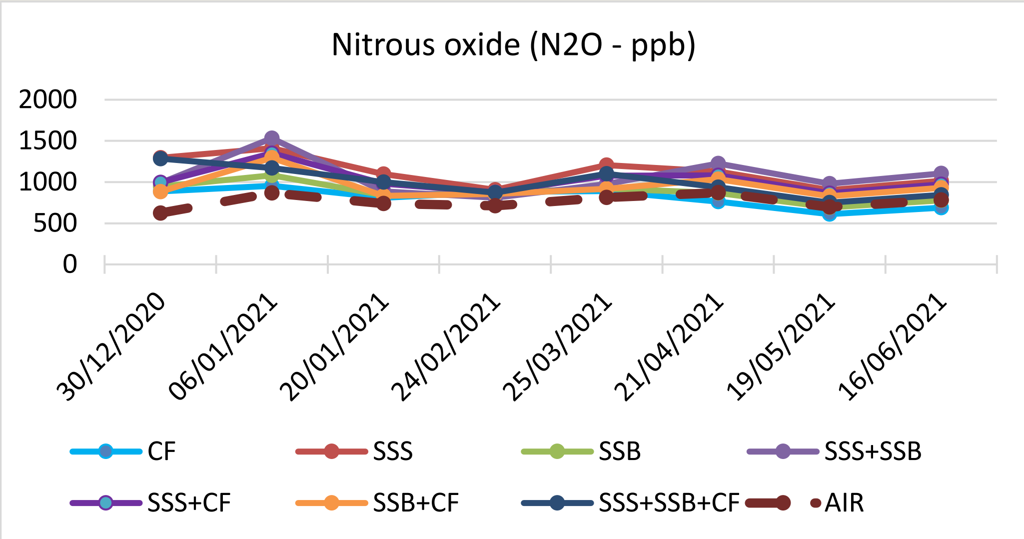


Figure 4: Nitrous Oxide (N2O – ppb)

3.9.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

In general, the use of organic wastes in agriculture by a consideration of certain conditions provides the opportunity to simultaneously increase soil productivity and potentially offer a more sustainable way of dealing with organic wastes. When organic wastes are thrown randomly, they cause a large amount of greenhouse gas emissions. In addition, our agricultural soils especially under the Mediterranean climatic condition need organic matter additions in terms of sustainable soil fertility.

Biochar (SSB) applications caused a 9% reduction in methane emissions from soil to the atmosphere, 21% in CO2 and 22% in N2O compared to sewage sludge (SSS) applications. It is thought that biochar had this effect because it has stable carbon and improves the physical and chemical properties of soils.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*

Economical barriers	How they have been addressed

Social barriers	How they have been addressed

Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This KPI is related with Challenge 1: Climate Mitigation and Adaptation. CO_2, CH_4 and N_2O are the main greenhouse gases that cause climate change. The experiments done in the Farming Lab shows one of the possibilities to decrease GHG Emissions.

What was the impact? (positive/negative, significant/non-significant)?

3.10 CH0213 Runoff estimation of bioswales in Bioboulevard

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0213	RUNOFF ESTIMATION OF BIOSWALES IN BIOBOULEVARD	IZT , Ege
CITY	*RELATED NBS*	
IZM	Bıo-boulevard, grassed swales, water retention pounds	

3.10.1 Results and Discussion

Table of results (summary, from Task 5.4)

A GIS based analysis is made to predict runoff by using the most common method called The Runoff Curve Number (CN), developed for ungauged basins to calculate runoff from rainfall data by USDA NRCS (United States Department of Agriculture Natural Resources Conservation Service) formerly known as the Soil Conservation Service (SCS). The method is used worldwide to predict runoff based on the amount of impervious area, soil group, land cover type, hydrological condition, and antecedent runoff (USDA NRCS, 1986).

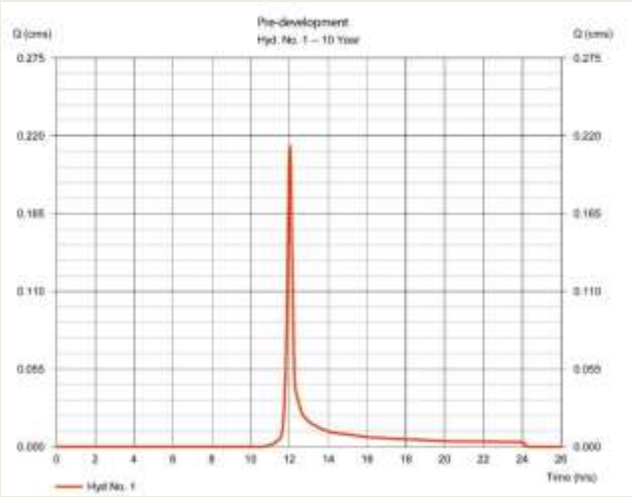
ArcMap 10.3 is the GIS software used in İzmir. Calculations for baseline values were carried out based on satellite images using GIS techniques. Land cover information is taken on site by visits. Noted down invasive *Eucalyptus* species and native herbaceous plant cover is the dominant vegetation covering app. 80% of the NBS area which is currently abandoned to its own natural dynamics. The needed soil information is provided by in-situ soil analysis. Precipitation values are estimated based on a 10-year return period with a 24-hour duration rainfall data for İzmir city.

Hydrograph Report

Hyd. No. 1 Sasalı

Pre-development

Hydrograph type	= SCS Runoff	Peak discharge	= 0.213 cms
Storm frequency	= 10 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 563.9 cum
Drainage area	= 1.374 hectare	Curve number	= 69
Basin Slope	= 0.7 %	Hydraulic length	= 289 m
Tc method	= TR55	Time of conc. (Tc)	= 11.80 min
Total precip.	= 113.00 mm	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



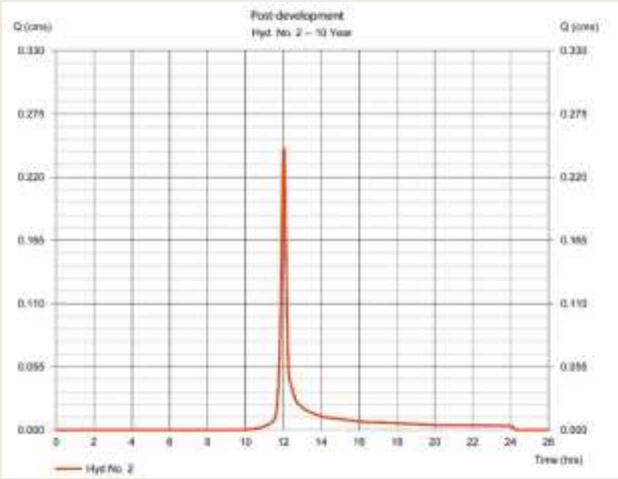
Hydrograph Report 1

Saturday, 08 / 11 / 2018

Hyd. No. 2 Sasalı

Post-development

Hydrograph type	= SCS Runoff	Peak discharge	= 0.245 cms
Storm frequency	= 10 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 641.5 cum
Drainage area	= 1.374 hectare	Curve number	= 72
Basin Slope	= 0.7 %	Hydraulic length	= 289 m
Tc method	= TR55	Time of conc. (Tc)	= 11.80 min
Total precip.	= 113.00 mm	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

	Peak Discharge	Hyd. Volume
Baseline	0.213 cms	563,9 cum
Post Intervention	0.245 cms	641,5 cum

There is 15% increase on peak discharge and 13.7% increase on hyd. volume

3.10.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No barriers	

Economical barriers	How they have been addressed

No barriers	
Social barriers	How they have been addressed
No barriers	
Environmental (including COVID)	How they have been addressed
No barriers	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This KPI is calculated under Challenge 2: Water Management.

Grassed swales, water retention pounds were applied in a pilot area within the scope of the project. These applications are one of the first sustainable stormwater management practices applications in İzmir. Especially in recent years, the effects of climate change have been experienced more severely in the city of İzmir, and heavy and sudden rains have been experienced. When this practice becomes widespread, it will be effective in reducing the impact of floods that result in loss of life and property in the city.

To mention a big step taken regarding the spread of applications, İzmir Metropolitan Municipality has adopted a new approach to sustainable stormwater management in İzmir, inspired by the experiences of sustainable management of water, low-impact urbanization, water-focused urban design and sponge city concepts applied in other cities of the world. For this purpose, for the first time in Turkey, the “Water Resources Research and Application Center” within the scope of local governments became active in Izmir Metropolitan Municipality as of September 2021. The team of experienced engineers, landscape architects and city planners are dedicated to water-oriented planning of Izmir, effective management of existing water resources, and all water-related problems, especially flood and drought events, which increase in severity with the changing climate, both in the city center and in the rural areas. Currently, an incentive campaign has been launched for the establishment of 10000 raingardens and the establishment of rainwater harvest tanks in 5000 buildings throughout the city.

What was the impact? (positive/negative, significant/non-significant)?

When Sustainable stormwater management practices become widespread in the city, it will be effective in reducing the impact of floods in a positive and significant way. In addition, the return of precipitation water to the water cycle in the most environmentally friendly way with on-site solutions will undoubtedly be very positive for the ecosystem. It is certain that it will be effective in spreading the awareness of the citizens that water is a valuable resource and asset.

3.11 CH0403 Green space accessibility (m/min)

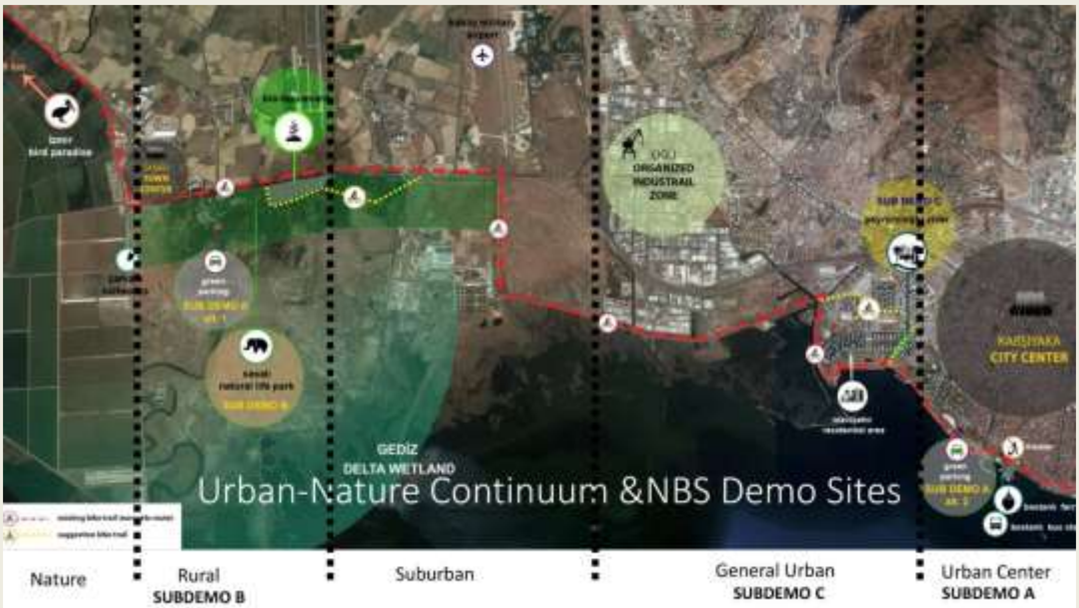
KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0403	GREEN SPACE ACCESSIBILITY (m/min)	
CITY	*RELATED NBS*	
IZMIR	IAc1, IAc2, IAc3, IAC4, IAc5, IAc8	

3.11.1 Results and Discussion

We accessed the Copernicus Land Monitoring Service (https://land.copernicus.eu/local/urban-atlas) and downloaded the 2018 release of the Izmir area. Urban Atlas is a polygon dataset created to monitor the land use alterations in densely inhabited Urban Zones (FUA's). We selected the two districts where the urban transformation has happened. We extracted the accessible green areas in the two neighbourhoods, then calculated, with a selection by location, all the residential plots 300 m closer to urban areas. We then summarized the population in the selection and transformed it into a percentage.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The following map shows the Izmir's demo areas. As can be seen, the areas of subdemo A, B, C, where several project actions have been implemented to increase green accessibility.



DISTRICTS	KPI INCREASE (%)	EXANTE	EXPOST
Mavisehir	4	96	100
Yali	0	100	100

Atakent
Bostanli
Sasali Center

Peynircioğlu Stream

3.11.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Green space accessibility is low for general public as they are insufficient comparing by population.	It is necessary to increase green areas and expand them by integrating with NBS throughout the whole city.

Economical barriers	How they have been addressed
-	-

Social barriers	How they have been addressed
In the construction of the parklets in subdemo A, the citizens reacted because the parking lot decreased.	By increasing the attractiveness and promotion of the use, the demand of the citizens can be ensured.

Environmental (including COVID)	How they have been addressed
Green spaces are insufficient for high population density.	It is necessary to increase green areas and expand them by integrating with NBS throughout the whole city.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This KPI has contributd the challenge in a positive way, especially in areas with urbanization pressure.

What was the impact? (positive/negative, significant/non-significant)?

Green spaces support urban well-being by providing space for resting, relaxation, exercise and keeping air temperatures low. So, accessibility of green space has impacted to providing crucial aspect of a livable environment and human well-being.

3.12 CH0406 Recreational value

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0406	RECREATIONAL VALUE	
CITY	*RELATED NBS*	
IZMIR		

3.12.1 Results and Discussion

Table of results

Quantify the number of people participating in the recreational activities per year, related to any NBS, both recreational (number of visitors, number of recreational activities) or cultural value (number of cultural events, people involved, children in educational activities), expressed in (nº people/year).

Halk Park, which is the continuation of the Peynircioglu Stream, has 3 separate children's playgrounds for different age groups and 2 fitness areas for increasing public health. In addition, there is a "free platform" in the park where the public can freely express themselves, based on the idea that there should be public spaces that the citizens can express themselves in there.

It has been calculated using İnVEST Visitation: Recreation and Tourism software freely available at https://storage.googleapis.com/releases.naturalcapitalproject.org/invest-userguide/latest/recreation.html). The InVEST recreation model predicts the spread of person-days of recreation, based on the locations of natural habitats and other features that factor into people's decisions about where to recreate

The indicator PUD_AVG_Year has been calculated in two neighbourhoods (Yali and Mavisehir).

PUD_YR_AVG is the average photo-user-days per year (Photo User Days). This corresponds to the average PUD described in Wood et al. (2013).

N.B. for this indicator we have only one-time threshold (which is BEFORE the transformation happened). We can make an "estimation" of the change according to other indicator.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

4 parklet implementations were carried

Green corridor in Peynircioglu Stream

Green pavements around Peynircioğlu Stream

3.12.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed

Economical barriers	How they have been addressed

Social barriers	How they have been addressed
Lack of dissemination and communication activity.	Promotion of NBS needs to be increased.

Environmental (including COVID)	How they have been addressed

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

What was the impact? (positive/negative, significant/non-significant)?

Recreational value has impacted the visitors' perceptions of the environmental quality. It has been providing recreational ecosystem services are demanded by society. Recreational value as an environmental system has provided life support services for citizens.

3.13 CH0412 Pollinator species increase

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0412	POLLINATOR SPECIES INCREASE	EGE Landscape
CITY	*RELATED NBS*	
IZM	Green shady structure, urban carbon sink, green parklets and new green corridor	

3.13.1 Results and Discussion

Native and pollinator friendly plant species were preferred in the planting design in order to increase the number of pollinator species. It is intended that they can blossom in the season when the most pollinator species are active in the area. Furthermore, pollinator houses (10 in Peynircioğlu and 10 in Sasali) were installed around the pollinator friendly plants to attract more (Figure 1).

Figure 1. Pollinator modules

The observations were carried out in the sample areas of 10 x 10 m stable quadrats representing the relevant location and every month in each area for 6 months from April to September. Simultaneously, microclimatic variables (air temperature and wind speed) of the observation areas (using a data logger) were recorded as well.

In Peynircioğlu; pollinator species observed and recorded increased dramatically up to 357 % in the 1st monitoring period and 385 % in the 2nd monitoring period compared to baseline values (Table 1 and Figure 2).

In Sasalı; pollinator species increased up to 40 % in the 1st monitoring period and 30 % in the 2nd monitoring period compared to baseline values (Table 2 and Figure 2).

	Baseline	**1st monitoring**	**2nd monitoring**
Number of plant species	306	3966	3936
Number of pollinator species	7	25	27

Table 1: Pollinator species in Peynircioğlu

	Baseline	**1st monitoring**	**2nd monitoring**
Number of plant species	299	3936	3936
Number of pollinator species	20	28	26

Table 2: Pollinator species in Sasalı

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

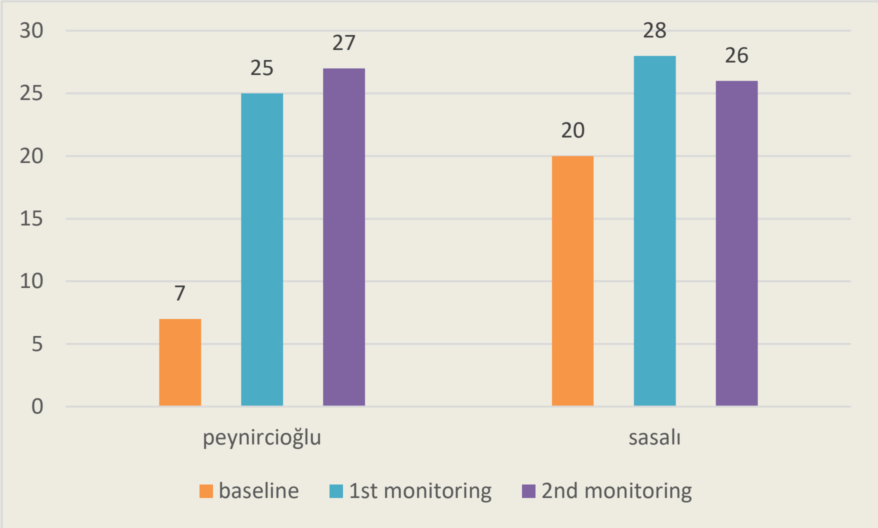


Figure 2. The number of pollinator species observed in Peynircioğlu and Sasalı

Based on the field observations in Peynircioğlu, the most favorite plants for the pollinators are Linden tree (*Tilia argentea*), Tree germander (*Teucricum fruticans*), Lavender (*Lavandula angustifolia and stoechas*), Sage (*Salvia microphylla*), Butterly bush (*Buddleja davidii*), Lilac (*Syringa vulgaris*), Judas tree (*Cercis siliquastrum*), Vitex (*Vitex agnus-castus*). Carpenter bees, flower flies, flower bees, butterflies, wasps increased dramatically in Peynircioğlu after the implementation. Honeybees stayed the same. This dramatic increase of pollinator species in Peynircioğlu In two years time showed that a successful pollinator friendly habitat was created. As the plants get older and mature and a sustainable habitat is achieved, it is expected to have more pollinator species (Figure 3).

In Sasali, Honeybees, flower bees, butterflies, wasps end carpenter bees increased. Lavender (*Lavandula angustifolia*), sage (*Salvia microphylla*), Butterly bush (*Buddleja davidii*), Lilac (*Syringa vulgaris*), Vitex (*Vitex agnus-castus*). Redroot pigweed (*Amaranthus retroflexsus*), (Rosemary (*Rosmarinus officinalis*) and Mallow (*Malva sylvestris*) seem to be the most favorable plants for the pollinator species.

Figure 3. Pollinator friendly plants

3.13.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Local governments do mowing and weeding frequently which sometimes hinders the data collection process.	There was a good communication with the Parks and Gardens Dept who are in charge of maintenance of green areas.
Economical barriers	How they have been addressed
Field surveys require high time dedication and qualified personnel for the identification of species.	The frequency of data collection is monthly instead of weekly.
Social barriers	How they have been addressed
No barriers detected.	
Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Regarding the fact that In Peynircioğlu demo site, pollinator species increased dramatically up to 385 % (in the 2nd monitoring period) compared to baseline values, this KPI shows a significant impact on biodiversity crisis or decrease.

What was the impact? (positive/negative, significant/non-significant)?

Since the climate crisis and biodiversity decrease are the challenges that greatly affect each other, every action for biodiversity could create a direct positive impact on climate change adaptation. Increased biodiversity in the demo sites would help improving ecosystem health and climate resilience in the region. That is for sure that more pollinator friendly implementations are made, more biodiversity could be achieved. This leads to more resilient urban landscapes.

3.14 CH0502 Annual mean levels of fine PM2.5 particles

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0502	ANNUAL MEAN LEVELS OF FINE PM2.5 PARTICULES	IZT-BIT
CITY	*RELATED NBS*	
IZM	Green shady structures, green covering shelter, parklets, urban garden biofilter, shade and cooling trees, grassed swales, new green corridor, green fences	

3.14.1 Results and Discussion

Table of results (summary, from Task 5.4)

Introduction

Fine particles ($PM_{2.5}$) are 2.5 micrometers in diameter or smaller, and can only be seen with an electron microscope. Fine particles are produced from all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

Air quality in Turkey is monitored by stationary Air Quality Monitoring (AQM) Stations, which were established in accordance with the Air Quality Control Regulation (AQCR), operated by the Ministry of Environment, Urbanization and Climate Change (MEUCC).

Background Data

PM2.5 values are collected by Cigli AQM station in 2019 and partially in 2020.

Figure 1: PM2.5 values

Table 1: PM2.5 values by Cigli AQM station

	Cigli 2019 (µg/m³)	**Cigli 2020 (µg/m³)**
January	2.413	-
February	2.449	-
March	2.346	-
April	9.674	-
May	9.4932	-
June	2.646	12.18
July	1.9752	13.562
August	5.452	11.692
September	7.838	11.34
October	7.838	11.583
November	7.793	16.069
December	7.826	33.454
Av.	5.645	15.697

Monitoring Data

Fixed stations

Figure 2: Vilayetler Evi Parking Lot

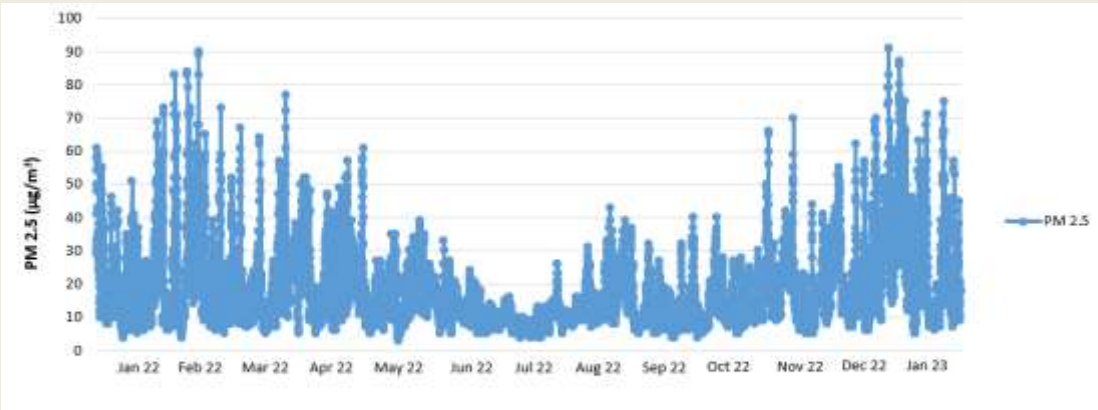


Figure 3: Vilayetler Evi Parking Lot (January 2022 - January 2023)

Figure 4: Sasali Natural Life Park Parking Lot

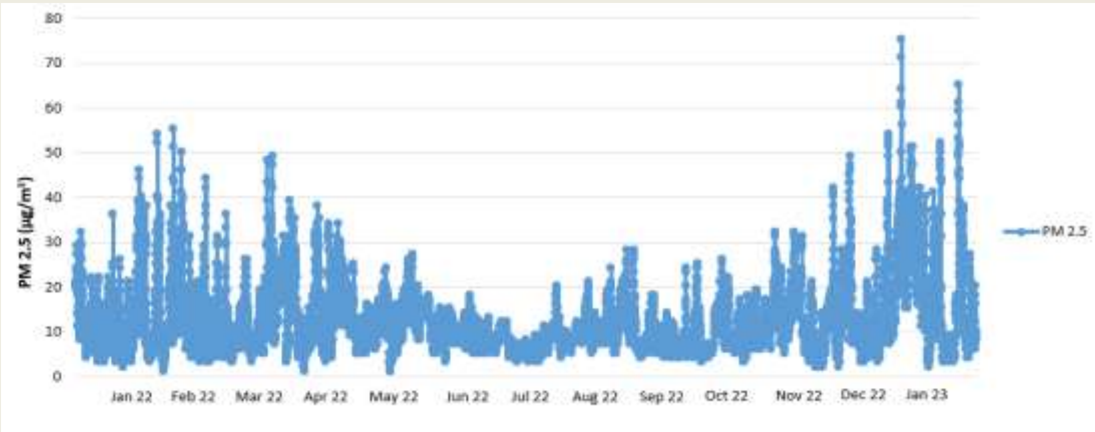


Figure 5: Sasali Natural Life Park Parking Lot (January 2022- January 2023)

Mobile Measurements

Figure 6: Fixed station at Vilayetler Evi Parking Lot (March 2022)

Figure 7: Mobile measurement device

Figure 8: Mobile measurement Control Point for Vilayetler Evi

Figure 9: Mobile measurement Control Point for Sasali

Table 2: Mobile measurement data of PM 2.5

	Vilayetler Evi (µg/m^3)	Control (µg/m^3)
March 22	1.6	1.5
April 22	18.57	19.75
May 22	14.37	15
June 22	10.62	10.25
July 22	6.33	5.6
August 22	19.29	22.67
September 22	4.8	5.5
October 22	16.52	17.2
November 22	26.33	29.25
December 22	45.8	75.5
January 23	44.36	48.56
Av.	18.96	22.80

Table 3: Mobile measurement data of PM 2.5

	Sasali (µg/m^3)	Control (µg/m^3)
March 22	11.1	9
April 22	15.46	12.25
May 22	8.53	9
June 22	11.29	6.12
July 22	10.22	8.2
August 22	16.93	18.33
September 22	4.7	4.7
October 22	9.87	10
November 22	16.8	14.14
December 22	56.3	50.6
January 23	46.43	38.17
Av.	18.87	16.41

Table 5: Fixed and mobile measurement data for 03.11.2022

March 11th, 2022	Vilayetler Evi			Sasalı		
	Intervention		Control	Intervention		Control
	Fixed	Mobile	Mobile	Fixed	Mobile	Mobile
T (°C)	6.0	10.0	11.6	8.0	11.3	9.2
RH (%)	42.8	35.0	33.0	38.0	34.9	36.1
PM 2.5 (μg/m³)	1.2	1.6	1.5	2.5	11.1	9.0

Figure 10: Growing Ivies at Vilayetler Evi (November 2022)

Table 6: Fixed and mobile measurement data for 01.23.2023

January 23rd, 2023	Vilayetler Evi			Sasalı		
	Intervention		Control	Intervention		Control
	Fixed	Mobile	Mobile	Fixed	Mobile	Mobile
T (°C)	16	20.84	20.43	20.5	23.41	24.76
RH (%)	64.25	49.98	50.04	49.73	47.16	44.84
PM 2.5 (μg/m³)	19.95	44.36	48.56	20.15	46.43	38.17

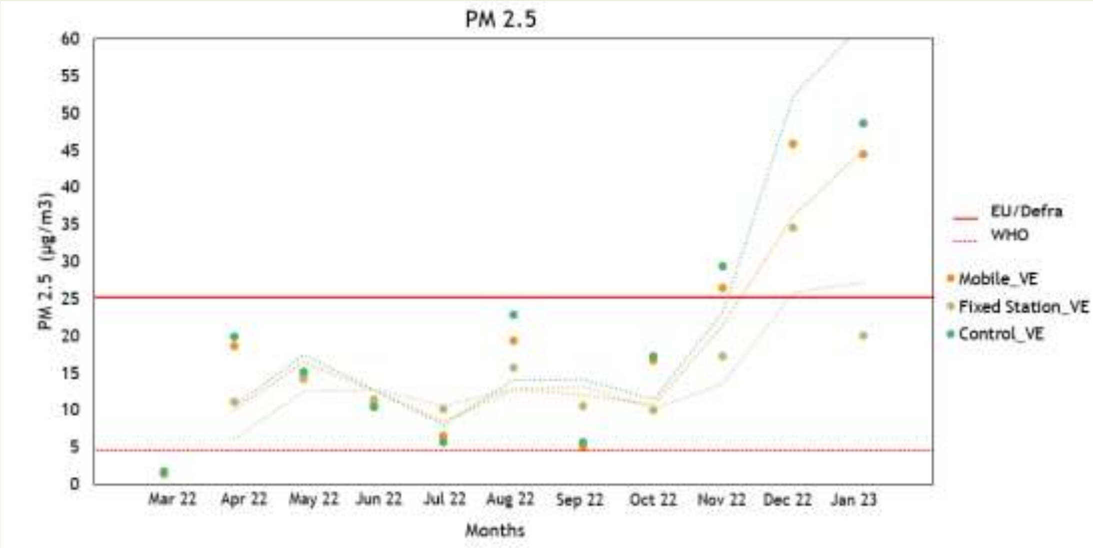


Figure 11: Comparison of the mobile measurement data at Vilayetler Evi (VE)(March 2022-January 2023).

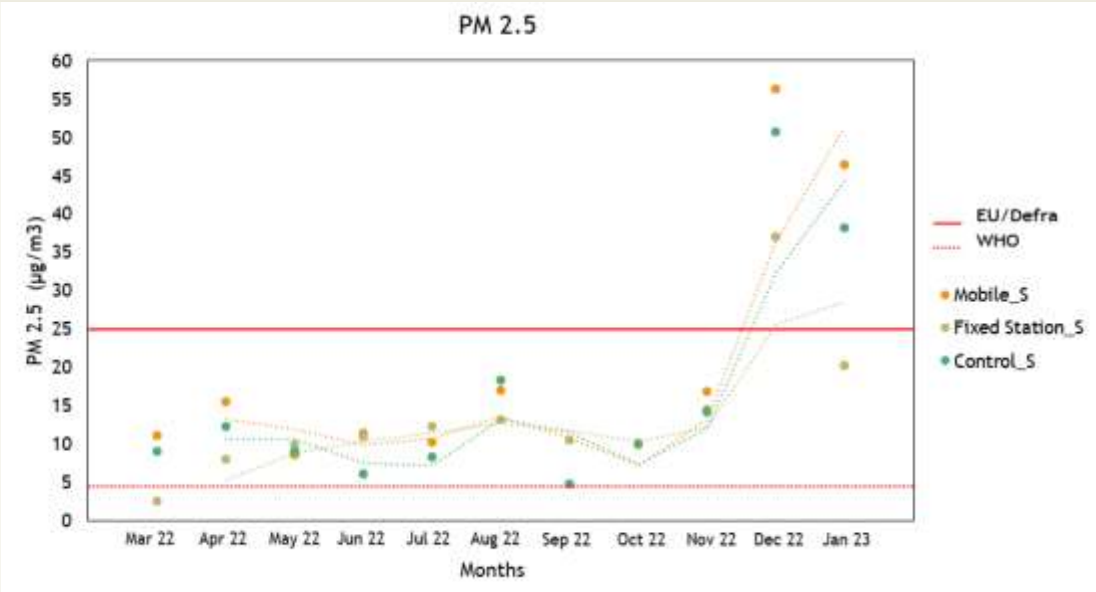


Figure 12: Comparison of the mobile measurement data at Sasali Natural Life Park (S) (March 2022-January 2023

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

In Cigli, PM2.5 values showed an increasing trend from 2019 to 2020 in summer, fall and winter seasons. Yearly average values are increased from 5.645 µg/m^3 to 15.697 µg/m^3. Fixed station measurements (av.) on the intervention sites are 13.21 µg/m^3 for Sasalı and 16.16 µg/m^3 for Vilayetler Evi. Trends indicate that in spring and fall, PM2.5 values are higher than other seasons. During the Covid-19 pandemic, all pollutants caused by traffic and industry were decreased. PM2.5 values of January-November 2022 indicate that the levels are already reached to pre-pandemic levels.

Subdemo A (Vilayetler Evi) is located in a heavily urbanized area with high population and traffic. It has been experiencing air pollution especially in winter months owing to fossil fuels. Although natural gas has been used for the heating, there are still neighborhoods in Karşıyaka and Çiğli districts that use solid fuels.

Additionally, in summer period, PM 2.5 values are decreased both for Subdemo A (Vilayetler Evi) and Subdemo B (Sasali). This is most likely because of wind speed during this season is lower than other periods. Other reason may be related the population of the city. During this period citizens go to vacation. However PM 2.5 values in most of the months are high with respect to the 'WHO' limit which is 5 µg/m^3 annualy mean.

3.14.2 Conclusions and recommendations.

People with heart or lung diseases, older adults and children are most likely to be affected by particle pollution exposure. Numerous scientific studies connect particle pollution exposure to a variety of health issues, including irritation of the eyes, nose and throat, coughing, chest tightness and shortness of breath, reduced lung function, irregular heartbeat, asthma attacks, heart attacks and premature death in people with heart or lung disease. Increasing the NBSs, number of trees will most likely reduce the impact of PM2.5 in the atmosphere to an extend while other activities causing the increase of PM2.5 continue to accelerate. There are a number of reasons the increasing of energy prices steers people to solid fuel, increasing traffic after pandemic and so on. At last glance, Subdemo A (Vilayetler Evi) and Subdemo B (Sasali) are still highly affected by the Industrial zone nearby, and also, prevailing wind direction carries the air pollutants from the Heavy Industrial Area at the north. However, despite that during the mobile measurement process, it was observed that when the wind is less, the growing ivies have a momentary positive effect on reducing the PM 2.5 values.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No technical barriers.	
Economical barriers	How they have been addressed

No economic barriers.	
Social barriers	How they have been addressed
No social barriers	
Environmental (including COVID)	How they have been addressed
Because of the Covid-19 pandemic, purchase and installation of monitoring devices are postponed. One of the fixed stations was installed at the beginning of the lock down. However, data could not be collected. The ivies were planted to the parking lots for shading are not yet covered the whole construction.	We have started to collect data at January 2022 from fixed and mobile measurement devices at the interventions. The data for 2017-2021 are obtained from Air Quality Monitoring Stations operated by the Ministry of Environment and Urbanization (MEU). These stations have lack of PM2.5 and NO_2 data. We are expecting the ivies will cover the constructions in a larger extend, then we will observe the impact of the interventions on air pollution data.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Yes, there is a positive impact on the challenge.

What was the impact? (positive/negative, significant/non-significant)?

As mentioned in the conclusions section, the positive impact was that when the wind speed is low, the growing ivies have a momentary positive effect on reducing the PM 2.5 values.

3.15 CH0503 Annual mean levels of fine PM10 particles

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0503	ANNUAL MEAN LEVELS OF FINE PM10 PARTICULES	IZT-BIT

CITY	*RELATED NBS*
IZM	Green shady structures, green covering shelter, parklets, urban garden biofilter, shade and cooling trees, grassed swales, new green corridor, green fences

3.15.1 Results and Discussion

Table of results (summary, from Task 5.4)

Introduction

Same as CH0502. Same measurement devices are used.

Background Data

PM10 values are collected by Cigli and Karsiyaka AQM stations in 2021.

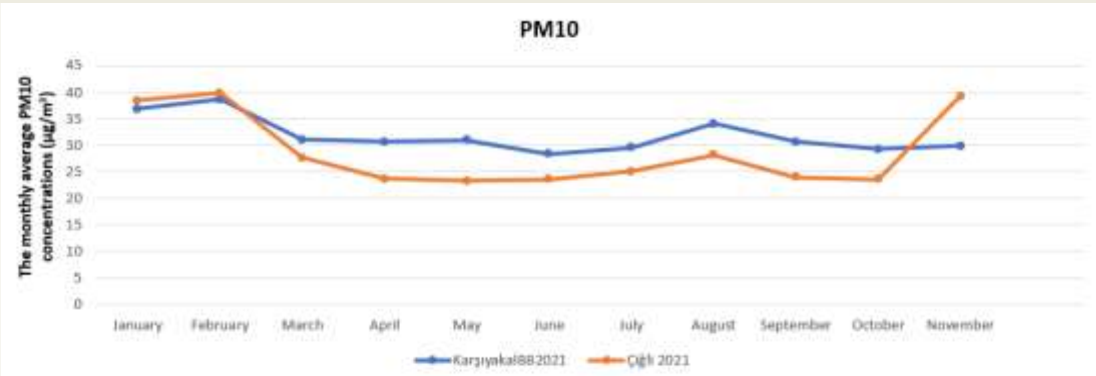


Figure 1: PM10 measurement for 2021 for Karşıyaka and Çigli

Table 1: PM 10 values by Karsiyaka and Cigli AQM station

	Karsiyaka 2021 (μg/m³)	**Cigli 2021 (μg/m³)**
January	36.87	38.49
February	38.64	39.83
March	31.06	27.74
April	30.64	23.69
May	30.99	23.27
June	28.41	23.63
July	29.62	25.07
August	34.02	28.23
September	30.71	24.0
October	29.26	23.58
November	29.87	39.29

Av.	31.82	28.81

Monitoring Data

Fixed stations

Figure 2: Vilayetler Evi Parking Lot

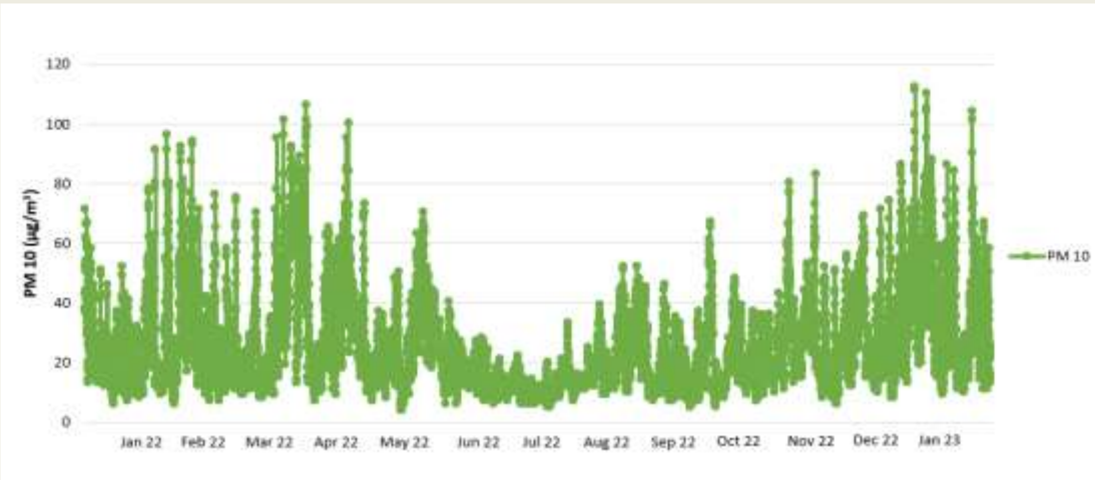


Figure 3: Vilayetler Evi Parking Lot (January 2022- January 2023)

Figure 4: Sasali Natural Life Park Parking Lot

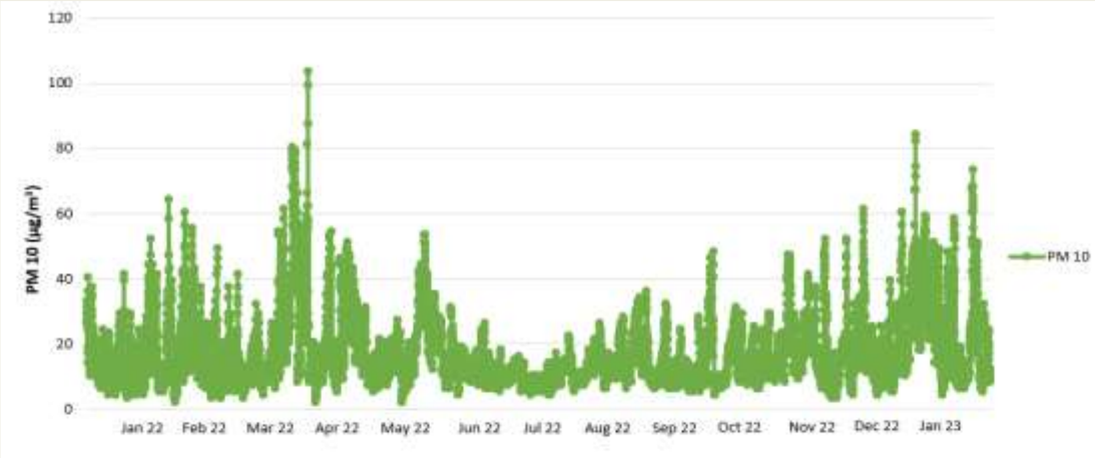


Figure 5: Sasali Natural Life Park Parking Lot (January 2022- January 2023)

Figure 6: Fixed station at Vilayetler Evi Parking Lot (March)

Figure 7: Mobile measurement device

Mobile Measurements

Figure 8: Mobile measurement Control Point for Vilayetler Evi

Figure 9: Mobile measurement Control Point for Sasali

Table 2: Mobile measurement data of PM 10

	Vilayetler Evi (µg/m^3)	Control (µg/m^3)
March 22	1.6	1.2
April 22	23.14	21.25
May 22	24.16	19
June 22	19.05	20.25
July 22	12.42	12
August 22	19	22
September 22	8.9	11
October 22	24.28	25.2
November 22	49.86	51.37
December 22	61.8	89.25
January 23	53.36	60.56
Av.	53.36	30.28

Table 3: Mobile measurement data of PM 10

	Sasali (µg/m^3)	Control (µg/m^3)
March 22	12.7	11.8
April 22	20.92	13.25
May 22	15.29	11
June 22	28.36	12
July 22	32.33	23
August 22	20	24.89
September 22	10.16	12
October 22	16.75	19.25
November 22	35.4	30.71
December 22	57.9	54.8
January 23	50.57	43.33
Av.	27.31	23.27

Table 4: Fixed and mobile measurement data for 03.11.2022

March 11th, 2022	Vilayetler Evi			Sasali		
	Intervention		Control	Intervention		Control
	Fixed	Mobile	Mobile	Fixed	Mobile	Mobile
T (°C)	6.0	10.0	11.6	8.0	11.3	9.2
RH (%)	42.8	35.0	33.0	38.0	34.9	36.1
PM 10 (μg/m³)	0	1.6	1.2	0.9	12.7	11.8

Figure 10: Growing Ivies at Vilayetler Evi (November)

Table 5: Fixed and mobile measurement data for 01.23.2023

January 23rd, 2023	Vilayetler Evi			Sasali		
	Intervention		Control	Intervention		Control
	Fixed	Mobile	Mobile	Fixed	Mobile	Mobile
T (°C)	16	20.84	20.43	20.5	23.41	24.76
RH (%)	64.25	49.98	50.04	49.73	47.16	44.84
PM 10 (μg/m³)	71.39	53.36	60.56	41.46	50.57	43.33

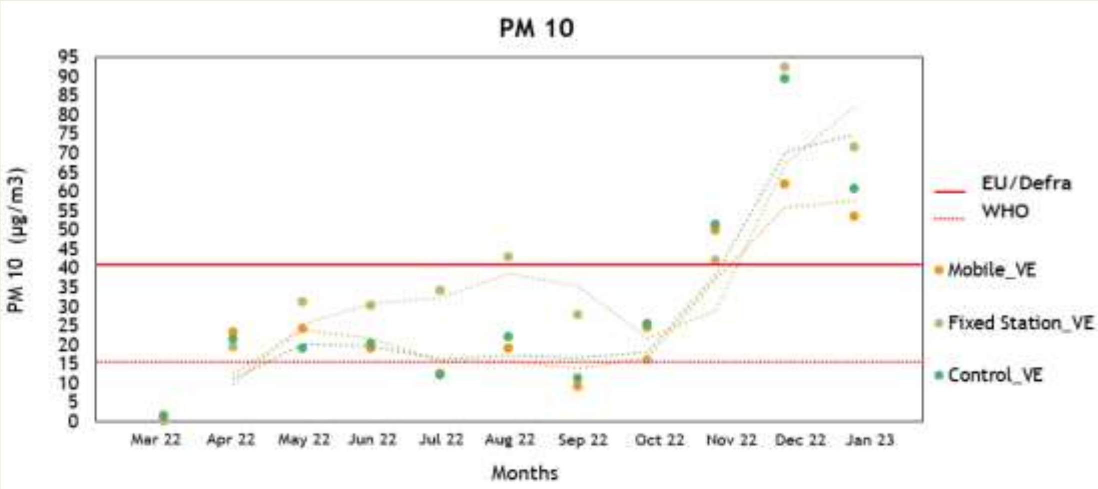


Figure 11: Comparison of the mobile measurement data at Vilayetler Evi (VE) (March 2022-January 2023).

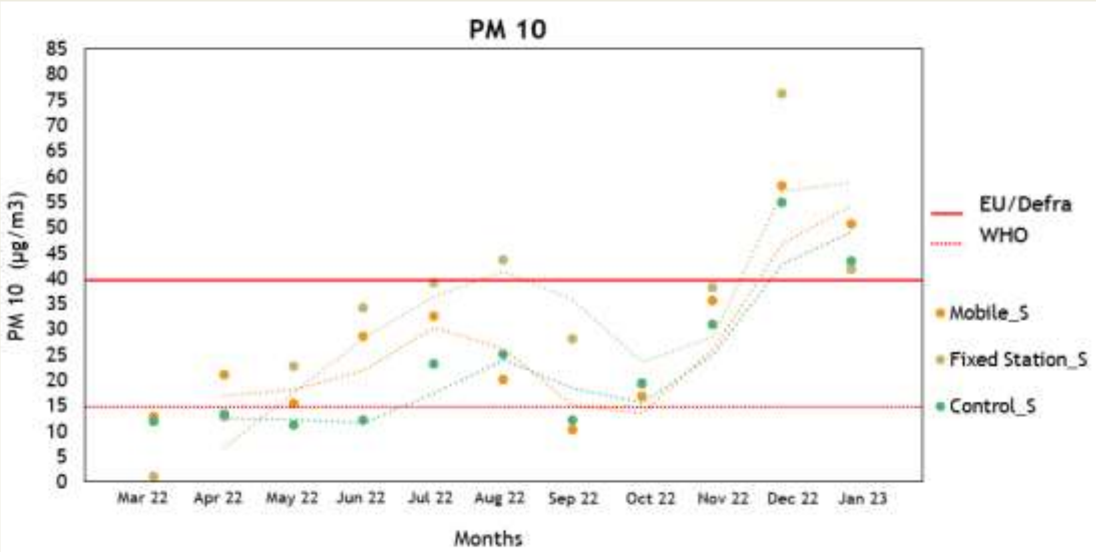


Figure 12: Comparison of the mobile measurement data at Sasali Natural Life Park (S) (March 2022- January 2023).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

When the PM10 graphs are examined, it is seen that the average value of November, December 2017 and January, February 2018 is 64.25 µg/m³. This value decreased in the following winter months to 54.25 µg/m³ for November-December 2018 and January-February 2019. Likewise, a decrease was observed for the 2020 and 2021 periods, and average values of 47.25 µg/m³ and 48 µg/m³ were measured, respectively. During the period of 16 March-31 May 2020 when the covid-19 measures were taken, there was a decrease in PM10 values as expected. Then, a sudden increase in PM10 values are observed in the second half of May in 2020. The reason of that would be the sudden relaxation of control measures after a lengthy lockdown within the city that resulted in increased human activity.

Fixed station measurements (av.) on the intervention sites are 21.74 µg/m³ for Sasali and 29.02 µg/m³ for Vilayetler Evi. The data in this period is still below the pre-pandemic levels.

3.15.2 Conclusions and recommendations.

At last glance, Subdemo A (Vilayetler Evi) and Subdemo B (Sasali) are still highly affected by the Industrial zone nearby, and also, prevailing wind direction carries the air pollutants from the Heavy Industrial Area at the north. However, despite that during the mobile measurement process, it was observed that when the wind is less, the growing ivies have a momentary positive effect on reducing the PM 10 values.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No technical barriers.	
Economical barriers	How they have been addressed
No economic barriers	
Social barriers	How they have been addressed
No social barriers	
Environmental (including COVID)	How they have been addressed

Because of the Covid-19 pandemic, purchase and installation of monitoring devices are postponed. One of the fixed stations was installed at the beginning of the lock down. However, data could not be collected. The ivies were planted to the parking lots for shading are not yet covered the whole construction.	We have started to collect data at January 2022 from fixed and mobile measurement devices at the interventions. The data for 2017-2021 are obtained from Air Quality Monitoring Stations operated by the Ministry of Environment and Urbanization (MEU). These stations have lack of PM2.5 and NO_2 data. We are expecting the ivies will cover the constructions in a larger extend, then we will observe the impact of the interventions on air pollution data.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

Same as CH0502. Yes, there is a positive impact on the challenge.

What was the impact? (positive/negative, significant/non-significant)?

As mentioned in the conclusions section of CH0502, the same applies to CH0503, the positive impact was that when the wind speed is low, the growing ivies have a momentary positive effect on reducing the PM 10 values.

3.16 CH0504 Emissions trends of NO2

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0504	EMMISIONS TRENDS of NO_2	IZT-BIT
CITY	*RELATED NBS*	
IZM	Green shady structures, green covering shelter, parklets, urban garden biofilter, shade and cooling trees, grassed swales, new green corridor, green fences	

3.16.1 Results and Discussion

Table of results (summary, from Task 5.4)

Introduction

Same as CH0502. Same measurement devices are used.

Background Data

NO_2 values are collected by only Cigli AQM station in 2018 and 2019.

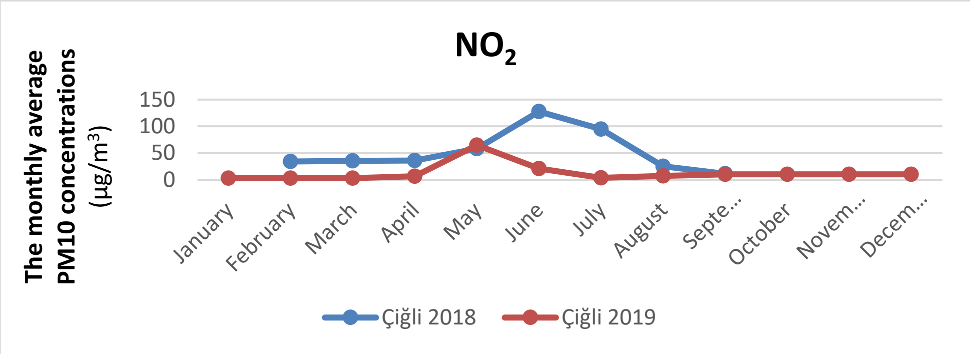


Figure 1: NO_2 values

Table 1: NO_2 values by Cigli AQM station

	Cigli 2018 (µg/m³)	Cigli 2019 (µg/m³)
January	-	3.008
February	34.327	3.02
March	35.265	3.016
April	36.164	6.71
May	58.484	64.795
June	127.609	20.925
July	95.023	3.8656
August	25.43	7.401
September	11.369	10.403
October	-	10.416
November	-	10.424
December	-	10.437
Av.	52.96	15.017

Monitoring Data

Fixed stations

Figure 2: Vilayetler Evi Parking Lot

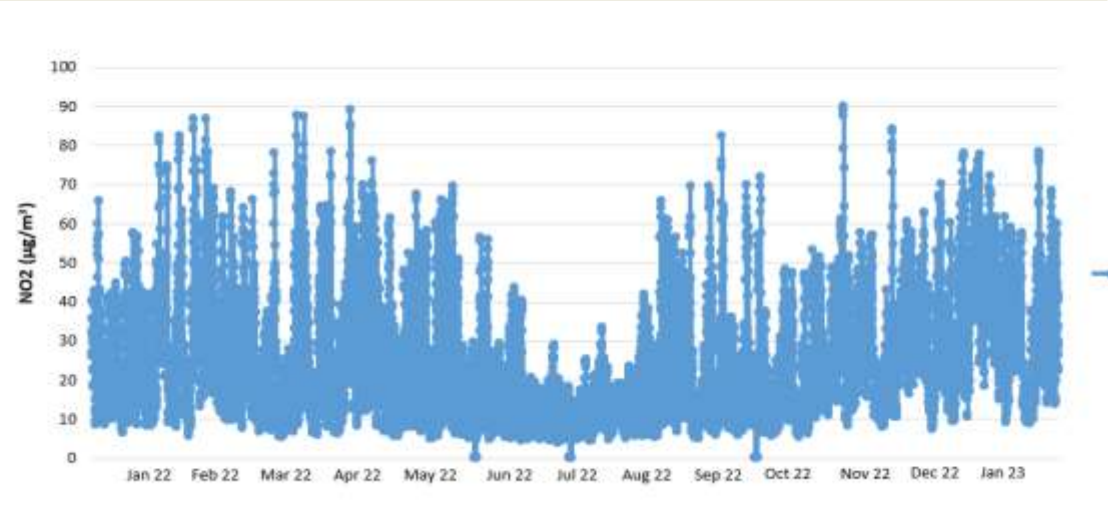


Figure 3: Vilayetler Evi Parking Lot (January 2022 – January 2023)

Figure 4: Sasali Natural Life Park Parking Lot

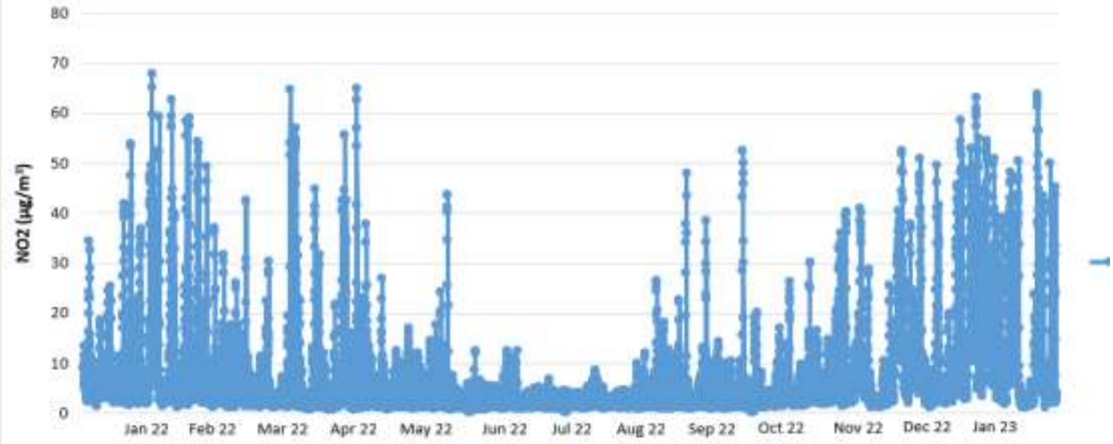


Figure 5: Sasali Natural Life Park Parking Lot (January 2022- January 2023)

Figure 6: Fixed station at Vilayetler Evi Parking Lot (March 2022)

Figure 7: Mobile measurement device

Mobile Measurements

Figure 8: Mobile measurement Control Point for Vilayetler Evi

Figure 9: Mobile measurement Control Point for Sasali

Table 2: Mobile measurement data of NO_2

	Vilayetler Evi (µg/m^3)	Control (µg/m^3)
March 22	99.6	114.7
April 22	31.82	48
May 22	42.45	72.5
June 22	36.31	38.4
July 22	15.83	38.4
August 22	31.76	64.44
September 22	10.12	43
October 22	27.2	36.75
November 22	44.25	43.71
December 22	94.37	100.33
January 23	111.36	128.33
Av.	49.55	66.23

Table 3: Mobile measurement data of NO_2

	Sasali (µg/m^3)	Control (µg/m^3)
March 22	110.9	97.8
April 22	42.31	52.57
May 22	19.12	32.5
June 22	25.85	10.25
July 22	21	3.2
August 22	31.89	44.33
September 22	63.7	54.25
October 22	54.15	55.4
November 22	42	45.55
December 22	53.37	83.2
January 23	104.14	105.6
Av.	51.67	56.06

March 11th, 2022	**Vilayetler Evi**			**Sasali**		
	Intervention		**Control**	**Intervention**		**Control**
	Fixed	**Mobile**	**Mobile**	**Fixed**	**Mobile**	**Mobile**
T (°C)	6.0	10.0	11.6	8.0	11.3	9.2
RH (%)	42.8	35.0	33.0	38.0	34.9	36.1
NO_2 (µg/m^3)	80.8	99.6	114.7	83.7	110.9	97.8

Table 4: Fixed and mobile measurement data for 03.11.2022

Figure 10: Growing Ivies at Vilayetler Evi (November 2022)

Table 5: Fixed and mobile measurement data for 01.23.2023

January 23rd, 2023	Vilayetler Evi			Sasali		
	Intervention		Control	Intervention		Contrc
	Fixed	Mobile	Mobile	Fixed	Mobile	Mobil
T (°C)	16	20.84	20.43	20.5	23.41	24.76
RH (%)	64.25	49.98	50.04	49.73	47.16	44.84
NO_2 (µg/m^3)	47.71	111.36	128.33	74.5	104.14	105.6

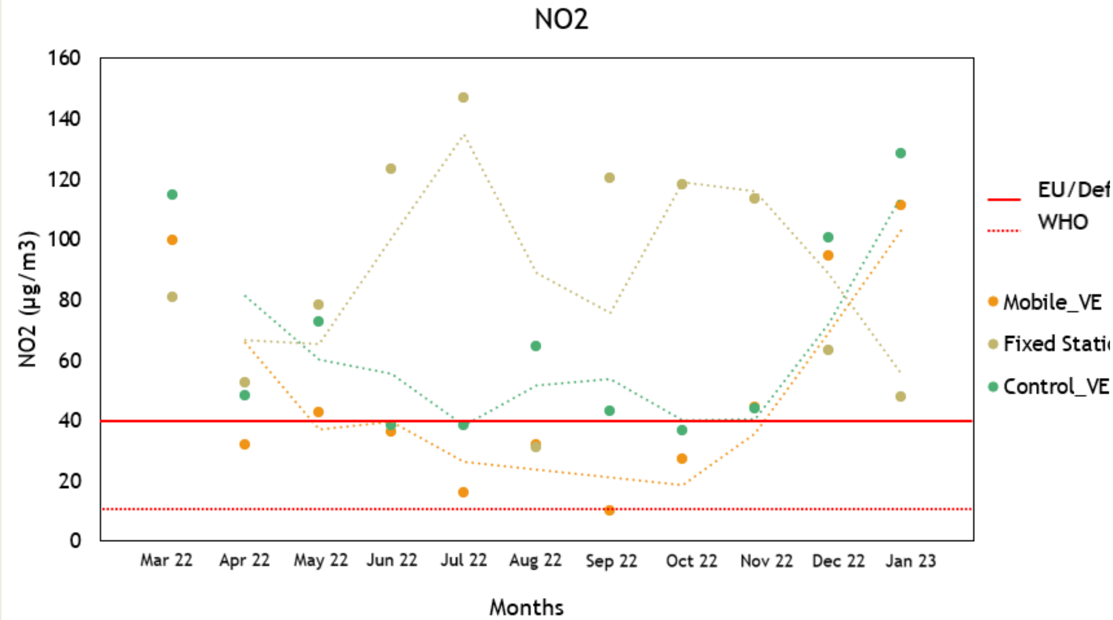


Figure 11: Comparison of the mobile measurement data at Vilayetler Evi (VE)(March 2022- January 2023).

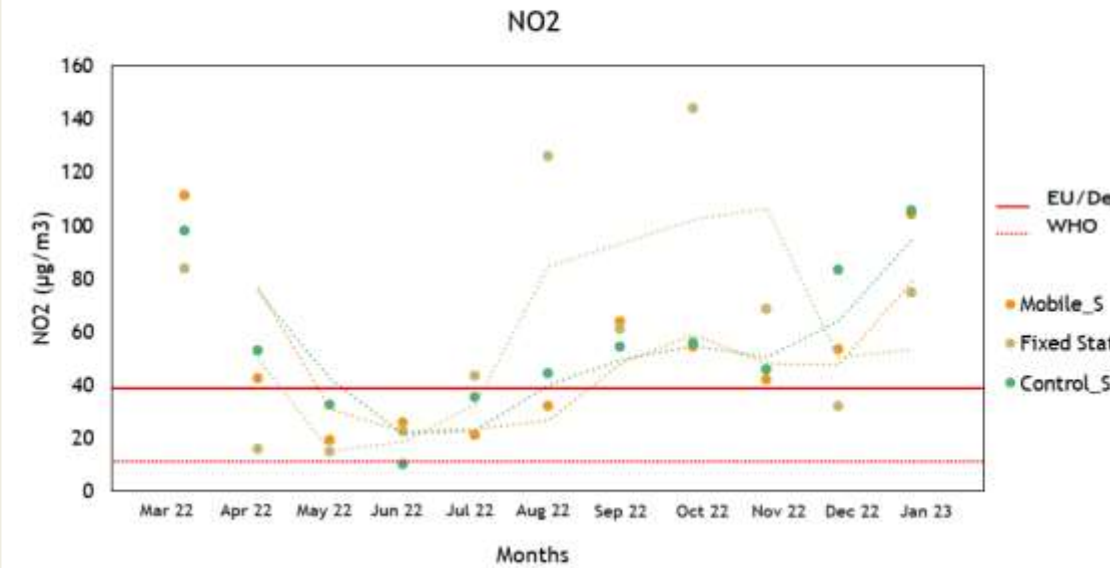


Figure 12: Comparison of the mobile measurement data at Sasali Natural Life Park (S) (March 2022- January 2023).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

In Cigli, NO_2 values are high in spring and summer months. Yearly average of 2018 is 52.96 µg/m^3 while 2019 value is 15.017 µg/m^3. Fixed station measurements (av.) on the intervention sites are 22.56 µg/m^3 for Sasalı and 48.88 µg/m^3 for Vilayetler Evi. Trends are increasing in spring period similar to historic data as can be seen mobile and fixed measurements in March 11th, 2022 (Mobile measurements: 99.6 µg/m^3 for Vilayetler Evi, 110.9 µg/m^3 for Sasalı).

Unlike CH0502, NO2 values passed both the EU/Defra and WHO limitations. Still, in summer months there is a drop in NO2 values similar to the reasons for CH0502 drop. It is observed that NO2 values are mostly less in Sasali than Vilayetler Evi data.

Conclusions and recommendations.

At last glance, Subdemo A (Vilayetler Evi) and Subdemo B (Sasali) are still highly affected by the Industrial zone nearby, and also, prevailing wind direction carries the air pollutants from the Heavy Industrial Area at the north. However, despite that during the mobile measurement process, it was observed that when the wind is less, the growing ivies have a momentary positive effect on reducing the NO_2 values.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No technical barriers.	
Economical barriers	How they have been addressed
No economical barriers.	
Social barriers	How they have been addressed
No social barriers.	
Environmental (including COVID)	How they have been addressed
Same as CH0502.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
Same as CH0502.

What was the impact? (positive/negative, significant/non-significant)?

Same as CH0502.

3.17 CH0505 Emissions trends of SOx

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0505	EMMISIONS TRENDS of SOx	IZT-BIT
CITY	*RELATED NBS*	
IZM	Green shady structures, green covering shelter, parklets, urban garden biofilter, shade and cooling trees, grassed swales, new green corridor, green fences	

3.17.1 Results and Discussion

Table of results (summary, from Task 5.4)

Introduction

Same as CH0502. Same measurement devices are used.

Background Data

SO_2 values are collected by Cigli and Karsiyaka AQM stations in 2021.

Figure 1: SO_2 measurement for 2021 for Karsiyaka and Cigli

Table 1: SO_2 values by Karsiyaka and Cigli AQM station

	Karsiyaka 2021 (µg/m³)	**Cigli 2021 (µg/m³)**
January	5.54	12.48

February	8.46	6.40
March	8.16	11.72
April	5.38	12.69
May	4.35	13.43
June	4.13	13.22
July	5.82	11.19
August	8.52	13.55
September	7.53	13.38
October	8.19	10.50
November	8.32	9.48
Av.	6.76	11.64

Monitoring Data

Fixed stations

Figure 2: Vilayetler Evi Parking Lot

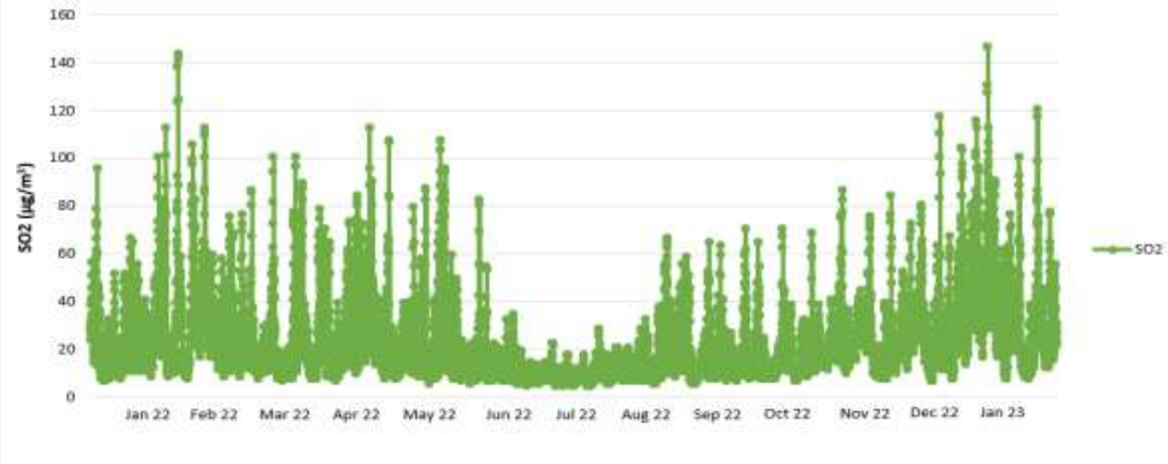


Figure 3: Vilayetler Evi Parking Lot (January 2022 – January 2023)

Figure 4: Sasali Natural Life Park Parking Lot

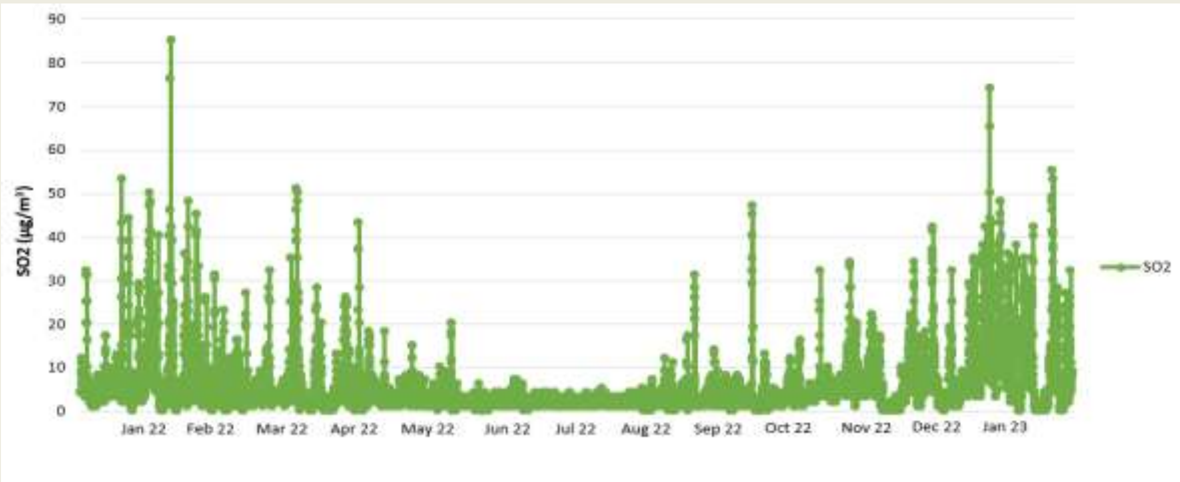


Figure 5: Sasali Natural Life Park Parking Lot (January 2022- January 2023)

Mobile Measurements

Figure 6: Fixed station at Vilayetler Evi Parking Lot (March)

Figure 7: Mobile measurement device

Table 2: Mobile measurement data of SO_2

Table 3: Mobile measurement data of SO_2

	Vilayetler Evi (µg/m³)	Control (µg/m³)
March 22	0	0
April 22	0	0
May 22	0	0
June 22	0	81.11
July 22	0	0
August 22	55.38	87.5
September 22	0	0
October 22	0	0
November 22	0	0
December 22	7.5	54
January 23	0	0
Av.	5.72	20.24

	Sasali (µg/m³)	Control (µg/m³)
March 22	13.1	13.1
April 22	0	0
May 22	0	0
June 22	0	3.75
July 22	0	12.5
August 22	1.11	140
September 22	12	61.67
October 22	5.71	0
November 22	0	0
December 22	96.25	0
January 23	0	0
Av.	11.65	21

Figure 8: Mobile measurement Control Point for Vilayetler Evi

Figure 9: Mobile measurement Control Point for Sasali

Figure 10: Growing Ivies at Vilayetler Evi (November)

Table 4: Fixed and mobile measurement data for 03.11.2022

January 23rd, 2023	Vilayetler Evi			Sasali		
	Intervention		Control	Intervention		Control
	Fixed	Mobile	Mobile	Fixed	Mobile	Mobile
T (°C)	16	20.84	20.43	20.5	23.41	24.76
RH (%)	64.25	49.98	50.04	49.73	47.16	44.84
SO_2 (µg/m^3)	11.42	0	0	7.5	0	0

Table 5: Fixed and mobile measurement data for 01.23.2023

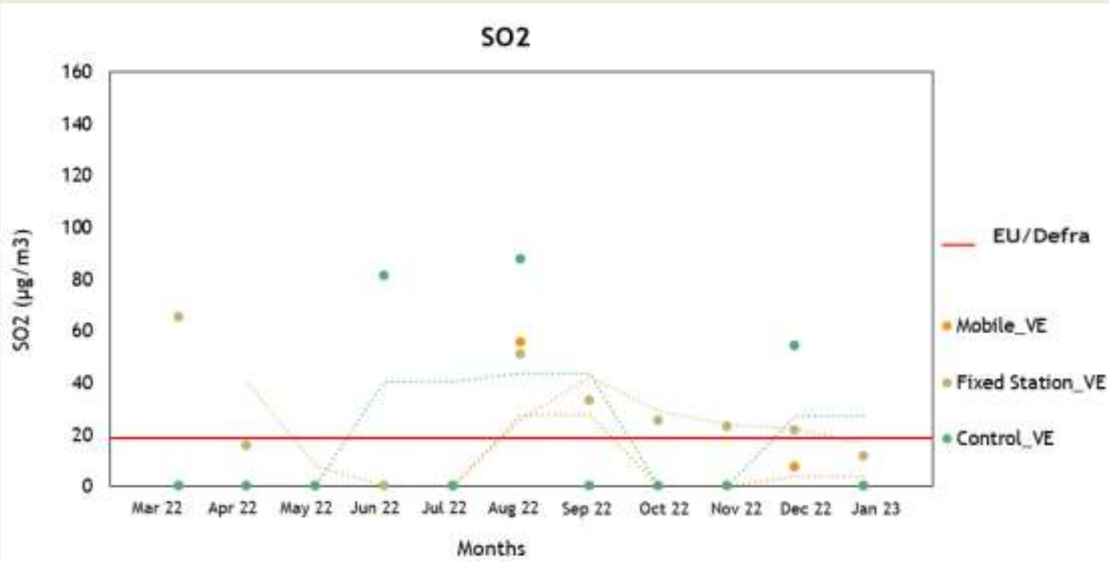


Figure 11: Comparison of the mobile measurement data at Vilayetler Evi (VE) (March 2022 - January 2023).

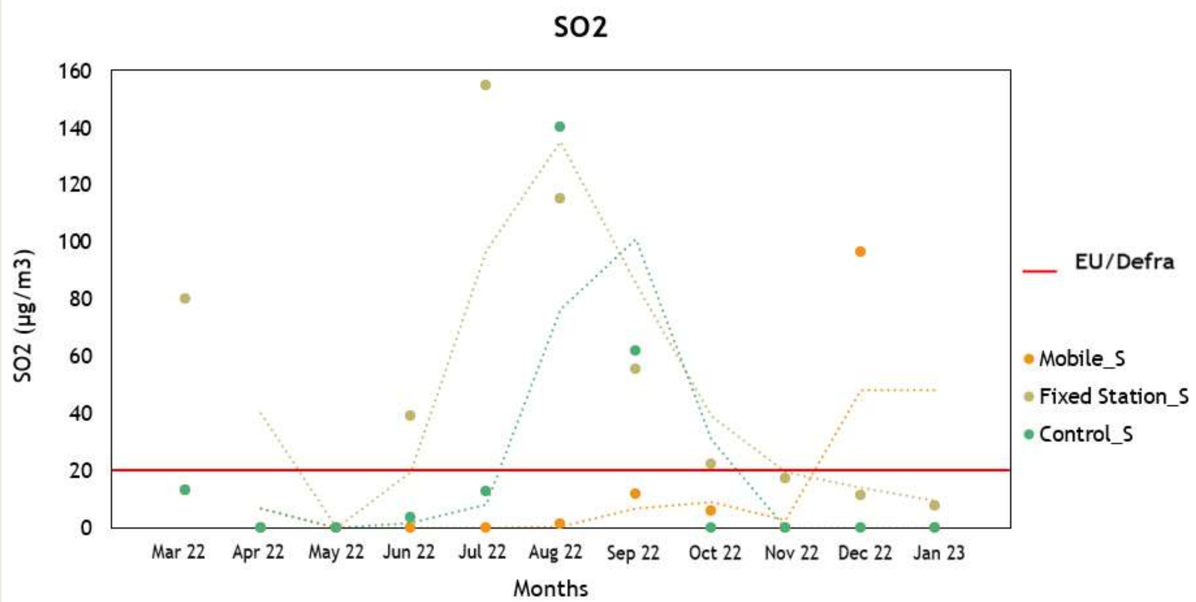


Figure 12: Comparison of the mobile measurement data at Sasali Natural Life Park (S) (March 2022 - January 2023).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The daily mean SO_2 graphs (2017-2021) reflects that SO_2 concentrations show fluctuations on a yearly basis. The highest decrease in SO_2 values is encountered in 2020. As a result of the measures taken within the scope of the pandemic in 2020, a serious decrease in SO_2 value recorded between March 16-May 31, 2020. In the following normalization period (June 1-30, 2020), decreasing trend was carried out.

Fixed station measurements (av.) on the intervention sites between January-March 2022 are 41.92 µg/m^3 for Sasali and 36.68 µg/m^3 for Vilayetler Evi. The data in this period is much higher than the pre-pandemic levels.

3.17.2 Conclusions and recommendations.

At last glance, Subdemo A (Vilayetler Evi) and Subdemo B (Sasali) are still highly affected by the Industrial zone nearby, and also, prevailing wind direction carries the air pollutants from the Heavy Industrial Area at the north. However, despite that during the mobile measurement process, it was observed that when the wind is less, the growing ivies have a momentary positive effect on reducing the SO_2 values.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No technical barriers.	
Economical barriers	How they have been addressed
No economical barriers.	
Social barriers	How they have been addressed
No social barriers.	
Environmental (including COVID)	How they have been addressed
Same as CH0502.	Same as CH0502.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
Same as CH0502.
What was the impact? (positive/negative, significant/non-significant)?
Same as CH0502.

3.18 CH0508 Pollutant removed by vegetation

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0508	POLLUTANT REMOVED BY VEGETATION	EGE Landscape
CITY	*RELATED NBS*	
IZM	Green parklets, urban carbon sink: planting new trees, green fences, green walls, shade and cooling trees	

3.18.1 Results and Discussion

Air pollutant removal capacity of trees and shrubs, such as carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM2,5 and 10) and sulphur dioxide (SO_2) was estimated based on dry deposition model of I-tree Eco v6. The structure information of plants including height, diameters of breast height and crown size is collected by measuring every single plant in the field for the baseline and monitoring calculations.

In Peynircioğlu, the air pollution removal capacity of plants increased up to 65% in the 1st monitoring period and 75 % in the 2nd monitoring period compared to baseline value (Table 1 and Figure 1).

On the contrary, after implementation in Sasalı, air pollutant removal capacity of plants decreased almost 50 % (Table 2 and Figure 2). But that was something very well expected because large grown trees in the demo site had to be replaced by the young ones. Thus, only one monitoring was carried out in Sasali because pollutant removal capacity of these large canopy trees is not replaceable easily in a couple of years. It is expected that this ecosystem service of the plants will be increasing over time as they grow.

	Baseline	First monitoring	Second monitoring
Number of plant species	306	3,966	3,936
Pollutant removed	51,51 kg/year	85,37 kg/year	90,15 kg/year

Table 1: Pollutant removal rate by vegetation in Peynircioğlu

	Baseline	First monitoring
Number of plant species	299	3,936
Pollutant removed	33,81 kg/year	16,83 kg/year

Table 1: Pollutant removal rate by vegetation in Sasalı

Figure 1: Large canopy trees of Peynircioğlu (left) and young plants of Sasalı (right)

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The main pollutants removed by trees are O_3 and PM10 in Peynircioğlu (Figure 3). It is obvious that after the intervention, pollutants removed by trees increased significantly because of increased number of plants and canopy cover in the 2nd monitoring.

In Sasalı, high amount of O_3, PM10, and NO_2 was absorbed by the plants (Figure 4). Before the implementation, pollutants were removed mainly by large eucalyptus trees (*Eucalyptus cameldulensis*) that were dominant in the area. After the implementation, mainly Strawberry tree (*Arbutus unedo*), Linden tree (*Tilia tomentosa*), Goat willow (*Salix caprea*) and other species provide contribution to this service.

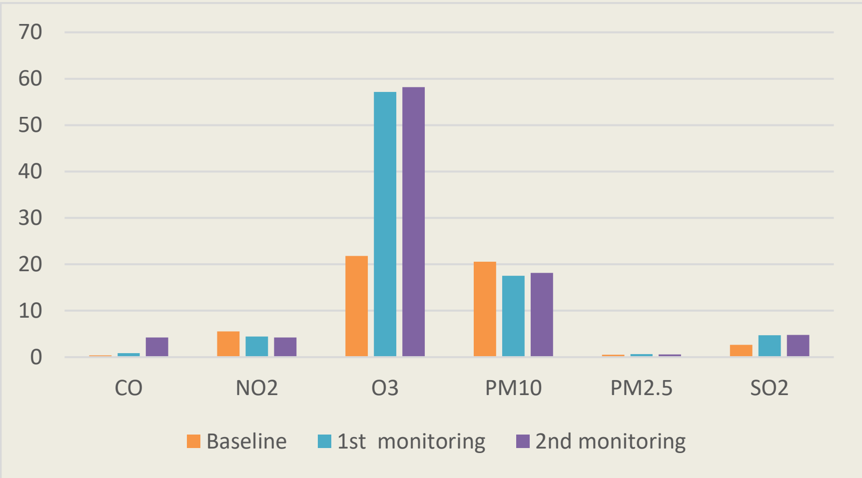


Figure 3: Pollutant removed by plants in Peynircioğlu

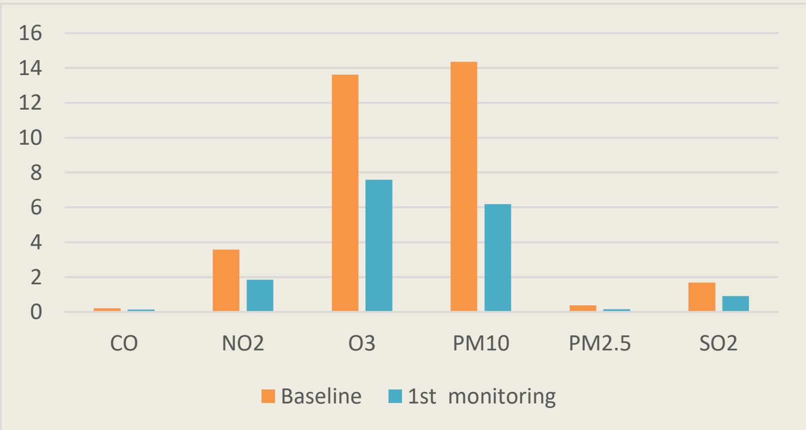


Figure 4: Pollutant removed by plants in Sasalı.

3.18.2 Conclusions and recommendations

It is vital that proper maintenance is required to keep the pollutant removal levels increasing over time. Canopy cover should not be trimmed at all unless it is completely dried. Death plants should be renewed immediately with large ones.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No barriers detected.	
Economical barriers	How they have been addressed
No barriers detected.	
Social barriers	How they have been addressed
No barriers detected.	
Environmental (including COVID)	How they have been addressed
No barriers detected.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This KPI creates a significant impact on the air pollution challenge. Planting new trees and increasing canopy cover definitely enhance the air purification functions of urban green areas. There are a number of studies that verifies this impact. Therefore, many cities try to increase the number of plants and canopy cover all over the city in order to combat air pollution as well as providing other ecosystem services.

Pollutant removal capacity of Sasalı decreased noticeably compared to baseline values because in the 1st monitoring. That decrease can be explained with removal of large old grown trees in the site. In the future, with sustainable maintenance measures, it is possible to see some increases for this service. But it may take a while to reach the level of pre-implementation.

What was the impact? (positive/negative, significant/non-significant)?

In Peynircioğlu, it is obvious that the impact of KPI was very positive.

In Sasalı, on the other hand, the impact of KPI was already quite negative in 1st monitoring. Loss of large canopy trees in the site could be compensated at least over a five years of period with sustainable maintenance measures as the new plants grow.

3.19 CH0601 Green space quantity (m/min)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0601	GREEN SPACE QUANTITY (m/min)	
CITY	*RELATED NBS*	
IZMIR		

3.19.1 Results and Discussion

Table of results (summary, from Task 5.4)

	KPI_CH0601
EXANTE (m)	
EXPOST (m)	
KPI INCREASE (%)	

Average distance from houses to the nearest Green Infrastructure (m).

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The following maps shows 1st Mavisehir, 2nd Yali neighbourhoods' boundry. The green space quantity has been increased from %16 to %17 in Mavisehir, from %9 to %10 in Yali neighbourhood.

Copernicus ONDA DIAS service has been accessed ,(https://www.onda-dias.eu/cms/) created an IZTECH user profile and downloaded the tile MSIL2A of 6th June 2021. We then processed the single bands and created a raster multiband made by band 4, band 3, band 2, and infrared band 8. We applied a supervised classification sampling and auto-produced a Land Use Land Cover for Izmir (10 meters ground resolution). We then calculated the green space as the quantity of permeable spaces in the two selected neighborhoods of the project area.

Measured on a postprocessed LULC by supervised classification sampling method on Sentinel L2A-downloaded image (06 June 2021). Extraction of green areas and calculation of the % of green areas per neighbourhood.

Figure 6: From 16% to 17% (Mavisehir Neighborhood)

Figure 7: From 9% to 10% (Yali Neighborhood)

DISTRICTS	KPI INCREASE (%)	EXANTE	EXPOST
Mavisehir	%1	16	17
Yali	%1	9	10

Examples of green spaces: 26 trees planted around car park and parklets

3.19.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*

As the rate of urbanization is very high, it is difficult to expand the quantity of green space in the whole city.	Green space quantity could be increased them by integrating with NBS throughout the whole city.
Economical barriers	How they have been addressed
-	
Social barriers	How they have been addressed
NBS implementation in the neighborhoods with high density may be seen as useless by the society.	The role of NBS in reducing the effects of climate change should be explained to the society.
Environmental (including COVID)	How they have been addressed
-	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?
What was the impact? (positive/negative, significant/non-significant)?
Increased green space has been providing to creation of environments that support active lifestyles and improve access to exercise opportunities significantly for citizens. Besides that, has significantly reduced greenhouse gas emission and the risk of floods and overflows, especially around the Peynircioglu Stream.

3.20 CH0702 Citizen perception

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0702	CITIZEN PERCEPTION	
CITY	*RELATED NBS*	
IZMIR	IAc23, IAc24, IAc25. IAc26, IAc27 and IAc28	

3.20.1 Results and Discussion

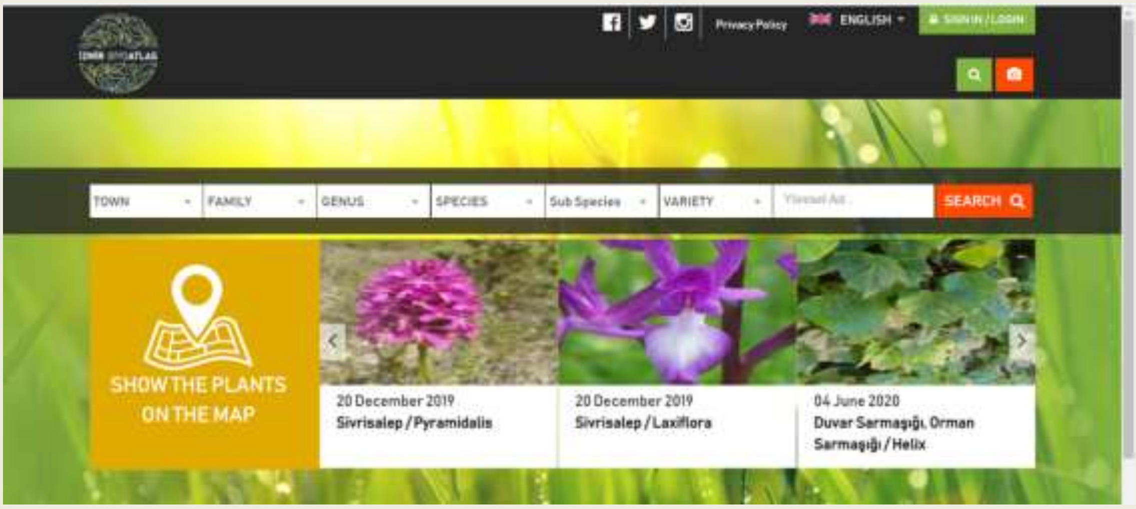
Table of results (summary, from Task 5.4)

- Nature Based Solutions Training
- Basic Ecology and Biogeography
- Ecology and Economy Relationship
- Nature Based Solutions

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

The bioatlas website has been introduced to citizens. The photos of plants captured by citizens are uploaded to the system (it is a must to be a member of the site). There are some rules regarding the light, the angle of the photos taken, etc. The location of the plant also need to be stated. Academics who are experts send the detailed information about the plant.

http://www.izmirbiyoatlas.org



3.20.2 Conclusions and recommendations.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	How they have been addressed
No barriers	

Economical barriers	How they have been addressed
No barriers	

Social barriers	How they have been addressed
Inability to reach all users in the demo site.	Dissemination and communication activities should be increased

Environmental (including COVID)	How they have been addressed
No barriers	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

What was the impact? (positive/negative, significant/non-significant)?
As the flood and overflow risk decreased through the NBSs implemented around the Peynircioglu stream, the approach of the citizens to the NBS implementations developed positively. In addition, the creation of a digital platform which is "Biz İzmir" that includes

some of the NBS implementations facilitates the work of city wide users. In particular, the users can record type of plant or obtain information about existing listed plants in "Bioatlas" application related to increasing biodiversity.

3.21 CH0704 Urban farming activities

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0704	URBAN FARMİNG ACTIVITIES	EGE Soil
CITY	*RELATED NBS*	
IZM		

3.21.1 Results and Discussion

Table of results (summary, from Task 5.4)

Climate-smart greenhouse can be defined as an approach for transforming and reorienting agricultural development under the new realities of climate change. Climate smart soil and agriculture will be practice in a greenhouse and on field together. This NBS employs greenhouse facilities to illustrate the effects of climate change on urban green vegetation used in urban green areas and farming (for both urban and peri-urban areas). This practice will help to select adequate vegetal species for urban farming and to establish community practices and new social forms of organization.

Figure 1: Climate smart greenhouse

Climate smart greenhouse includes 3 production & demonstration parts and it is located in the eastern part of the Sasalı Natural Life Park. There is also an open field agriculture that demonstrates on effects of changed climate condition on soils and plants (162 sqm) and a seminar room designed for educative propose for students and visitors (162 sqm).

Studies are being done within the greenhouses to demonstrate producing agricultural crop continuously under changed climate condition. In another 162 sqm of the greenhouse there is a parabolic solar heating system and also use of solar energy for lightening.

There is also a vertical planting system implemented (Figure 2) we plan to get 17 times more product from the unit area.


Figure 2: Vertical farming system

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

One of the studies on urban farming is about agricultural production on high-level salty soils at field conditions. For this purpose, a spatial planting technique has been developed. According to this technique, high ridge planting pads 70 cm high from the ground are prepared for planting seedlings.


Figure 3: Production under salty conditions

Baseline measurements are made in sections such as high ridge planting and data are obtained periodically. In other sections, measurement data will begin to be obtained as each section is completed.

Fruit trees are sensitive to salinity and cannot grow in salty soils. After these processes, soil samples were taken both from the top of the high ridges and the areas between this row (ground). Soil samples were taken from 9 points separately in July and October to see the effect of climate on soil salinity. It was observed that the salinity (EC) was minimally increased in the high ridge (HR) samples while rising in the soils taken from the ground (GR).

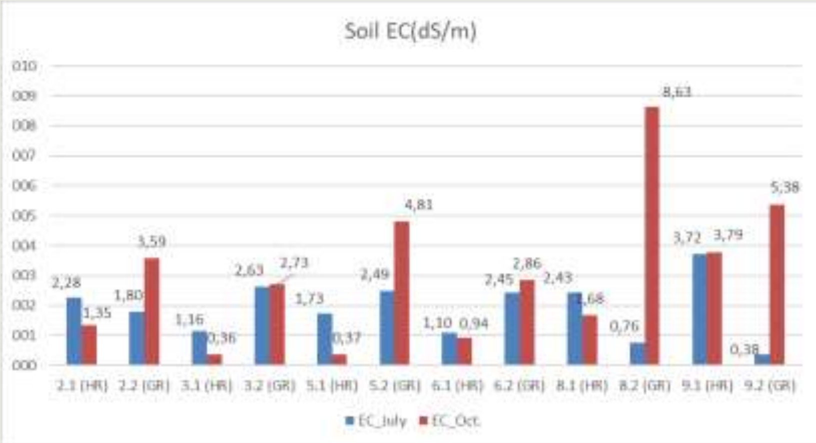


Figure 4: Seasonal changes in soil salinity in the study area (HR: High ridge, GR : Ground

When the analysis results of the samples made from the surface of the soil between the rows without any treatment were examined, it was seen that the salinity (EC) values increased in all samples from July to October due to evaporation. This result shows that if the winter precipitation is insufficient to wash the soils, there will be salt accumulation in the soils and it will not be possible to grow plants. For this reason, it has been determined that the high ridge planting technique that we suggested and implemented was successful. In addition, the results of this effect will be better understood when followed for many years (Figure 5). The pomegranate and quin trees developed quite well and started to bear fruit (Figure 5, 6).

Figure 5: Fruits grown so far

In order to protect both agricultural production and urban green spaces, we need to identify both planting techniques and plants types that are resistant to salinity and increasing drought.

Figure 6: Tamarix plant that survived the salty soil

3.21.2 Conclusions and recommendations.

The aim is to show three different ways in this field, which was constructed in order to raise awareness about the effects of climate change and measures to be taken. First, we aimed for an answer to the problem of being unable to cultivate due to the salinization of the soil, which is our most important natural resource. As a result of planting on the high ridge, it can be seen that the rate of increase in soil salinity slows down and decreases in some areas, so fruit trees can continue their development. This technique can provide the continuity of food production in agricultural areas can be ensured in the coming years. It is anticipated that this development will be even more successful with the integration with the developing smart agriculture technologies. Of course, it should be noted that it is necessary to ensure the continuity of practices and studies on this subject.

In the coming decades, vertical farming systems will become widespread in order to increase food production and to produce even in inefficient or unsuitable areas. Therefore, it is successfully demonstrated both soilless horizontal and vertical farming techniques in order to demonstrate these examples in the field and ensure their widespread use. Thanks to these new systems, it was possible to show that it is possible to get more of the product to be taken from the unit area in a shorter time. In particular, the way to ensure the transfer of knowledge successfully is to show the results with real applications.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
Lack of qualified technical local personnel in the production and use of new technologies.	Problems were tried to be solved by finding personnel who would provide support from different locations.
Economical barriers	How they have been addressed
No economic barriers.	The greenhouse belongs to the Municipality and the relevant departments will keep the facility to continue the training activities.
Social barriers	How they have been addressed
No social barrier	All visitors had positive feedbacks regarding the area.
Environmental (including COVID)	How they have been addressed
During the COVID period, there were problems with the lack of timely implementation of some applications and the supply and transportation of the materials to be applied.	The problems were solved by repeating the applications.

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

The KPI is among Challenge 7 Participatory Planning and Governance. The results of the experiments made in the field gives a lot of feedback and information about urban farming and all these experiences are shared with students from different majors and farmers. The good practices can be used by other stakeholders.

What was the impact? (positive/negative, significant/non-significant)?

As mentioned before, explaining theoretical knowledge to people does not actually guarantee learnedness. Therefore, as a result of practices demonstrations in such an area, it was observed that increasing this level of knowledge and awareness was more successful. On the negative side, it can be said that there are many people who will benefit from this field, but it takes a long time for them to see these applications due to the high demand.

3.22 CH0706 Energy savings

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0706	ENERGY SAVINGS	EGE
CITY	*RELATED NBS*	
IZM	URBAN FARMING ACTIVITIES – Energy Savings	

3.22.1 Results and Discussion

This section of the Greenhouse includes some applications aimed at reducing energy from the national electricity network. The heating of this part of the greenhouse will be provided by parabolic solar energy. For this purpose, isolated water tanks that store heat during daytime hours will be used for night heating purposes. The use of Parabolic (concave) type Solar Collector is aimed at the heating of 200 sqm size greenhouses. In the parabolic type solar collectors, 0.5 kW/h thermal power is obtained from 1 sqm reflective surface area.

The total reflectance of 6 Parabolic Type Solar Collectors planned to be used in the system mirror area is 24 sqm.

The hourly thermal power to be obtained from the 24 sqm mirror surface is 12 kW/h. Average of the system to be installed based on the daily 7-hour sun exposure data. In this case; energy gains of 7 hours x 12 kW / h = 84 kW / h will be provided and it means annually; 30,240 kW / h of energy will be saved.

The required thermal power for the 200 sqm greenhouse to be heated is 24 kW/h. The operating principle of the system the thermal energy stored in the daytime will be used for heating the greenhouse for 3 hours at night. The total amount of energy consumed per night in heating is 3 x 24 kW h = 72 kW/h.

Additional, photovoltaic solar energy system (battery) will be use lightening needs of the greenhouse.

Figure 1: Parabolic solar collectors and photovoltaic solar panels

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Table 1: Electricity production

Reflective surface Area m²	kW/h m²	Total kW/daily	Months 2022	Total kW/month
24	12	84	July	2.520
24	12	84	August	2.520
24	12	84	September	2.520
24	12	84	October	2.520
	12	84	November	2.520
	---	---	December	Continue
Total	60	420		12.600

3.22.2 Conclusions and recommendations.

The parabolic test practice was arranged to operate under steady conditions. This is essential to measure the data for the determination of the useful heat gain given in equation parameters which are needed for the analysis. Outdoor tests were performed in the midday hours on clear days when the beam radiation was high and the incidence conditions were almost the same.

Parabolic trough solar collector is a proven technology for heat and electricity generation but its usage in city applications has not matured completely, yet. In this project, the sample performance tests of the special hand-made parabolic collector were performed to characterize it under the climate conditions of Izmir. This parabolic solar collector can also be used in future studies.

As a result of the study, it has been understood that the use of parabolic solar panels in cities with long sunshine durations such as Izmir will be successful and can be used within nature-based solutions to reduce carbon emissions.

Regarding the monitoring process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*

Although it is not a major challenge, the cleaning and maintenance of parabolic systems and the lack of experts in parabolic systems can be a problem in solving specific problems.	The establishment that will ensure the continuity of the system must employ an expert for this job.
Economical barriers	How they have been addressed
No economic barriers	-
Social barriers	How they have been addressed
The system is built in a publicly owned greenhouse so social acceptance was not an issue. It also draws the attention of the people who visited the area for training activities.	-
Environmental (including COVID)	How they have been addressed
.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This KPI is among Urban Farming Activities Challenge. Parabolic solar collector attracts the attention of visitors. Demonstrating this system serves as an important precursor for its dissemination.

What was the impact? (positive/negative, significant/non-significant)?

While the amount of energy obtained is important, it is also important that no carbon emissions for this. It has become widespread to obtain energy from the photovoltaic solar panel system. Its use for lighting purposes in greenhouses also has started to become widespread. However, fossil fuels or electricity are still used for heating. The parabolic system saves energy by storing the heat during the daytime and using it for heating during the day or night. The use of the parabolic system in greenhouse heating is not known in Turkey. The case study made in this project will contribute positively to teaching and dissemination for both urban and rural farming systems.

3.22.3 Other comments

Optional: Any other relevant comments that you would like to include.

As it is known, the use of fossil fuels increases carbon emissions. Since the water stored in the dams decreases due to climate change and recent droughts and can only meet the drinking water need, electricity production from hydroelectric systems should be abandoned. Energy is needed for lighting and heating in the greenhouse during the production season. In this project, instead of using the energy produced from fossil fuels or hydroelectric power plants, it is planned to obtain the energy needed from renewable sources with nature-based solutions.

3.23 CH0707 Water savings

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0707	WATER SAVINGS	EGE
CITY	*RELATED NBS*	
IZM	URBAN FARMING ACTIVITIES – Water Savings	

3.23.1 Results and Discussion

Depending on the changing climatic conditions, temperature and evaporation increase, while there is a decrease in water resources. In addition to these, the salinity rate in water and soil increases. Under these conditions, it is getting harder and harder to farm in the field. Greenhouse, which uses less water than field agriculture, is an important alternative for uninterrupted food production. Treated water is needed for agricultural production in the greenhouse. It is planned to harvest water from the roof of the greenhouse in order to save both water and obtain clean water for hydroponic-type productions. For this purpose, the rain falling on the roof is collected and stored by a gutter system.

Figure 1: Collecting and transferring rainwater from the roof of the greenhouse to the tank

Figure 2: Rainwater Storage

Discussion of results: comment on all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Harvested Water from monthly rain between November 2021- January 2022 can be seen in table below.

Table 1: Water harvested

Roof area m^2	Monthly rain (mm)	Months 2021-2022
596,7	92	November 2021
596,7	146.8	December 2021
596,7	136.9	January 2022
596,7	102.9	February 2022
596,7	80.3	March 2022
596,7	60.4	April 2022
596,7	56.5	May 2022
596,7	37.4	June 2022
596,7	----	July
596,7	----	August
596,7	11.6	September

596,7	34.3	October
596,7	76.5	November
Total	**835.4**	**Total Rain (mm)**

HW =Roof Area (m^2) x RLC x FSC x Total Rain (mm)

HW = 596.7 (m^2) x 0.8 x 0.9 x 0.8534 (m)

HW = 358.91 m^3

Glossary

HW = Harvested Water (mm)

RLC = Roof Layer Coefficient (Roof layer coefficient is 0,8 according to German DIN1989).

FSC = Filtering System Coefficient (filtering system coefficient is 0,9 according to German DIN1989).

Total Rain (mm) = TR (From meteorological observation)

Explanations of the calculations used for water harvesting are given below.

The size of the roof collecting area is the calculated base area of the greenhouse (plus the roof overhang), independent of the roof shape and roof slope. If only one side of the roof of the greenhouse is used as a collecting area, only the corresponding base area will be taken into consideration. In the case of other areas, the base area upon which there is rainfall will be used as an estimate.

Yield Coefficient

The position, slant, orientation, and composition of the collecting area are to be taken into consideration in the determination of the yield coefficient. The value 0,8 can be used as a planning basis for the slant and composition of the collecting area.

Filter Systems

The manufacturer information with regard to the usable rainwater volume flow is to be taken into consideration for hydraulic-action filter systems that are used in the reservoir supply line.

Note: A hydraulic filter efficiency of 0.9 is achieved as a rule with filter systems that are maintained on a regular basis.

3.23.2 Conclusions and recommendations.

Rainwater harvesting is an innovative alternative water supply approach commonly used. Rainwater harvesting captures, diverts, and stores rainwater for later use. Implementing rainwater harvesting is beneficial because it reduces demand on the existing water supply, and reduces run-off, and contamination of surface water.

Rainwater can be used for nearly any purpose that requires water. If groundwater is used for soilless (hydroponic) agriculture in the greenhouse, the water must be purified. For this purpose, additional chemicals and energy should be used. No treatment is required for rainwater. Rainwater is used for soilless agriculture within the scope of the project. These include landscape use, stormwater control, wildlife and livestock watering, indoor use, and fire protection. In the project, the water obtained as a result of rainwater harvesting was used to support the irrigation needs in agricultural productions.

A rainwater harvesting system can range in size and complexity. All systems have basic components, which include a catchment surface, conveyance system, storage, distribution, and treatment.

Regarding the monitoring process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No technical barriers	
Economical barriers	How they have been addressed
No economic barriers	-
Social barriers	How they have been addressed
The system is built in a publicly owned greenhouse so social acceptance was not an issue. IT also draws the attention of the people who visited the area for training activities.	-
Environmental (including COVID)	How they have been addressed
The construction of the greenhouse is one of the last implementations made within the project due to COVID and other reasons. The collection of water and monitoring started relatively late.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

This KPI is among Urban Farming Activities Challenge. Farming/agriculture consumes more than 70% of the water in Turkey. As it is expected to have water stress in the near future due to increasing population, consumption patterns, different industries increasing use as well as climate change, the competition among sectors is expected to increase (clean water, industry, energy, tourism, etc.). The use of harvested water in the greenhouses is one of the first good practices in the country and can be used especially in areas where there are a lot of greenhouses (the Aegean and Mediterranean Regions to be specific).

What was the impact? (positive/negative, significant/non-significant)?

Demonstrating to farmers, citizens, and also municipal personnel how to obtain water without or less the need for existing water resources and treatment through rain harvesting has had a significant and positive impact. The amount of collected rainwater may increase depending on the amount of rain and the storage capacity. Demonstrating and teaching rain harvesting is important for dissemination so that urban landscape areas and urban agriculture will be less affected by water and soil salinization in the future.

3.24 CH0802 Green intelligence awareness (m/min)

KPI CODE	*KPI NAME*	*PARTNER(S)*
CH0802	GREEN INTELLIGENCE AWARENESS (m/min)	
CITY	*RELATED NBS*	
IZMIR		

3.24.1 Results and Discussion

Table of results (summary, from Task 5.4)

Some of the training activities and visits to Agriculture Center and Sasalı Area.

- Çiğli Municipality Agricultural Services Directorate (about 30 people)
- Political groups and Artists (about 100 people)
- Chamber of Landscape Architects İzmir Branch, (about 30 people)
- Izmir Efes Rotary Club and Efes Rotaract clubs (about 50 people)
- Yaşar University Vocational School of Food Technologies (about 100 people)
- 20 different primary school student groups of about 20 each came. (about 400 people)

- Gediz delta UNESCO workshop (about 100 people)

- Antalya Metropolitan Municipality Agricultural Services Department Agricultural Structures and Irrigation Branch (about 30 people)

- Technical Workshop on “Back to Our Nature” as part of the “Economics Congress of the Second Century” (about 100 participants)

- Bilkent University Parks and Gardens Department Students (about 50 people)

- Employees of Izmir Metropolitan Municipality Department of Studies and Projects (about 100 people)

- AIPH coordination team (about 10 people) within the scope of Expo 2026 Project

- Manisa Celal Bayar University Landscape Architecture Students (about 150 students)

- Ege University Landscape Architecture and Agricultural Engineering Soil Department Students (about 200 People)

In total approximately 1350 academics, local government representatives, students, international institutions.

Discussion of results: comment all relevant information to put in context the results from the table: Local considerations, trends, evolution, differences between NBSs, etc. Include other relevant material if necessary: maps, graphs, photos, etc.

Citizen science activity on biodiversity in Izmir (November 2018)

3.24.2 Conclusions and recommendations.

(300 words max.) Please, answer to the questions.

Regarding the monitorization process

Barriers encountered during the monitoring of this KPI and how they have been addressed.

Technical barriers	*How they have been addressed*
No barriers	

Economical barriers	How they have been addressed
No barriers	

Social barriers	How they have been addressed
Frequent change of the department heads after the elections affected the process	the Agriculture Center will continue to be active after the project number of activities are expected to accelerate.

Environmental (including COVID)	How they have been addressed
Pause in work of council because of covid 19.	

Regarding the results of the KPI(s)

Is there a significant impact on the challenge?

What was the impact? (positive/negative, significant/non-significant)?

The negative effects of climate change were understood by the students who attended the special trainings and activities, provided at the established agricultural center. Increasing temperatures, drought, decreasing rainfall, changes in soil chemistry, negative effects of living creature in Izmir habitats were simulated in the "laboratory of the future" and the awareness of students has been raised.