D7.7: Reporting to the SCIS System (3)

+CityxChange | Work Package 7, Task 7.3 & 7.4

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+CITYXCHANGE

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29-04-2020	v.01	Daniel Rood	Setting up Doc structure. Updated structure from D7.6
30-04-2020	v.02	Daniel Rood	Structure changes, Content in Section 3 (addition of 3.1.3)
07-05-2020	v.03	Daniel Rood	Updates to Sections 3 & 4
22-06-2020	v0.4	Daniel Rood	Amendments made after initial review. Changes to Table 4, addition of Table 5.

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List of Acronyms

API	Application Programming Interface
BCV	Bold City Vision
DPEB	Distributed Positive Energy Block
DPED	Distributed Positive Energy District
DST	Decision Support Tool
EC	European Commission
eMaaS	eMobility as a Service
FC	Follower City
FoA	Fields of Action
GHG	Greenhouse Gasses
GWh	Gigawatt hour
ICT	Information and Communication Technology
KPI	Key Performance Indicator
LHC	Lighthouse Cities
M&E	Monitoring and Evaluation
MERT	Monitoring and Evaluation Reporting Tool
MWh	Megawatt hour
NOX	Nitrous Oxides
RES	Renewable Energy Sources
SCD	Sub-city District level
SCIS	Smart Cities Information System
SRT	Self-Reporting Tool
UFA	Usable Floor Area

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Executive Summary

This report, *Deliverable 7.7 - Reporting to the SCIS (3)*, is the third iteration in the series of reports delivered bi-annually through the 5-year cycle of the +CityxChange project. The report records the actions taken, progress made and ongoing work relating to the capturing and reporting of project Key Performance Indicator (KPI) data to the +CityxChange Monitoring and Evaluation Reporting Tool (MERT) and the Smart Cities Information System (SCIS) (connected to Task 7.3 and 7.4). Deliverable 7.7 (D7.7) is the third iteration of this report based on the previous versions submitted in Month 6 (*D7.2 - Reporting to the SCIS (1)*[1]) and Month 12 (*D7.6 - Reporting to the SCIS (2)*[2]) of the project. This report provides an update to prior deliverables and sets out ongoing work that will be attended to in order to have information submitted to the SCIS.

Developed in *Deliverable 7.1: Approach and Methodology for Monitoring and Evaluation*[3], the +CityxChange KPI Framework forms the basis from which each KPI description, expected (or targeted) impact, and proposed calculation is derived for the Monitoring and Evaluation (M&E) process. As detailed in previous iterations of this report, the MERT will be the main platform on which all 33 KPIs' data is captured, stored, processed, and visualised. Since the launch of the prototype MERT in Month 12 of the project, refinement to the platform has included: updates to manual data capturing tables; updates to KPI calculations; addressing User Interface (UI) and visualisation issues across multiple devices; and the development of processes that would allow qualitative data submissions. These refinements have assisted in improving the user interface and functionality of the MERT, to enable more efficient data submission for the KPI/data owners. As the project has progressed, very little KPI data has been submitted to the MERT. By the time of submitting this deliverable, data has been submitted for only 12 of the 33 KPIs, but it is expected that further development of project interventions will lead to more frequent data submissions in the short term. Further developments in the MERT have included the amendment of data capturing fields to suit the data requirements for KPIs which will report to the SCIS Self-Reporting Tool (SRT) as well.

As it stands, only six of the 33 KPIs are expected to report to the SCIS, while recent engagement with KPI owners confirmed that two of the six KPIs' calculations are acceptable for reporting to the SRT. In collaboration with KPI owners and the SCIS, FAC will prepare the MERT and SRT for subsequent submission of KPI data as soon as it is available from the KPI owners. Ongoing engagement with KPI owners hope to increase the number over the coming months, by addressing potential mismatches between the data granularity and aggregation requirements of the SRT, and the monitoring data that will be available to KPI owners.

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[1] D7.2 available at: https://cityxchange.eu/knowledge-base/reporting-to-the-scis-system/
[2] D7.6 available at: https://cityxchange.eu/knowledge-base/reporting-to-the-scis-system-2/
[3] D7.1 available at:
https://cityxchange.eu/knowledge-base/approach-and-methodology-for-monitoring-and-evaluation/

After the launch of the MERT, KPI owners have been provided with login credentials to enable data submission, which is expected to increase as the project progresses and as data from different interventions become available. Restrictions of movement and interaction brought on by the COVID-19 pandemic have hindered the implementation of project interventions and slowed the accumulation and sharing of data. Although recent interactions have had to shift to an online format, all stakeholders are working together to reach project milestones. WP 7 leads will continue to liaise with KPI/data owners and relevant task leads to source quantitative and qualitative data, and work with the SCIS on the best possible solutions to have data shared and available to all relevant users.

1 Introduction

This report, *Deliverable 7.7: Reporting to the SCIS (3)*, is the third iteration in a series of reports, and is the subsequent revision of *Deliverable 7.6: Reporting to the SCIS (2)* submitted in Month 12 of the +CityxChange project. In this third iteration, an update will be provided on the ongoing actions taken to refine the calculations of particular KPIs that were earmarked for potential reporting to the Smart Cities Information System (SCIS). In conjunction with the relevant Key Performance Indicator (KPI) owners and Work Package (WP) leads, Future Analytics Consulting (FAC) as WP 7 and Task leads have been working on various Monitoring and Evaluation (M&E) processes to have data reported to the purpose-built +CityxChange M&E Reporting Tool (MERT) and the European SCIS Self-Reporting Tool (SRT).

The MERT was developed as a platform that would capture the specific +CityxChange KPI monitoring data from various sources, and use this data in calculating the indicators that were refined in *Deliverable 7.1: Approach and Methodology for Monitoring and Evaluation (D7.1)*. SCIS provides a central platform where European smart city projects can report and exchange data, experience and knowledge with other stakeholders to develop best practices and promote replication of smart city interventions. The SRT was developed as a tool for projects to report relevant outputs and information to the SCIS database, and therefore provides first-hand, actual monitored data and information that could inform decision-making in smart city projects overall.

Due to the complex nature of KPI calculations as defined in D7.1, and an ongoing process to review and amend calculations where necessary, the flow of actual monitoring data into the MERT and the SRT has been lacking. The calculations of a number of KPIs in the 'Common Energy Market' KPI theme (KPI 8-12, 14-21, 23-26) are undergoing review as interventions are planned and implemented and KPI owners get a better understanding of available data. This deliverable will provide an update on the processes followed leading up to the submission of this report, to enable partners to provide the data required in the calculation of the KPIs, whether to the MERT and / or the SRT.

This Deliverable also details ongoing changes and refinements to the KPIs and the MERT. Updates compared to the previous version D7.6 include:
- Ongoing work to refine KPI calculations to have monitoring data reported to the SRT and the MERT
- Ongoing work to refine data capturing fields of the SRT to better suit KPI requirements
- Improvements and updates to the MERT user interface
- Measurement of KPI data submitted to the MERT by KPI owners
- Processes to capture qualitative and contextual information linked to the KPI data submitted to the MERT and SRT

2 M&E in +CityxChange

2.1 Measuring impact in +CityxChange

As detailed in D7.1, and referenced in the previous iterations of this report, the KPI framework developed for measuring the impact of project interventions is still in use. With the setup of the SCIS data capturing fields it has been noted that not all KPIs will be able to report to the SCIS due to misalignment of data requirements and calculation methodology processes between the SRT and the +CityxChange KPI framework.

Table 1 lists the KPIs used in the M&E process.

Table 1: KPI Overview with Expected Impacts and Baselines

Theme	KPI ID	KPI Type	KPI Definition	Expected / Targeted Impact	Baseline
Integrated Planning and Design	1	Decision/ planning support	No. of APIs connected to the Decision Support Tool (DST)	20	0
	2	Decision/ planning support	Number of use case stories in the Information, Communication Technology (ICT) Ecosystem repository	15	0
	3	Training and skills development	No. of municipal staff trained to use the DST	40	0
	4	Enabling DPEB/DPEDs [4]	No. of new DPEB/DPED-enabling prototypes	30	0
	5	Enabling DPEB/DPEDs	No. of study visits by regulatory authorities	60	0
	6	Enabling DPEB/DPEDs	No. of politically approved Bold City Visions (BCV) with guidelines, roadmaps, and action plans	7	0
	7	Impact on regulation	No. of changes in regulation	15	0
Common Energy Market	8	Greenhouse gas (GHG) emissions	Tonnes of CO_2-equivalent emission reduction per year	12.801 tonnes/ year	N/A*
	9	Air quality	Tonnes per year Nitrogen Oxides (NOX) emissions reduction	6.2 tonnes/ year	N/A

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[4] DPEBs/DPEDs - Distributed Positive Energy Blocks / Distributed Positive Energy Districts

10	RES share	The percentage of total Renewable Energy Sources (RES) self-supply	Limerick: 100 Trondheim: 75	N/A	
11	RES Integration	Increase in new renewable energy system integration	4.538 GWh/year	N/A	
12	District level optimized self-consumption	Percentage district level production versus total energy consumption	47.7 % new production	N/A	
13	Replication	No. of new DPEBs realised	7	0	
14	Energy efficiency	kWh/m² usable floor area (UFA) per year improved energy efficiency (final energy demand)	62 kWh/m² / year	N/A	
15	RES efficiency	Net useful thermal recovery/year (GWh)	2.134 (GWh) net increase/year	N/A	
16	Reduction in energy grid investment	€million reduction compared to planned investment	€20M	0	
17	RES curtailment	Percentage of energy grid failures	<1%	0	
18	RES traded	Percentage of the total Distributed Energy Resources (DER) capacity traded	10%	0	
19	RES flexibility	Percentage of peak load reduction (<30 hours)	20%	N/A	
20	RES storage	Increase in installed RES storage capacity	1.65 MWh	0	
21	Increased uptake of e-mobility solutions	Percentage modal shift from fossil-fuel vehicles to eMobility as a Service (eMaaS) (vehicles/bikes)	24 % increase	N/A	
22	Replication	No. of new or existing buildings participating in the energy markets	60	0	
23	Investment	Total new investments generated (€M)	€40M	0	
24	Investment	Percentage reduction in simple payback periods (years)	20% decrease	N/A	
25	Investment	Annual return on investment (%)	10% annual ROI	N/A	
26	Investment	No. of new jobs created	900	0	

Community xChange	27	Community participation	No. community participation events organized across all +CityxChange cities	15	0
	28	Community participation	No. citizen observatories established	5	0
	29	Community participation	No. of community participation events/actions	55	0
	30	Innovation	No. of innovation labs/playgrounds contributing to the creation of DPEB	5	0
	31	Training and skills development	No. of Positive Energy Champions trained	20	0
	32	Behaviour influence	No. of organisations with new sustainable energy approaches	60	0
	33	Replication	No. of demonstration projects implemented in Follower Cities	35	0

*Where baselines have not been established/finalised yet they have been left as N/A.

3 Monitoring Data

In previous deliverables D7.1 and *Deliverable 7.3: Data Collation, Management and Analysis Methodology Framework*[5] (D7.3), it is stated that the KPI and data owners (as defined for each KPI in the framework) are responsible for the initial capturing and management of monitoring data that is to be reported for the KPIs they take ownership of. Depending on the calculation complexity of the particular KPI, KPI owners will process the captured data according to the data input requirements of the KPI. After data is captured and processed, partners feed the data to the MERT where it is stored, KPI calculation processes are applied (where necessary), and displayed through the MERT's individual KPI interfaces.

3.1 Data Submission

After data is captured and processed by the KPI and/or data owners and is ready for submission to the MERT, partners are able to submit data using two methods described in the subsections below. Both methods of data submission are applied to all 33 KPIs, and the usage of the methods depend on the KPI/data owners' data repository and sharing capabilities.

3.1.1 Automated Data Submission to the MERT

Data submission is automated through the use of Application Programming Interfaces (API). The APIs enable a link between the MERT and live systems or online project data repositories specified by project partners (KPI/Data owners) from where data will be pulled and stored in the MERT repository.

In conjunction with Task 1.2 within WP1, FAC has worked on the development of API specification to share data between partners. As part of Task 1.2, efforts are made to design a standardised API specification for API endpoints shared by partners within the consortium. WP7 developed a prototype API structure for KPI data sharing to the MERT, which is currently under review by WP1 for the development of a standardised API structure to be used by all partners. Through standardising the API specification, various data platforms within +CityxChange ICT ecosystem will be able to communicate seamlessly without the need for different programming (coding) to read the APIs structures. These APIs enable the sharing of the project monitoring data points from partner databases to the MERT (and other data systems in the project) at the relevant frequency and level of aggregation required. The data received in the MERT is then modelled according to the processes and calculations defined for each KPI in the KPI Framework (refined in D7.1) and displayed to end users in the MERT's KPI interfaces.

To date, FAC as developers of the MERT, is working to establish a regular functioning API link with KPI/Data owners' data repositories to enable automated data sharing. Engagement

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[5] D7.3 available at:
https://cityxchange.eu/knowledge-base/data-collation-management-analysis-methodolgy-framework

with WP1 leads and Lighthouse Cities (LHC) in particular is ongoing to establish these connections.

3.1.2 Manual Data Submission to the MERT

Manual data submission process where KPI/data owners access data capturing sheets through the online MERT interfaces where monitoring data from each intervention is captured and stored to the specific KPI in the MERT repository.

Each of the 33 KPIs have an individual KPI interface on the MERT where KPI/data owners are able to submit monitoring data for their KPIs. After logging in to the MERT, partners can redirect from the KPI interface through a dedicated link to the data capturing fields for the KPI. These fields were designed according to the data parameters for performing KPI specific calculation requirements of the KPI. This allows the KPI/data owner to manually input data for each variable required in the calculation, as well as editing previously submitted data points. The manual and automated data capturing fields (API specifications and capabilities) in the MERT are both determined by the variables needed for the calculation of the KPI.

3.1.3 Data Submission to the SRT

KPI owners in +CityxChange are only expected to submit KPI data to one platform, the MERT. From this, data will be reported by WP7 to the SCIS SRT, which will be a manual process as the SRT does not accommodate automated data sharing.

The data capturing fields of the MERT are designed to reflect the Fields of Action (FoA - criteria used in the creation of data collection fields in the online manual data collection pages of the SRT) designed by the SCIS in the SRT. WP7 is working on the setup of the SRT data capturing fields for relevant KPIs at city level (data capturing fields are set up for each LHC and FC), to form the closest possible alignment with the +CityxChange KPI specifications. This will ensure that the reported data provides an accurate measurement of the KPI and can be compared to the targeted/expected impact, whilst adhering to the SRT calculation formulas and reporting themes. From the MERT, KPI data will be exported and manually transferred to the SRT 12 months after the first data submission of the KPI data to the MERT. As the SRT only allows annual data reporting, the data submitted for these KPIs will be processed (if necessary where KPIs reporting frequency is more regular) for submission to the SRT.

4 Reporting Data to the SRT and MERT

Data generated by the project interventions are captured by KPI/data owners, after which it is submitted to the MERT and/or SCIS[6] SRT for further processing, display and dissemination. The following subsections provide an update on the usage of the two data reporting tools used in the +CityxChange project.

4.1 The SCIS SRT

In previous iterations of this report, it is stated that the SRT does not allow tailoring of its data input fields to specifically accommodate the capturing of +CityxChange KPI monitoring data. This is due to the rigid setup of the SRT's FoA designed to accommodate the capturing of smart city project data across common themes, from multiple European Commission (EC) Smart City projects, and do not allow tailoring to fit the specific +CityxChange KPI data requirements. Due to the abovementioned, and as discussed in D7.6, only a limited number of the project KPIs would be able to report to the SCIS SRT. The KPIs that would potentially report to the SCIS are listed in Table 2A, with more detail regarding calculation refinement in Table 2B.

In Table 2A, the 'Potential SRT Option' column refers to the option of setting up SRT data capturing fields for the KPI. If marked as 'Potentially, TBC' the KPI has been identified as a potential option for reporting to the SRT, but that a review of the KPI's calculation methods in the MERT and SRT are still undergoing, and that the final KPI calculation method and variables are still to be confirmed. Table 2B provides more information on the calculation gaps and ongoing work on the KPI calculations.

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[6] Smart Cities Information System: https://smartcities-infosystem.eu/

Table 2A: KPIs to report to the SRT

KPI	KPI Definition	KPI owner	Calculation defined by	Potential SRT option	Proposed calculation that could work in the MERT (from D7.1)	KPI/data owner input needed
8	Tonnes of CO_2-equivalent emission reduction per year	LCCC, TK, MAI, MP, SB, SMO, VORU	SCIS KPI Guide	Potentially, TBC	Initial proposal to be refined	Critical
9	Tonnes per year Nitrogen Oxides (NOX) emissions reduction	LCCC, TK, MAI, MP, SB, SMO, VORU	Project Defined	Potentially, TBC	Initial proposal to be refined	Critical
10	The percentage of total Renewable Energy Sources self-supply	LCCC, TK, MAI, MP, SB, SMO, VORU	SCIS KPI Guide	Potentially, TBC	Yes	Confirmation
11	Increase in new renewable energy system integration	MPOWER, SV, TE	Project Defined	Potentially, TBC	Yes	Confirmation
12	Percentage district level production versus total energy consumption	MPOWER, SV, TE	SCIS KPI Guide	Yes	Yes	Critical
14	kWh/m² (UFA) per year improved energy efficiency (final energy demand)	MPOWER, SV, TE	SCIS KPI Guide	Yes	Yes	Critical
15	Net useful thermal recovery/year (GWh)	MPOWER, SV	Project Defined	Potentially, TBC	Yes	Confirmation
16	€M reduction compared to planned investment	MPOWER, SV, TE	Project Defined	Potentially, TBC	Yes	Critical
17	Percentage of energy grid failures	MPOWER, SV, TE	SCIS KPI Guide	Yes	Yes	Critical

18	Percentage of the total Distributed Energy Resources capacity traded	MPOWER, POW	Project Defined	Potentially, TBC	Yes	Confirmation
19	Percentage of peak load reduction (<30 hours)	MPOWER, NTNU, SV, TE	SCIS KPI Guide	Yes	Yes	Critical
20	Increase in installed RES storage capacity	TE, MPOWER	SCIS KPI Guide	Yes	Yes	Critical
21	Percentage modal shift from fossil-fuel vehicles to eMaaS (vehicles/bikes)	LCCC, ABG, TK	Project Defined	Yes	Yes	Critical
23	Total new investments generated (€M)	MPOWER, SV, TE, all partners (tentative)	SCIS KPI Guide	Potentially, TBC	Yes	Confirmation
24	Percentage reduction in simple payback periods (years)	ABG, GKIN, MPOWER, TE, SV, NHP, all partners (tentative)	SCIS KPI Guide	Potentially, TBC	No	Critical
25	Annual return on investment (%)	ABG, GKIN, MPOWER, TE, SV, NHP (tentative)	SCIS KPI Guide	Potentially, TBC	No	Critical
26	No. of new jobs created	All 32 partners	Project Defined	Potentially, TBC	Yes	Critical

Table 2B: KPIs to report to the SRT

KPI	KPI Definition	Calculation Gaps	Update (April/May 2020)
8	Tonnes of CO_2-equivalent emission reduction per year	Need to confirm calculation and variables for modelling in the MERT; potential option for SRT - KPI owners need to confirm if SRT inputs are available AND if it would work in the calculation of performance vs target. How can we use the SRT variables to calculate and display data in the MERT?	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
9	Tonnes per year Nitrogen Oxides (NOX) emissions reduction	Need to confirm calculation and variables for modelling in the MERT	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
10	The percentage of total Renewable Energy Sources self-supply	Need to confirm if SRT option will work AND if it will work for the calculation of performance vs target	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
11	Increase in new renewable energy system integration	Need to confirm if SRT option will work AND if it will work for the calculation of performance vs target	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
12	Percentage district level production versus total energy consumption	Need to confirm calculation and variables for modelling in the MERT; potential option for SRT - KPI owners need to confirm if SRT inputs are available AND if it would work in the calculation of performance vs target. How can we use the SRT variables to calculate and display data in the MERT?	Ongoing engagement with KPI owners on suitable calculation method. Planned engagement with SCIS on data aggregation and minimum data requirements

14	kWh/m² (UFA) per year improved energy efficiency (final energy demand)	Need to confirm calculation and variables for modelling in the MERT; potential option for SRT - KPI owners need to confirm if SRT inputs are available AND if it would work in the calculation of performance vs target. How can we use the SRT variables to calculate and display data in the MERT?	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
15	Net useful thermal recovery/year (GWh)	Need to confirm if SRT option will work AND if it will work for the calculation of performance vs target	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
16	€M reduction compared to planned investment	Need to confirm if SRT option will work AND if it will work for the calculation of performance vs target	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
17	Percentage of energy grid failures	Need to confirm calculation and variables for modelling in the MERT; potential option for SRT - KPI owners need to confirm if SRT inputs are available AND if it would work in the calculation of performance vs target. How can we use the SRT variables to calculate and display data in the MERT?	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
18	Percentage of the total Distributed Energy Resources capacity traded	Need to confirm if SRT option will work AND if it will work for the calculation of performance vs target	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
19	Percentage of peak load reduction (<30 hours)	Need to confirm calculation and variables for modelling in the MERT; potential option for SRT - KPI owners need to confirm if SRT inputs are available AND if it would work in the calculation of performance vs target. How can we use the SRT variables to	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.

		calculate and display data in the MERT?	
20	Increase in installed RES storage capacity	Need to confirm calculation and variables for modelling in the MERT; potential option for SRT - KPI owners need to confirm if SRT inputs are available AND if it would work in the calculation of performance vs target. How can we use the SRT variables to calculate and display data in the MERT?	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
21	Percentage modal shift from fossil-fuel vehicles to eMaaS (vehicles/bikes)	Need to confirm calculation and variables for modelling in the MERT; potential option for SRT - KPI owners need to confirm if SRT inputs are available AND if it would work in the calculation of performance vs target. How can we use the SRT variables to calculate and display data in the MERT?	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
23	Total new investments generated (€M)	Need to confirm if SRT option will work AND if it will work for the calculation of performance vs target. If SRT option is not agreed, we need KPI/data owner input to confirm if proposed calculation is correct/relevant	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
24	Percentage reduction in simple payback periods (years)	Need to confirm if SRT option will work AND if it will work for the calculation of performance vs target. If SRT option is not agreed, we need KPI/data owner input to confirm if proposed calculation is correct/relevant	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
25	Annual return on investment (%)	Need to confirm if SRT option will work AND if it will work for the calculation of performance vs target. If SRT option is not agreed, we need KPI/data owner input to confirm if proposed calculation is correct/relevant	Ongoing engagement with KPI owners on suitable calculation method. Awaiting input from KPI owner for finalisation of capturing fields in MERT/SRT.
26	No. of new jobs created	Determining the appropriate multipliers to be applied to calculate indirect/induced jobs created	Calculation configured in the MERT for partner data submissions. Multipliers not yet applied.

Recent engagement with KPI owners have highlighted the need to further refine and formulate suitable KPI calculations for the KPIs listed in Table 2B. KPI owners have confirmed that the proposed data input requirements for 2 of the 33 KPIs are acceptable (while a process is ongoing to have more KPIs report to the SRT), and have committed to compiling the data points required for submission to the MERT (pending confirmation of baseline data). These KPIs are listed in Table 3 below.

Table 3: SRT Thematic Fields to which KPIs are Reporting

KPI	KPI Definition	KPI owner	SRT Thematic Field
17	Percentage of energy grid failures	MPOWER, SV, TE	Information and Communication Technologies
19	Percentage of peak load reduction (<30 hours)	MPOWER, NTNU, SV, TE	Information and Communication Technologies

Subsequently, the MERT data capturing sheets will be reconfigured to capture the variables relevant to calculations in the SRT format, using the SCIS Self-Reporting Guide (SCIS, 2020) and the SCIS Monitoring KPI Guide (SCIS, 2018). Depending on the calculation requirements, the data will be processed in the MERT, after which the annualised data will be transferred to the SRT for further modelling and visualisation.

The relevant FoAs in the SRT are configured for each LHC (and Follower Cities (FC) when data will be reported) to which the data is submitted. The captured data will then be displayed in the 'Project Data Visualisation' section of the SCIS website[7], and is filtered according to the location (country, city, demosite), project (+CityxChange, or other projects reporting to SCIS) and type of intervention (i.e. building level energy analysis, energy system integration, and mobility and transport). The SCIS also offers a '.csv' download of project data for further external use.

Ongoing engagement will take place with KPI/data owners on the balance of the suggested KPIs listed in Table 2A in an effort to match as many KPIs as possible to the SRT data requirements to increase the number of KPIs reported to the SCIS.Further discussions will be held with SCIS following requests from KPI owners to clarify how data aggregation in the SRT can be done, and how the data, captured at specific spatial levels in the project, can be applied to the SRT format. These will be ongoing refinements of the data sharing process between the data suppliers, the MERT, and the SRT, as KPI owners have indicated that building and block energy management and monitoring systems are still being developed. The development of these systems will inform what data, and the granularity in which it will be available, which would warrant the potential amendment of the KPI calculation methodology, reporting frequency, and spatial scale of reporting. As data becomes available, KPI owners and WP7 will collaborate to configure the KPI calculations accordingly.

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[7] SCIS Experiences (navigate to: > Project Data Visualisation):
https://smartcities-infosystem.eu/experiences

4.2 The +CityxChange MERT

The MERT online dashboard has been created with an individual interface for each KPI, where KPI/data owners are able to submit the data points for the KPIs calculation (as defined in D7.1). All 33 KPIs are active on the MERT, although ongoing refinement of the KPI calculations mentioned in Table 2B will require further updates to the MERT's KPI interfaces and calculation processes. The MERT was launched in November 2019 as a prototype (part of *Deliverable 7.4: Monitoring and Evaluation Dashboard*[8]), and has undergone further refinement to overall design and various functionalities and tools available to the user. The refinements to the MERT include improvements to manual data capturing tables, updates to KPI calculations, and addressing User Interface (UI) and visualisation issues across multiple devices. Where data capturing tables require multiple inserts, the sections were rearranged to simplify data submission. As mentioned in Section 4.1, the ongoing refinement of KPI calculations will require periodic updates and changes to the MERT back-end processes to enable efficient data capturing in the MERT and the manual transfer of data to the SRT. Administrative updates to the MERT include the assignment of rights and privileges to certain (super admin, admin) users for the amendment and deletion of data submitted to the MERT, while other users have the ability to add and amend data. Project managers within each LHC and FC will be given these rights.

Further development of the MERT functionalities aim to allow KPI owners to submit contextual information or comments relating to KPI data. As discussed in D7.1, the collection of qualitative information will provide insight beyond the quantitative data submitted relating to the project interventions being implemented. In accordance with Task 7.4, contextual information provided by relevant partners will be evaluated to derive a practical assessment and guidelines of ICT, mobility, energy, social, and regulatory interventions trialed in the project, which will be elaborated on in upcoming deliverables (D7.8 - Data Collection and Management Guideline Report). The concept is to allow KPI owners to collate the contextual/qualitative information in multiple formats (simple comment field, imagery, tabular data or other reports in a Word or PDF file) for submission to the MERT or other central project data repositories (pending development of these features in the MERT). These supplemental files can be uploaded at intervals relevant to each KPI and can be accessed by all users of the MERT dashboard. The content uploaded shall not include any GDPR-relevant data to ensure it can be made available as open data. FAC has shared login credentials with partners to enable the submission of KPI related monitoring data. This data submission allows MERT developers to test data flow, calculations and other processes within the MERT capabilities.

Manual data submission to the MERT has taken place for 12 of the 33 KPIs. The KPIs for which data have been submitted are listed in Table 4.

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[8] D7.4 available at: https://cityxchange.eu/knowledge-base/monitoring-and-evaluation-dashboard/

Table 4: KPIs for which Data Points have been submitted to the MERT

Theme	KPI ID	KPI Definition	Has data been submitted? (Yes/No)	Number of data entries
Integrated Planning and Design	3	No. of municipal staff trained to use the DST	Yes	2
	4	No. of new DPEB/DPED-enabling prototypes	Yes	3
	5	No. of study visits by regulatory authorities	Yes	4
	6	No. of politically approved Bold City Visions (BCV) with guidelines, roadmaps, and action plans	Yes	4
	7	No. of changes in regulation	Yes	3
Common Energy Market	13	No. of new DPEBs realised	Yes	3
Community xChange	27	No. community participation events organized across all +CityxChange cities	Yes	3
	28	No. citizen observatories established	Yes	2
	29	No. of community participation events/actions	Yes	2
	30	No. of innovation labs/playgrounds contributing to the creation of DPEB	Yes	3
	31	No. of Positive Energy Champions trained	Yes	1
	32	No. of organisations with new sustainable energy approaches	Yes	3

Total Yes	12	33
Total No	21	

The 12 KPIs for which data have been submitted are KPIs that were defined specifically for the +CityxChange project. As such, these KPIs will not be reported to the SCIS SRT, as the definition of the KPI and required data inputs do not correlate with the setup and data capturing requirements of the SRT. These KPI data points have been captured, processed and displayed in the MERT, the results of which are disseminated through each KPIs interface on the MERT online dashboard.

As KPI calculation refinement is ongoing for multiple KPIs, Trondheim Kommune has captured data for additional KPIs which have not yet been submitted to the MERT. These KPIs include the following from the Common Energy Market KPI theme.

- KPI 8 – Tonnes of CO_2-equivalent emission reduction per year
- KPI 9 – Tonnes per year Nitrogen Oxides (NOX) emissions reduction
- KPI 10 – The percentage of total Renewable Energy Sources self-supply
- KPI 11 – Increase in new renewable energy system integration
- KPI 12 – Percentage district level production per total energy consumption
- KPI 15 – Net useful thermal recovery/year (GWh)

4.3 KPI Performance Status at Month 18

In addition to the above, the data submitted to the MERT has been compared to the expected impact (target) listed for each KPI, which provides an overall performance score of the KPI at the stage of reporting. Table 5 provides an overview of the captured data and overall performance of the KPIs.

Table 5: Captured KPI data and overall KPI performance

KPI ID	KPI Definition	Expected Impact (Target) / KPI Owner	Measured data	Performance vs Target (%)	Overall Target	Overall Score	Overall Perform-ance
3	No. of municipal staff trained to use the DST	LCCC: 15; TK: 15; MAI: 2; MP: 2; SB: 2; SMO: 2; VORU: 2	LCCC: 4; TK: 0; MAI: 0; MP: 0; SB: 0; SMO: 0; VORU: 0	LCCC: 27%; TK: 0; MP: 0; SMO: 0	40	4	10%
4	No. of new DPEB/DPED-en abling prototypes	LCCC: 13; TK: 13; MP: 2; SMO: 2	LCCC: 4; TK: 2; MP: 0; SMO: 0	LCCC: 31%; TK: 15%; MP: 0; SMO: 0	30	6	20%
5	No. of study visits by regulatory authorities	LCCC: 20; TK: 20; MAI: 4; MP: 4; SB: 4; SMO: 4; VORU: 4	LCCC: 11; TK: 1; MAI: 0; MP: 0; SB: 0; SMO: 0; VORU: 0	LCCC: 55%; TK: 5%; MAI: 0; MP: 0; SB: 0; SMO: 0; VORU: 0	60	12	20%
6	No. of politically approved Bold City Visions (BCV) with guidelines, roadmaps, and action plans	LCCC: 1; TK: 1; MAI: 1; MP: 1; SB: 1; SMO: 1; VORU: 1	LCCC: 0; TK: 0; MAI: 0; MP: 0; SB: 0; SMO: 0; VORU: 0	LCCC: 0; TK: 0; MAI: 0; MP: 0; SB: 0; SMO: 0; VORU: 0	7	0	0%
7	No. of changes in regulation	LCCC: 5; TK: 6; MP: 2; SMO: 2	LCCC: 4; TK: 0; MP: 0; SMO: 0	LCCC: 80%; TK: 0; MP: 0; SMO: 0	15	4	27%

8	Tonnes of CO$_2$-equivalent emission reduction per year	LCCC: 1.188; TK: 11.613	LCCC: 0; TK: 495	LCCC: 0; TK: 4.3%	12,801	495	4%
9	Tonnes per year Nitrogen Oxides (NOX) emissions reduction	LCCC: 1.5; TK: 4.7	LCCC: 0; TK: 0.5	LCCC: 0; TK: 10.6%	6.2	0.5	8%
10	The percentage of total Renewable Energy Sources (RES) self-supply	LCCC: 100%; TK: 75%	LCCC: 0; TK: 34%	LCCC: 0; TK: 45%	-	-	LCCC: 0; TK: 45%
11	Increase in new renewable energy system integration	MPOWER: 1.29GWh; SV: 1.99GWh; TE: 1.28GWh	MPOWER: 0 SV + TE: 1.118GWh	MPOWER: 0; SV + TE: 34.4%	4.538	1.118	25%
12	Percentage district level production versus total energy consumption	MPOWER: 24.7%; SV: 46.5%; TE: 28.8%	MPOWER: 0; SV: 27%; TE: 7%	MPOWER: 0; SV: 58.1%; TE: 24.3%	47.7%	17.0%	36%
13	No. of new DPEBs realised	LCCC: 3; TK: 4	LCCC: 1; TK: 0	LCCC: 33%; TK: 0	7	1	14%
15	Net useful thermal recovery/year (GWh)	MPOWER: 1.43GWh; SV: 1.99GWh	MPOWER: 0; SV: 510	MPOWER: 0; SV: 25.6%	2.134	0.51	24%
23	Total new investments generated (€M)	Total contribution from multiple partners: 40	Sum of total contributions: 16.6	42%	40	16.6	42%
27	No. community participation events organized across all +CityxChange cities	LCCC: 8; TK: 7	LCCC: 5; TK: 0	LCCC: 63%; TK: 0	15	5	33%
28	No. citizen observatories established	LCCC: 1; TK: 4	LCCC: 2; TK: 0	LCCC: 200%; TK: 0	5	2	40%

29	No. of community participation events/actions	LCCC: 30; TK: 25	LCCC: 12; TK: 15	LCCC: 40%; TK: 60%	55	27	49%
30	No. of innovation labs/playgrounds contributing to the creation of DPEB	LCCC: 1; TK: 4	LCCC: 3; TK: 0	LCCC: 300%; TK: 0	5	3	60%
31	No. of Positive Energy Champions trained	LCCC: 20	LCCC: 1	LCCC: 5%	20	1	5%
32	No. of organisations with new sustainable energy approaches	LCCC: 30; TK: 30	LCCC: 14; TK: 0	LCCC: 47%; TK: 0	60	14	23%

As seen in the table, KPIs related to engagement with community and regulatory stakeholders (KPI 5, 7, 27, 29, 32) have had multiple data entries and relatively high indicator scores compared to other KPIs. KPIs in the CommunityxChange theme have, on average, performed at 35% to expected impact (target), while KPIs in the Integrated Planning and Design theme performed at an average of 15% to expected impact (target). Although the majority of the Common Energy Market KPIs were not reported to the MERT, the KPI theme's overall average performance was calculated at 22%. As the project progresses, more data will become available and be submitted to the MERT, which will provide more insight on the overall performance of KPIs.

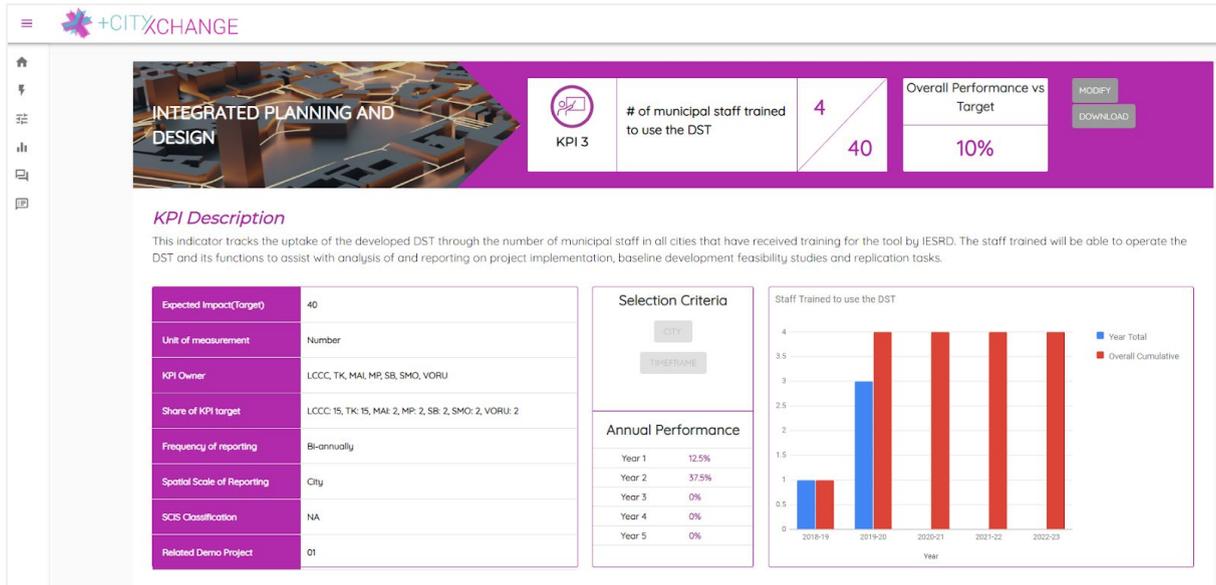The following figures provide an example of data submitted to the MERT.

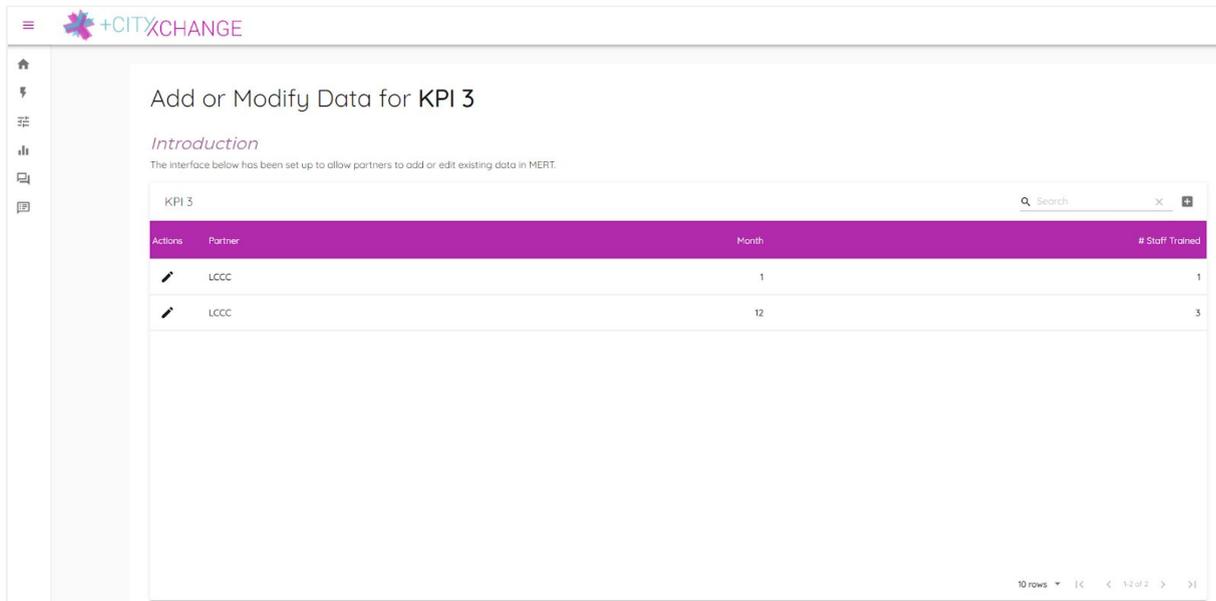*Fig 1: Submitted data visible in KPI Interface (KPI 3)*

Fig 2: Manual data submission page for KPI 3

The captured data for each KPI is downloadable from the MERT KPI interface using the 'Download' button, which exports a snapshot of the interface and a summary data table in '.pdf' format seen in Figure 3.
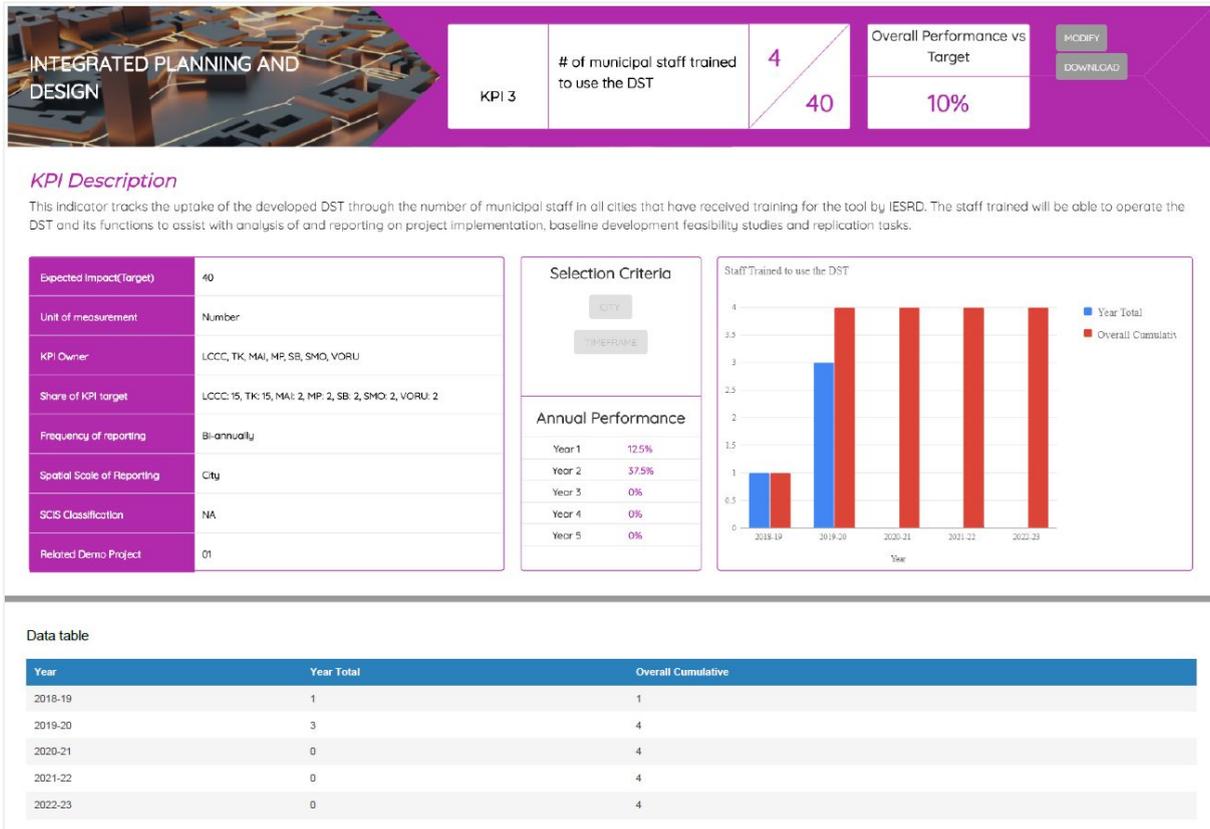
Fig 3: PDF export of KPI 3 from the MERT

4.4 Data Availability

KPI owners have started manually submitting data to the MERT. As reported in Section 4.2 of this report, available data for 12 KPIs have been submitted to the MERT. With the login credentials provided, it is expected that more KPI owners will start submitting KPI monitoring data for KPIs that have already started with phases of intervention implementation. As mentioned in D7.6, not all KPI data will be available for reporting at the same time, and with ongoing development of interventions, some KPI calculations and data input requirements will be refined and adapted, and therefore submitted at a later, appropriate time in the project.

The project data will be made available to the public in accordance with the European Commission (2013) Directive 2013/37/EU on the re-use of public sector information (PSI) and specified licenses based on the latest Creative Commons 4.0 (CC) licensing structures, which is in line with the data sharing guidelines developed in the DMP.

The impact of COVID-19 has resulted in delays in data collection, data sharing strategies and additional information collation features. However, the WP7 goals and milestones have remained on track despite minor delays and WP7 remains on a productive, teleological track. Every effort is, and will continue to be made to get relevant feedback from KPI/data owners and the SCIS, through regular online conference calls, workshops, and other forms of electronic feedback, to enable reporting of data to the MERT and the SRT. This

engagement will primarily be through calls, online workshops, and other forms of electronic correspondence.

4.5 Reporting Insights and Additional Information

The SCIS has a set of guidelines for the sharing of the +CityxChange quantitative data to the SCIS SRT. To streamline the sharing of qualitative and contextual data between the project and the SCIS, it is proposed that the qualitative reports sourced from partners are, for example, done according to the SCIS format for capturing 'Lessons Learned' at demonstration city level This will enable the sharing of qualitative data not only in the project, but also to multiple projects sharing insights through the SCIS. The aim is to provide a 'Lessons Learned' section with topics relevant to +CityxChange (and T7.4 - ICT, mobility, energy, social, and regulatory interventions) in the SCIS format where these are uploaded to the SCIS website[9].

WP7 and the SCIS are currently exploring options to simplify the submission of qualitative data and project reports. The way that qualitative data will be gathered is under discussion, possibly in a free or in a structured 'template' format applicable to themes and KPIs in the MERT and also reportable to the relevant sections of the SCIS, including Lessons Learned. The SCIS have confirmed that it will assist in formulating a guideline to identify the key points to be addressed in the submission of specific lessons learned in the implementation of project interventions. Working closely with KPI/data owners, and other WP and Task leads, these inputs gathered will be analysed and interpreted to extract practical recommendations and guidelines from the interventions implemented in the project.

The assessment of other WPs and associated Tasks have highlighted that other tasks already undertaken in the project address, to different extents, the social impacts of project interventions. Alongside the analysis of KPI monitoring data submitted to the MERT or the SRT, the qualitative, citizen-centric effects of project interventions will be evaluated to complement and add context to the quantitative KPI data analysis. WP7 will work with other WP and Task leads to source contextual information, which will be elaborated on in subsequent WP7 deliverables D7.8: Data Collection and Management Guideline Report, and annual iterations thereof.

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[9] Reports on 'Lessons Learned' to be uploaded to +CityxChange section of the SCIS website: https://smartcities-infosystem.eu/sites-projects/projects/cityxchange

5 Conclusion

KPI monitoring data has been submitted to the MERT for 12 KPIs. Ongoing project developments, the implementation of interventions, and external factors such as the effects on normal operation caused by the COVID-19 pandemic, complicates the collation and submission of available KPI data it is difficult to determine the KPIs for which data will be submitted, and when this data will be available. While project interventions are ongoing, WP7 will engage with KPI owners to ensure KPI calculations are adequate, and that data can be captured in the MERT, and transferred to the SRT where relevant. The development of data capturing functionalities in the SRT will also guide the processes of engagement with KPI owners to ensure that data capturing procedures within the project align to the eventual submission requirements of KPI, and other qualitative data points.

Other points to be discussed for the next revision of this deliverable are tabled below.

Table 6: Points to be addressed

Topic	Points to be addressed	Actions needed
Data availability	Partners to provide the data points required by the SRT	Ongoing engagement with KPI/data owners to confirm whether they will be able to provide the data required for KPI calculation in the SRT.
Data updates	Baseline data	Engagement with KPI owners to get the latest update on KPI baseline data.
	KPI 23 - KPI owner contributions	Update on the breakdown of KPI owner contributions and how overall performance for the KPI is calculated.
MERT	Refinement of MERT data capturing sheets to allow data capturing formats in line with the SRT	Updates to the manual data submission pages of the MERT according to SRT data requirements
	Modelling of data points in the MERT to display the KPI data in the MERT interfaces	Ensure that the MERT performs KPI calculations and visualisations as it should.
	Submission of qualitative information	Further development of the MERT functionality (or other data repositories) to accept submission of qualitative data reports from KPI owners. This will feed into T7.4 and D7.8 to provide qualitative evaluation of project interventions.

	MERT Visualisations	Add baseline data to charts. Explore the use of different chart types. Refine 'data per city/partner' view.
	Data Exports	Standardise data sharing license annotation to MERT data exports (in line with DMP specifications).
SCIS	General collaboration	Ongoing engagement with the SCIS to discuss improvements in the SCIS data monitoring capabilities, changes to the SRT, reconfiguration of SRT data input fields, data visualisation options in the SCIS
	Gap analysis and data mapping of the SCIS KPIs to the +CityxChange KPIs to set up the SRT FoA in line with how +CityxChange KPIs should be monitored	Ongoing engagement with project partners to get alignment on the SRT FoA and if the proposed FoA would sufficiently calculate what the KPI is measuring.
	Submission of qualitative information	Through engagement with the SCIS, explore ways of sourcing and submitting qualitative information in formats suitable to the MERT and the SCIS

The addressing of the above mentioned points will be an ongoing exercise with the relevant project partners to ensure the submission and exchange of data to the MERT and the SRT.

6 References

EU Smart Cities Information System (2018). Monitoring KPI Guide, D23.1 [PDF File]. Retrieved from: https://smartcities-infosystem.eu/sites/www.smartcities-infosystem.eu/files/document/scis-monitoring_kpi_guide-november_2018.pdf

EU Smart Cities Information System (2020). SCIS Self Reporting Guide. [PDF File]. Retrieved from: https://smartcities-infosystem.eu/sites/www.smartcities-infosystem.eu/files/document/scis-selfreporting_guide_feb2020.pdf