IRIS

Integrated and Replicable Solutions for Co-Creation in Sustainable Cities

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Deliverable 9.5

Report on monitoring framework in LH cities and established baseline

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0.1	06/19	UU created the structure of the deliverable
0.2	08/19	All partners wrote Introduction (chapter 1) and Methodology (chapter 2)
0.3	01/20	All partners added information regarding the monitoring plans and aggregation of KPIs
0.4	01/20	All partners updated information regarding the monitoring plans and aggregation of KPIs
0.5	03/20	Conclusions and Executive summary where added
0.6	03/20	Update of table, figure and page numbers and styles
DRAFT	03/20	Draft version to be sent to reviewers.
1.0	04/20	Final version to be sent to reviewers
1.1	04/20	Updated final version to be sent to EC
2.0	06/20	Final version with updates to be sent to EC

Disclaimer

Executive Summary

The IRIS project has defined goals and targets in the project proposal, and the monitoring and evaluation work package (WP) 9 will analyse to what extent the project reaches these goals and objectives. The monitoring and evaluation will also provide information concerning the performance of the different solutions demonstrated in the Lighthouse (LH) cities in IRIS which is important for the replication of the solutions both in the LH cities and in other cities. This is of importance for the replicability of the solutions, both in the LH cities (Utrecht, Nice and Gothenburg) and in other cities. The project consists of several demonstration projects which are divided by 5 transition tracks (TTs): TT1; Smart renewables and closed-loop energy positive districts, TT2; Smart Energy Management and Storage for Grid Flexibility, TT3; Smart e-Mobility Sector, TT4; City Innovation Platform (CIP) Use Cases, TT5; Citizen engagement and co-creation.

D9.5 is the result of 2 years of work with several iterative processes involving the LH cities and their partners with the ultimate goal to:

- Define a set of Key Performance Indicators (KPIs) which evaluate the effectiveness and impact of the cities proposed measures.
- Setup monitoring plans for each IS to define how each parameter is being measured to ensure that the KPIs can be calculated.
- Define how the baseline and the targets are defined and measured.

This work started as described in D9.2 (Report on monitoring and evaluation schemes for integrated solutions) [1] with:

- The definition of the initial list of KPIs and how to calculate them, based on Smart Cities Information System (SCIS) [2], the CITYKeys Project [3] and the IRIS project itself .
- The assignment of KPIs to relevant measures within the project.
- An evaluation plan to measure performance on project level, including aggregation of KPIs.

The process has continued with D9.3 (Report on data model and management plan for integrated solutions) [4] and D9.4 (Report on unified framework for harmonized data gathering, analysis and reporting) [5], which define the basis of the methodologies used to come to the results written in this report.

Feedback from several workshops on this topic has led to a guideline that supports the partners responsible for implementation of the demonstrators in setting up their projects such that:

- KPIs that are being measured are well understood.
- KPIs give a meaningful result.
- The right data is being measured to calculate the required KPIs during the implementation of the measures.

An important part of this process is to have a close look at the KPIs that are projected for each demonstrator, the calculation method of the KPIs, and the expected results. By means of KPI interpretation forms. By doing so:

- KPIs are defined and calculated such that only one way of interpretation is possible. This way results from different projects and cities are homogenized.

- It is well understood what result the measurement of a KPI leads to.

The method and results of this process are described in this report, which is a revised KPI list where KPIs are added, removed or adapted.

In addition to this, the KPI interpretation forms created the basis for the formulation of detailed monitoring plans for all measures within the project. Together with template forms for reporting these plans and a common data structure, which were provided to the affiliated partners, these plans are obtained and described for all measures per Transition Track and per Lighthouse city in this report.

Another essential part of measuring the performance of the IRIS project is the establishment of the baseline measurements and review if targets are met. Tables with KPI data requirements, consisting of the associated parameters, data sources, baseline and (possible) targets for all measures are incorporated.

An important part of the monitoring strategy of the IRIS project is the KPI tool, which is described in detail in report D9.4 [5]. This tool is established to collect all relevant monitoring data from the IRIS project in order to calculate and visualize the performance of the project. The tool partly obtains it's data by means of the City Information Platforms (CIP). The monitoring details combined with the updated KPIs, result in an inventory containing an overview of all data sources with as main objective:

- To make sure that all data sources are known and will be measured by the responsible partners.
- To know what kind of data needs to be collected by the KPI tool.
- To know when monitoring in each demonstrator starts and data can be expected.
- To have a clear overview for all responsible partners what to deliver.

Besides setting up the collection of the indicators data, D9.5 also continues the work on aggregation of KPIs. For each city a revised list is made that indicates which KPIs will be aggregated to Transition Track-, City- and IRIS-level.

In the conclusion the challenges that where met during the process of setting up the monitoring framework are described. Because of delays within the IRIS project, not all monitoring plans have been obtained yet. Therefore, a future update of this report will be submitted as soon as this information is available. Further on a perspective is described for future work to start gathering the data and visualize results of the IRIS project.

The target group for this report is mainly people who:

- Are interested in how to apply a unified monitoring and evaluation scheme into a large Smart City project with many different partners and stakeholders. For example, people working on comparable (Smart City) projects, or the follower cities within the IRIS project.
- Are interested in how the performance of several different Smart city projects can be evaluated.
- Are interested in the implementation of KPIs from projects such as SCIS and CITYkeys.
- Want to learn from project partners from within the IRIS project who work on similar projects about their monitoring. For example, partners from different cities affiliated with the same transition track or transition track leaders.

- Want to find out what kind of data can be expected from the IRIS project. For example, external researchers interested in the results of Smart City projects, but also partners working on WP4 (CIP) and WP9 (monitoring and evaluation).
- Want to learn what the current state is of the monitoring and evaluation of the IRIS project.

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List of Acronyms and Abbreviations

Abbreviation	Definition
AC	Alternating Current
APIs	Application Programming Interfaces
AWL	A Working Lab
BAU	Business As Usual
BESS	Battery Energy Storage Systems
BIPV	Building Integrated Photovoltaics
CIM	City Information Model
CIP	City Innovation Platform
CITYkeys	Smart City performance measurement system (Project funded by the European Union HORIZON 2020)
DC	Direct Current
DEMS	District Energy Management System
DER	Distributed Energy Resources
DHCN	District Heating Cooling Network
DoA	Description of Action
DSO	Distribution System Operator
EC2B	Easy to be
EMSs	Smart Energy Management System
EPC	Energy performance contracting
FC	Follower City
GA	Grant Agreement
GDPR	General Data Protection Regulation
GOT	Gothenburg
HEMS	Home Energy Management System
ICT	Information and Communication Technology
IL	IRIS project level
IRR	Internal Rate of Return
IS	Integrated Solution
ISO	International Standards Organization
KPI	Key Performance Indicator
LCL	Lighthouse City Level
LC	Lighthouse City
LH	Lighthouse
lm	Lumen
MaaS	Mobility as a Service
MVP	Minimal Viable Product

NCA	Nice Côte d'Azur
OCPP	Open Charge Point Protocol
PCM	Phase Change Materials
PDS	Public Delegation of Service
POC	Proof of concept
PV	Photovoltaic
RES	Renewable Energy Sources
ROI	Return of Investment
SC	Smart City
SCIS	Smart Cities Information System (Project funded by the European Union HORIZON 2020)
STT	Solution level
TES	Thermal Energy Storage
TSO	Transmission System Operator
TT	Transition Track
UC	Use Case
UNS	University of Nice
UTR	Utrecht
USEF	Universal Smart Energy Framework
USI	Utrecht Sustainability Institute
V2G	Vehicle to Grid
WP	Work Package

Additional note for the reader:

Within this report, the terms**: Measure, Demonstration, Demonstrator and Solution** all stand for the measures that are demonstrated within the IRIS project. An **Integrated solution** is a combination of several different measures which are thoroughly related.

For example, the **Integrated Solution** Near Zero Energy Building (NZEB) refurbishment could consist of several **Measures,** such as: Implementation of PV panels, Insulation, Energy management systems, low temperature heating etc.

1. Introduction

1.1 Scope, objectives and expected impact

The IRIS project aims to use the full ability of existing urban platforms and Information and Communication Technology (ICT) systems in the Lighthouse (LH) cities to provide better services, innovative business models and implementation of new ways to reach and engage citizens in sustainable, smart city solutions. The overall aim is to build a secure local energy system that is both cheaper for the citizens and local authorities and contributes to reduced environmental impact by reduction of transport-based CO_2 emissions, sustainable electricity production and heating at district level. The project consists of several demonstration projects which are divided by 5 transition tracks (TTs): TT1; Smart renewables and closed-loop energy positive districts, TT2; Smart Energy Management and Storage for Grid Flexibility, TT3; Smart e-Mobility Sector, TT4; City Innovation Platform (CIP) Use Cases, TT5; Citizen engagement and co-creation.

The IRIS project has defined goals and targets for each Lighthouse (LH) city in the project proposal [6] and the work package (WP) 9 on monitoring and evaluation (WP) 9 will analyse to what extent the project reaches these goals and objectives. The monitoring and evaluation will also provide information concerning the performance of the different solutions demonstrated in the LH cities in IRIS which is important for the replication of the solutions both in the LH cities and in other cities.

Deliverable D9.5 *Report on monitoring framework in LH cities and established baseline* is the result of Task 9.4 *Deployment of monitoring framework in LH cities.* This task constitutes of:

- Deployment of a unified framework of for monitoring with the support from the technical partners of each lighthouse city
- Initial testing and verification of the baseline data to ensure that the data provided to the CIP os pertinent and provides tangible results

D9.5 gives an overview of the work done in WP9 to provide data for monitoring the results of the IRIS project. It presents the output of the feedback process with the Transition Track (TT) leaders, which was done to optimize the selection and definition of the Key Performance Indicator (KPI)s for each solution. Further on it presents a detailed monitoring plan and determination of the baseline for each measure with a detailed list of parameters to be measured or provided. These lists form the basis for completion of the KPI tool, which is created to collect data and calculates KPIs for the whole IRIS project and to visualize and report the project results in a homogeneous manner. Lastly, the aggregation of the KPIs to TT, city or IRIS level is described for each city.

1.2 Contributions of partners

Deliverable D9.5 has been authored by Utrecht University (UU), Research Institutes of Sweden (RISE) and the Centre of Research & Technology (CERTH). The work on updating the KPIs and establishing the necessary data to collect for each indicator took place in close collaboration with the leaders of the demonstrators of each LH city (Utrecht, Nice and Gothenburg). Furthermore, the partners of WP4, the City Innovation Platform (CIP), participated in the connection of the KPI tool with this platform

1.3 Relation to other activities

In D9.5, the continuous work on developing the monitoring and evaluation process within the IRIS project is presented, therefore the deliverable is closely related to all other activities within WP9. In addition, the launch of the activities of each transition track defines the basis of the description of each measure and its associated variables. Furthermore, the work in task 9.4 is also closely related to the development of the CIP, as a means for data collection. Table 1 explains the relation of D9.5 to other activities (deliverables) developed within the IRIS project.

Due to delays in the submission of deliverables in which detailed monitoring plans for each TT are described, the development of D9.5 also experienced a delay. The current version of D9.5 is still submitted with certain gaps in the monitoring plans. Therefore, an updated version of this document will be submitted as soon as all information is available.

Table 1 Relation of D9.5 with other activities (deliverables)

Number	Title	Relation (Input/Output)
D4.6 [M30]	Integration of CIP in LH Cities	Output used to connect to the CIP, in each LH city, the monitoring equipment that is required to collect real time, high resolution data.
D5,6,7. 3,4,5,6,7 [M24]	Launch of the activities on each TT in Utrecht, Nice, Gothenburg	Input used for description of the monitoring methodology and listing of all variables to be measured.
D9.2 [M12]	Report on monitoring and evaluation schemes for integrated solutions	Input used for the creation of the data collection and data analysis methodologies.
D9.3 [M12]	Report on data model and management plan for integrated solutions	Input used for the creation of the data collection methodology.
D9.4 [M24]	Establishment of a unified framework for harmonized data gathering, analysis and reporting	Input used for the creation of the data collection methodology.
D9.6: (M38)	Intermediate report after one year of measurement	Output, as the actual performance data collection and reporting will be carried out in this deliverable. Moreover, the KPI tool will be used to calculate and visualize the KPIs in each LH city.
D9.6: (M60)	Report on evaluation and impact analysis for integrated solutions	Output, as the actual performance data collection and reporting will be carried out in this deliverable. Moreover, the KPI tool will be used to calculate and visualize the KPIs in each LH city.
D9.9: (M30)	Second update of the Data Management Plan	Output, the information for all data variables provide the basis for the data input of the data management plan.

D8.4 – D8.12	Replication plans of follower cities, European level replication guidelines	Output used for monitoring and evaluation of IRIS replicable solutions.

1.4 Structure of the deliverable

The structure of this deliverable is as follows:

Chapter 1: Introduction, where the scope, objectives and expected impact of the report is described and related to the other work packages in the IRIS project

Chapter 2: Methodology, describes what methods are utilized to obtain all results described in this report.

Chapter 3: Revision of KPIs, represents what modifications were made to the original KPI lists, and what data sources are related to all KPIs within the IRIS project.

Chapter 4: Monitoring plans TT1, presents detailed monitoring plans of the Lighthouse cities for all measures within transition track 1; Smart renewables and closed loop energy districts.

Chapter 5: Monitoring plans TT2, presents detailed monitoring plans of the Lighthouse cities for all measures within transition track 2; Smart Energy Management and Storage for Energy Grid Flexibility.

Chapter 6: Monitoring plans TT3, presents detailed monitoring plans of the Lighthouse cities for all measures within transition track 3; Smart e-Mobility Sector.

Chapter 7: Monitoring plans TT4, presents detailed monitoring plans of the Lighthouse cities for all measures within transition track 4; City Innovation Platform (CIP).

Chapter 8: Monitoring plans TT5, presents detailed monitoring plans of the Lighthouse cities for all measures within transition track 5; Citizen engagement and co-creation.

Chapter 9: Monitoring timeline, provides a graphical overview of when monitoring data is expected to be obtained from all measures per city.

Chapter 10: Output to other work packages, specifies how the work described in this report will be used by other work packages in the IRIS project.

Chapter 11: Conclusions and recommendations, summarizes the conclusions drawn from this report and gives recommendations for future work on monitoring and evaluation of the project.

2 Methodology

2.1 Methodology for collecting indicators data

The assessment of the different IRIS demonstrations within the LH cities is undertaken through the evaluation of various indicators showing the effectiveness of the implementations. To establish these defined KPIs, for each demonstrator project, several parameters need to be measured. Monitoring of these measurements will take place during the operation of the demonstrators. A cornerstone of the measurement procedure is the data collection. Data collection is the process of gathering information on specific variables following a systematic method that enables measuring and evaluating outcomes. The emphasis in the data collection process is put on ensuring accurate data collection.

In IRIS, data collection processes in different fields (energy, mobility, ICT, and citizen engagement) need to be analysed. These fields are defined as 5 Transition Tracks (TT) which are illustrated with their related demonstrators in Figure 1. The heterogeneous nature of those fields implies that data sources and means of data collection and storage might differ. In some cases, data will be provided by systems that include smart meters, which automatically collect data and upload it to a repository. In other cases, they reside in another system's repository and simply needs to be moved or copied. Data can be also collected by other methods such as questionnaires, interviews, direct observations, etc. and their results are registered in forms (electronic or paper).

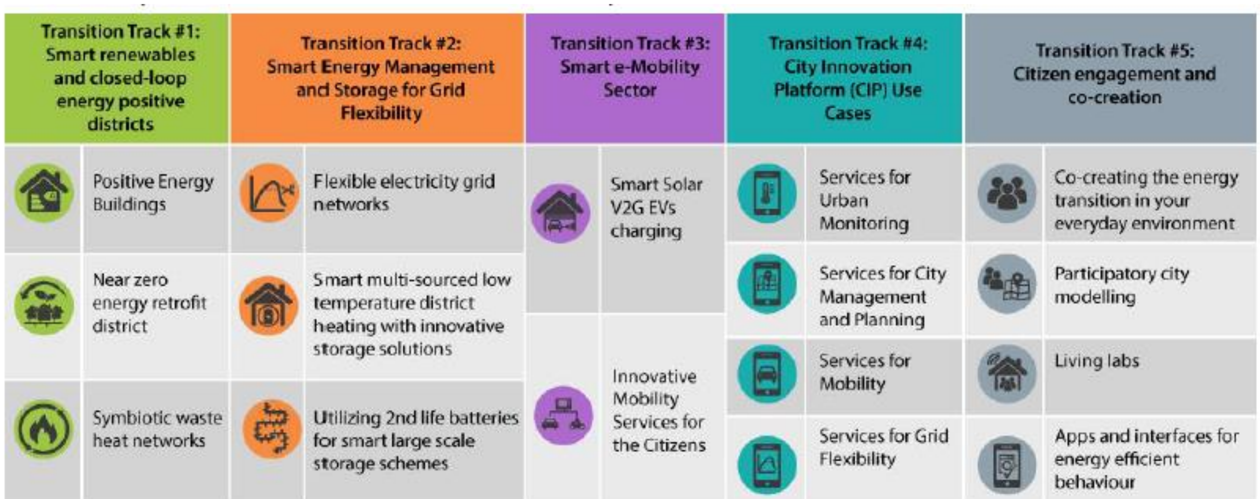


Figure 1 The 5 IRIS Transition Tracks with their related demonstrators [6]

In some cases, data transformation is required so that the information can be used in analysis and evaluation. For example, instant data about electrical consumption provided by a smart meter might not be easy to interpret but the electrical energy consumed by a building during one month is relevant. This second value can be calculated from the information of several smart meters like the first one providing information during a whole month.

This section presents the methodology for the collection of the various types of data required for the calculation of the KPIs in the IRIS LH cities. The collected data will be stored in the City Innovation Platform (CIP) and they will used by the IRIS KPI tool to calculate and visualise the KPIs.

2.1.1 Methodology for updating KPIs

The feedback from the workshops as described in chapter 2 of D9.3 (Report on data model and monitoring plan for integrated solutions) [4], and workshops in smaller groups in Utrecht have led to a guideline that supports the partners who implement the demonstrators in setting up their projects such that:

- KPIs that are being measured are well understood
- KPIs give a meaningful result
- The right data is being measured to calculate the required KPIs during implementation of the measures.

An important part of this process is to have a close look at the KPIs that are projected for each measure, the calculation method of the KPIs, and the expected results. By doing so:

- KPIs are defined and calculated such that only one way of interpretation is possible. This way results from different projects and cities are homogenized.
- It is well understood what result the measurement of a KPI leads to.

Figure 2 gives a schematic representation of the process of interpreting and applying the KPIs to the demonstrators.

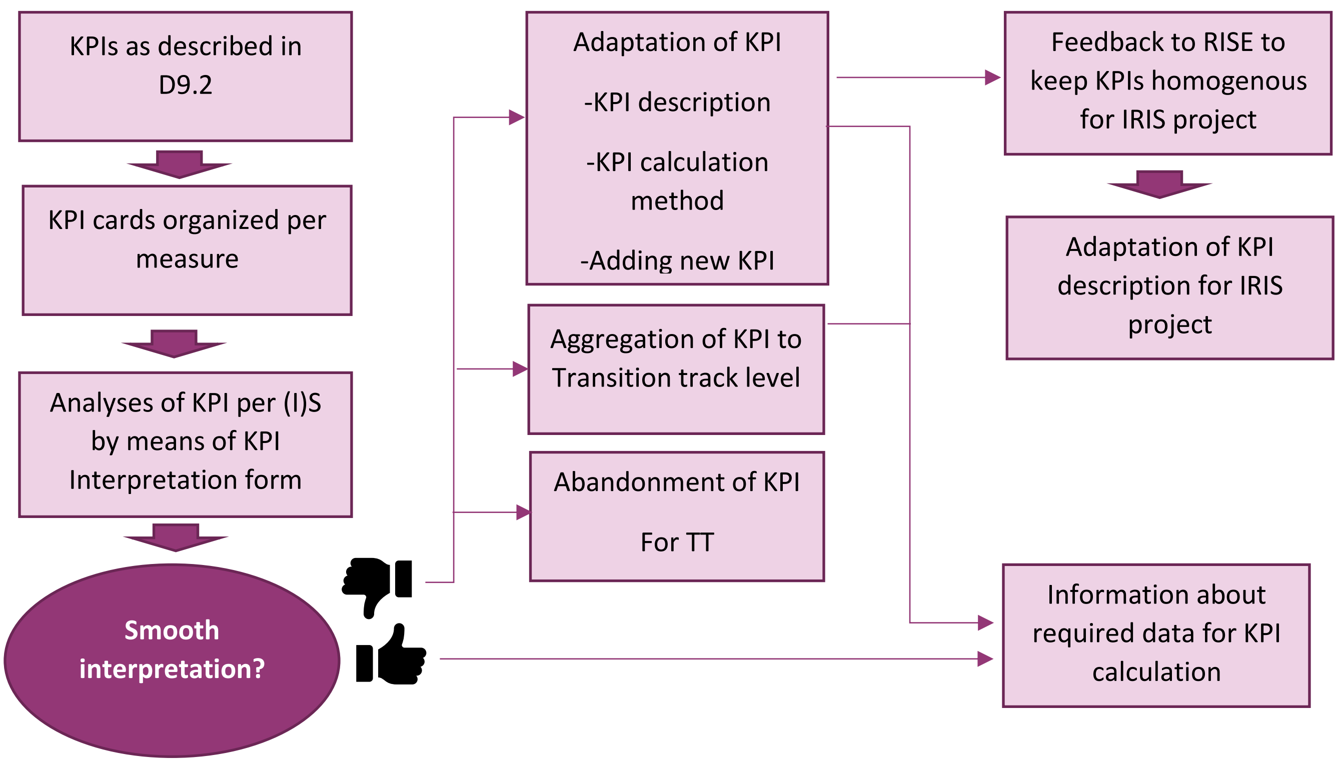


Figure 2 Schematic representation of KPI interpretation process

The interpretation starts with the KPIs as described in D9.2 (Report on monitoring and evaluation schemes for integrated solutions) [1]. To facilitate the work, for each (integrated) solution (IS) the KPIs that are

projected to be measured are organized in a separate folder. Then the solutions and the KPIs are analysed by means of the KPI interpretation form. An example of this form is provided in the Form for interpretation of KPIs, Appendix A1.

In case of a smooth interpretation of a KPI for a demonstrator, the interpretation form leads to a list of required information to calculate the KPIs during the project.

When interpretation does not happen smoothly, different options are possible:

- **Adaptation of the KPI**: This could either mean that the KPI description or the KPI calculation method will be changed. Adjustment of the KPI will happen in close contact with RISE, to make sure that KPIs remain homogenous for each city throughout the IRIS project. Alternatively, a new KPI could be added to the database.
- **Aggregation of the KPI to transition track (TT) level**: In some cases, integrated solutions are so much integrated in a transition track, that it's impossible or meaningless to distinguish the effect of the solutions separately. In this case the KPI will be calculated for more solutions combined, at transition track level.
- **Abandonment of KPI**: In case a KPI cannot be measured neither at solution or TT level, or measurement is possible, but gives a meaningless result. Abandoning the KPI will be requested.

Besides adaptation of the KPI or aggregation of the KPI to transition track level, filling in the interpretation form provides information which is required to calculate the KPIs during the project. This information is the basis of the data collection framework, which is described in paragraph 2.2.

Paragraphs 3.1.1, 3.1.2 and 3.1.3 show for each city which modifications are made to the initial KPI list as presented in D9.2 [1].

2.1.2 Obtaining monitoring plans from TT partners

In order to collect the data from the TT leaders in a structured way, a template is prepared for the deliverables which describe the activities of each transition track (D5.3 to D5.7, D6.3 to D6.7 and D7.3 to D7.7. These deliverables form the basis for chapters 4 to 8, which provides the monitoring plans for each measure. The part of the template representing the required monitoring data for this report is shown in appendix 0. The template is based on the approach that is described in chapter 3 of deliverable D9.3 [4].

2.2 Data Collection Framework

2.2.1 KPI data requirements

This section continues the work done in D9.4 chapter 3 [5]. The table below is a template to provide an overview of the most important variables per measure. It represents all parameters that are required for calculation of each KPI, how this data is retrieved, how the baseline is defined and the target as stated in the Grant Agreement (GA). The 3rd row of the table gives an example of a possible completion of this template for the KPI 'Degree of local renewable energy production'.

By providing this table in the monitoring plan of each demonstrator as shown in chapters 4 to 8, a quick scan can be made to check whether the key variables of the KPIs are taken care of.

Table 2 KPI data requirements

KPI	Parameter(s)	Data source	Baseline	GA- Target
Key performance indicator	*Required parameter to calculate indicator*	*How the parameter is measured e.g. (smart-)meter, survey, product specifications*	*How the baseline is defined (if applicable)*	*The target as stated in the grant agreement*
	Required parameter to calculate indicator	*How the parameter is measured e.g. (smart-)meter, survey, product specifications*		
20-Degree of local renewable energy production	Annual electricity generated by Photovoltaic (PV) panels	TOON (HEMS)	0, Before the measure, no electricity was generated by RES	60%
	Annual Electricity consumption	TOON (HEMS)		

2.2.2 Common data structure

Besides the key variables as stated in the paragraph above, more detailed information is required for each parameter. The combination of the work completed in D9.3 and D9.4 has led to a new common data structure which is presented as Table 3. Compared to the table in D9.3, that the table is rotated 90 degrees, to facilitate documentation of the parameters. Further on some parameters are renamed to smoothen processing of the tables. And certain parameters are added as described in D9.4 [5]

The template as shown in Table 3 identifies relevant categories of information to be collected during the operation of the integrated solutions. For less technical parameters, for example parameters measured more from a financial or societal approach, it might not be possible to fill in certain categories. When this is the case for a whole dataset, columns could be deleted from the template table.

The table also provides guidance in what information to provide in each column. The basis for this structure is related to the data model of the Celsius smart cities project and the FIWARE data models [7, 8]

Table 3 Template table for detailed description of parameter/variable per measure (one for each).

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Define the type of main physical parameters to be measured and recorded such as: Electric energy consumption / production, temperatures, water / gas flows etc. Besides these technical parameters, also other parameters such as tariffs, emissions, pollution particles etc. could be given. Where possible, keep this typology in line with the data types mentioned in the “Description format of each KPI”, as mentioned in D1.1. [9] A full, readable and distinguishable short name should be provided here.

2	Measure Number *As it is stated in the measure tracker*	As described in the measure tracker, Annex A2
3	KPI Number *KPI('s) that are related to the data*	As described here, Annex 0
4	Units of measurement *i.e. kWh, Euro, etc.*	Define which units are being used. Try to keep units uniform, for example when electrical energy is measured in kWh, try to use the same unit for electrical energy in the whole dataset.
5	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	How is the baseline of the variable measured?
6	Data Source *i.e. smart meter, survey, energy bill, etc.*	Indicate here how the variable will be measured
7	Location of measurement *Where the measurements take place*	Where do the measurements take place?
8	Data accuracy *How accurate is the measurement*	The accuracy of the data set describes how well the data corresponds to the "real world" object or event. This can be assessed for example by comparing the data to data from a reliable source. The accuracy relates very much to the validity of the data, data that is out of range could be inaccurate and should be further analysed.
9	Collection interval *How often the data is recorded*	The recording frequency depends on the purpose of each solution and the associated KPIs that are evaluated by monitoring. Define what frequency suits your situation and indicate the recording frequency (hourly, daily, yearly….) for each measurement here.
10	Start of measurements *i.e. 1-1-2019, 0:00CET*	At what date will the measurements start?
11	End of measurements *i.e. 31-12-2020, 24:00CET*	At what date will the measurements end?
12	Expected availability *i.e. open data, public, confidential, no data available*	For the availability the following values are possible: open data, public, confidential, no data available.

13	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Data accessibility is divided into three categories: 1) Data is available over common networking protocols without access constraints, 2) data is available online, but requires authentication, and, 3) data is not accessible online, or requires manual work to get data out from internal systems. Open data mostly satisfies the first category requirement, as it is also part of the open data definition that data should be accessible in machine readable format, at machine findable location.
14	Data format *i.e. csv file, json…*	When choosing the right **format** for **open data**[1] it is recommended to start with comma separated values (CSV) files. CSV is perfect for tabular data and can be easily loaded into and saved from applications like Excel, making it accessible to users. For geospatial open data formats, formats to be considered are geoJSON (based upon JavaScript Object Notation - JSON) and Keyhole Markup Language (KML) which is based upon Extensible Markup Language – XML.
15	Data owner *i.e. the name of the company that will give access to data*	The name of the company that gives access to the data
16	Comments *Further info*	Add extra information that is relevant for the measurements, which is not covered by the other columns

2.3 Aggregation of KPIs

In IRIS, the solutions implemented in the LH cities have been clustered into Transition Tracks representing a general sector of interest in the IRIS project. The Transition Tracks are presented in Figure 1. All Transition Tracks are represented in all three LH cities, although the solutions in each Transition Track differ between the cities. To compare the results of the LH demonstrations, it is therefore of interest to not only evaluate the project on the individual solution level, but on Transition Track level as well as LH city level. Additionally, the performance of the entire IRIS project also needs to be evaluated.

The KPIs on Transition Track level have been chosen to reflect the theme of each Transition Track, but since each LH city has its own set of solutions and targets, the KPIs for the Transition Tracks vary between the LH cities. In the same way the KPIs on LH level reflect the objectives and demonstrated solutions of each LH city. On IRIS level only two KPIs have been chosen, **energy savings and CO_2 emission reduction**. These KPIs have been chosen since they reflect the performance of all the IRIS Transition Tracks and can be aggregated to evaluate the impact of the whole project. Other KPIs are also of importance to the IRIS project but they are of most interest in the context of the LH city where they are implemented, not on an aggregated level.

[1] Choosing the right format for open data: https://www.europeandataportal.eu/elearning/en/module9/#/id/co-01

The possible aggregation of IRIS KPIs is illustrated by a house, where the first floor of the house contains the KPIs calculated on individual solution level (STT1 to STT5, where STT stands for Solution of Transition Track 1), the second floor contains KPIs that can be aggregated to Transition Track level (TT1-5), the third floor has KPIs that can be aggregated to lighthouse city level (LCL) and the attic has the KPIs that can be aggregated all the way up to IRIS project level (IL). The house is illustrated in Figure 3.

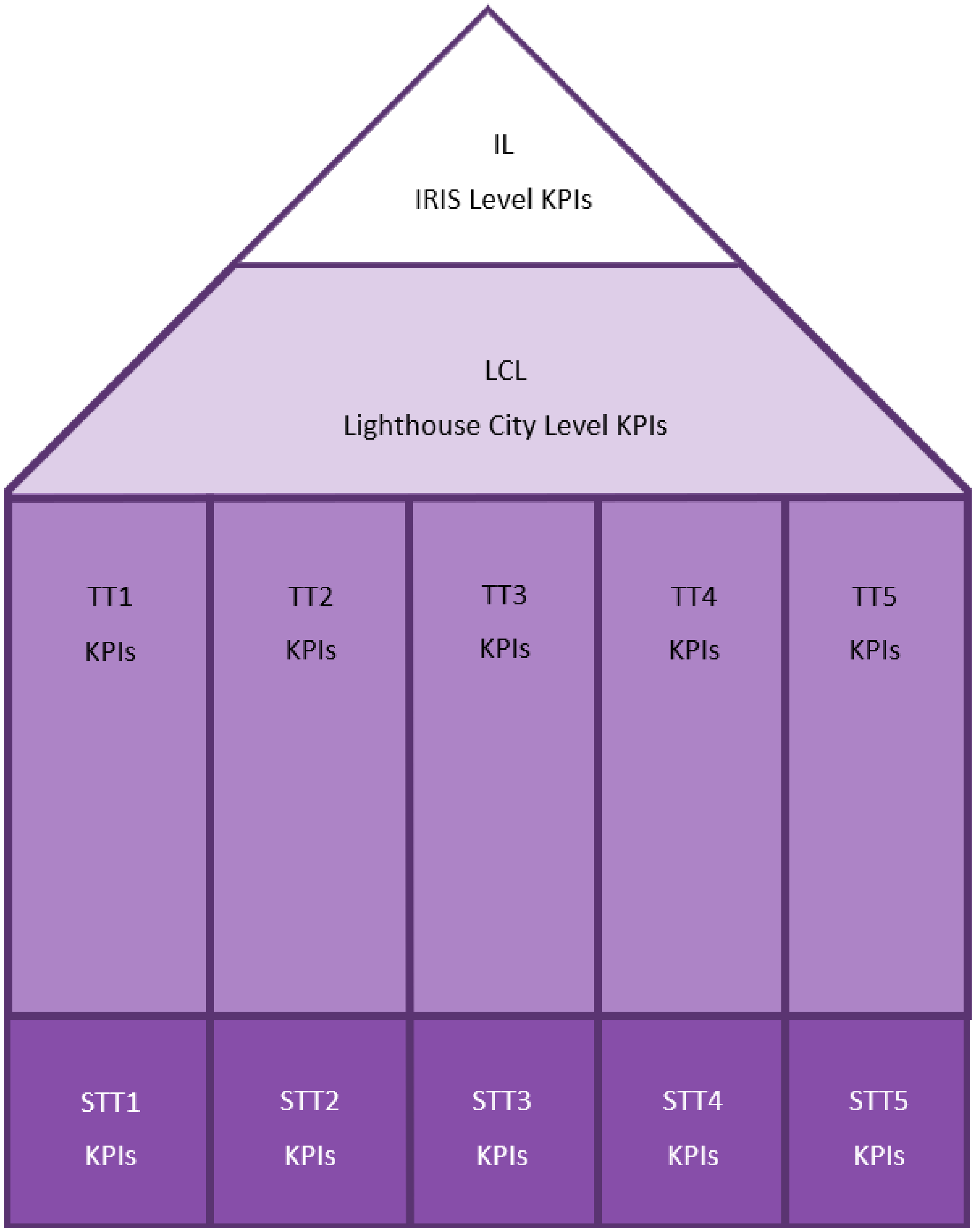


Figure 3 IRIS KPI-house. The KPIs presented the bottom part (STT1 – STT5) are, if possible, aggregated to transition track level (TT1-5) or higher

Each LH city has its own set of KPIs that can be related to the IRIS KPI house; the top level of the house containing the IRIS level KPIs (IL) is however the same for all cities. On solution level (STT1-5), the KPIs

may vary between the cities since different solutions are implemented in each city and the cities have different objectives. In many cases the same KPIs can be found in all cities, thus allowing comparison between the Transition Tracks of the cities. For some Transition Tracks the evaluation of integrated solutions cannot be separated and the KPIs are hence calculated at Transition Track level (TT1-5) [1].

In paragraph 4.2 of D9.2, possible aggregation of KPIs to solutions and the IRIS KPI-house are presented for each city. As certain KPIs and ISs where updated in the process described in 2.1.1, these tables require revision. Revision of the aggregated KPIs is achieved by requesting updated KPI tables by means of the template for deliverables D5.3 to D5.7, D6.3 to D6.7 and D7.3 to D7.7. as presented in Appendix A5. The information acquired from these deliverables has been cross-checked with the KPI tables as presented appendix A8, A9 and A10. This leads to the updated tables of paragraphs 3.6 to 3.9 which show the KPIs of each transition track and their position in the IRIS-KPI-House for each city.

2.4 Keeping track of progress

To keep track of the progress of the actions described in this methodology, an extra tab is added to the online IRIS measure tracker [10]. In this tab a table is designed which gives a quick overview of the development of the monitoring program for each integrated solution by means of colour code.

Besides a column for comments, the table indicates the progress of the following subjects:

- Clear monitoring plan with well-defined variables
- Appendices for each variable are completely filled in
- Clear planning with data input
- Targets are specified
- Well defined Baseline

The color code indicates the progress of the IS on each subject as a percentage as shown in the table below. For an impression of the actual table, an excerpt is presented in appendix 0.

Table 4 Colour code of the table representing the progress of monitoring plans

90%	**50%**	**25%**	**0%**

3 Revision of KPIs

Deliverable D9.2 (Report on Monitoring and evaluation schemes for integrated solutions) [1] describes all KPIs to be evaluated for each measure within the IRIS project. Since these KPIs where defined in an early stage of the project, a revision of this list of KPIs is required. Paragraph 2.1.1. defines a method to analyse, review and update the KPIs by means of KPI-interpretation forms.

3.1 Feedback from KPI-interpretation forms

The feedback from the KPI interpretation forms has led to adaptations of the original KPI list as presented in D9.2. These alterations are represented for each city in the tables in this chapter.

Each table represents:

- Which transition track (TT) and measure (M) each KPI belongs to.
- Which KPI needs adaptation
- What kind of adaptation is required, related to the KPI for each measure:
    - Definition of a new KPI
    - Modification of an existing KPI
    - Removal of the KPI
- Comments on reasons why revision is required.

3.1.1 Utrecht

Table 5 Revision of the list of KPIs to be analysed in the measures in Utrecht

TT.M	KPI	New	Modify	Remove	Comment
1.1	Increase in local renewable energy production		x		-Change title to: **Degree of local renewable energy production** This fits the formula and KPI description better. Further on, an increase as a percentage would have been infinite/ unmeasurable, since the baseline is 0. -Unit of measurement is % (instead of % kWh)
1.1	Installed capacity	X			Not a KPI, but an integer to state the amount of installed PV in kWp for this IS
1.1/1.2/1.4/1.5	Reduced energy costs for costumers			X	As different measures are taken simultaneously, results are not distinguishable per solution. Therefore, the KPI is shifted to TT level
1.1/1.2/1.4/1.5	CO_2 reduction cost efficiency			X	As different measures are taken simultaneously, results are not distinguishable per solution. Therefore, the KPI is shifted to TT level
1.2/1.4/1.5	Energy savings - for the tenants (Thermal)			X	As different measures are taken simultaneously, results are not distinguishable

TT.M	KPI	New	Modify	Remove	Comment
					per solution. Therefore, the KPI is shifted to TT level
1.2/1.4/1.5	Carbon dioxide Emission Reduction			X	As different measures are taken simultaneously, results are not distinguishable per solution. Therefore, the KPI is shifted to TT level
1.6	CO_2 reduction cost efficiency			X	
1.7	CO_2 reduction cost efficiency			X	
1.7	Reduction in annual final energy consumption by street lighting Energy savings				These two KPIs are predominantly similar for this measure.
2.1	Carbon dioxide emission reduction			X	
2.1/2.2	Reduced energy curtailment of RES and DER			X	
2.1/2.2	CO_2 reduction cost efficiency			X	
2.3	Increase self-consumption of PV energy by e-cars			X	
2.4	Increased system flexibility for energy players			X	
2.4	Peak load reduction	X			
2.1/2.2/2.3/2.4	Peak load reduction		X		Detailed determination of how the KPI is being monitored in this TT is still work in progress
5.1	Increased consciousness of Citizenship			X	Not measurable with this solution
5.2	Local community involvement in planning/ implementation phase			X	
5.3	Increased environmental awareness			X	
5.4	Local community involvement in development process	X			
5.4	Increased environmental awareness			X	

3.1.2 Nice

Table 6 Revision of the list of KPIs to be analysed in the measures in Nice.

TT.M	KPI	New	Modify	Remove	Comment
1.1	Degree of energy self-supply by RES		X		
1.1	Storage capacity installed				
1.1	Energy savings	X			
1.1	Carbon dioxide Emission Reduction		X		
1.1	CO_2 reduction cost efficiency				
1.1	Energy savings			X	
1.1	Reduced energy costs for consumers			X	
1.1	Carbon dioxide Emission Reduction			X	
1.1	CO_2 reduction cost efficiency			X	
1.1	Data loss prevention	X			
1.1	Increased awareness of energy usage.	X			
1.2	Peak load reduction			X	
1.2	CO_2 reduction cost efficiency		X		
1.2	Return on investment	X			
1.4	Carbon dioxide Emission Reduction		X		
1.4	Increased environmental awareness	X			
1.4	Ease of use for end users of the solution	X			
1.4	User engagement	X			
1.4	CO_2 reduction cost efficiency			X	
1.4	Primary Energy Demand and Consumption			X	
2.1	Energy savings		X		
2.1	Storage capacity installed		X		Useful storage capacity installed
2.1	Investment cost	X			
2.1	Increased awareness of energy usage			X	
2.1	Increased system flexibility for energy players				Increased system flexibility
2.1	Degree of energetic self-supply by RES		X		RES self-supply ratio
2.1	Ratio of valorised PV RES	X			

TT.M	KPI	New	Modify	Remove	Comment
2.1	Reduced energy curtailment of RES and DER			**X**	
2.1	Carbon dioxide Emission Reduction		**X**		CO_2 savings
2.1	CO_2 reduction cost efficiency			**X**	
2.2	Energy savings		**X**		
2.2	Degree of energetic self-supply by RES		**X**		RES self-supply ratio
2.2	Carbon dioxide Emission Reduction		**X**		CO_2 savings
2.2	Useful storage capacity installed	**X**			
2.2	Battery degradation rate	**X**			
2.2	Increased system flexibility	**X**			
2.2	Investment cost	**X**			
2.2	CO_2 reduction cost efficiency			**X**	
2.2	Peak load reduction			**X**	
2.3	Storage capacity installed		**X**		Useful storage capacity installed
2.3	Peak load reduction			**X**	
2.3	Increased system flexibility	**X**			
2.3	Investment cost	**X**			
2.3	CO_2 reduction cost efficiency			**X**	
3.1	CO2 savings	**X**			D9.2 didn't propose KPIs for this demonstration as it was part of 3.2
3.1	Peak load reduction	**X**			D9.2 didn't propose KPIs for this demonstration
3.1	Useful storage capacity installed	**X**			D9.2 didn't propose KPIs for this demonstration
3.1	Increased system flexibility	**X**			D9.2 didn't propose KPIs for this demonstration
3.1	Energy costs reduction	**X**			D9.2 didn't propose KPIs for this demonstration
3.1	Supervised fast charging poles	**X**			D9.2 didn't propose KPIs for this demonstration
3.1	Investment cost	**X**			D9.2 didn't propose KPIs for this demonstration
3.2	Improved access to vehicle sharing solutions			**X**	
3.2	Access to vehicle sharing solutions for city travel			**X**	Replaced by the "Mobility efficiency (cars)" KPI
3.2	Number of e-charging stations deployed in the area			**X**	Replaced by "Supervised fast charging poles" KPI included in 3.1

TT.M	KPI	New	Modify	Remove	Comment
3.2	Yearly km driven in e-car sharing system				Replaced by "Mobility efficiency (cars)" KPI
3.2	Number of efficient vehicles deployed in the area				Replaced by the "Mobility efficiency (cars)" KPI
3.2	Number of Free Floating subscribers				Replaced by the "Mobility efficiency (users)" KPI
3.2	Ease of use for end users of the solution				
3.2	CO_2 reduction cost efficiency			**X**	Very difficult to measure it.
3.2	C02 saving	**X**			
3.2	Mobility efficiency (users)	**X**			
3.2	Mobility efficiency (cars)	**X**			
3.2	Fleet availability	**X**			
4.1 -4.4	Developer engagement			**X**	
4.1 -4.4	Data safety			**X**	
4.1 -4.4	Data loss prevention			**X**	
4.1 -4.4	Expiration date of open data			**X**	
4.1 -4.4	Platform downtime			**X**	
4.1 -4.4	User engagement			**X**	
4.1 -4.4	Usage of open data	**X**			
4.1 -4.4	Share of RES in ICT power supply	**X**			
4.1 -4.4	Quality of CIP	**X**			Quite similar to existing "Number of connected urban objects" KPI
4.1 -4.4	Quality of datasets	**X**			
4.1 -4.4	Usage of the CIP	**X**			
4.1 -4.4	Usage of the dashboard	**X**			
4.1 -4.4	Usability of open data	**X**			
5.1	Ease of use for end users of the solution			**X**	
5.2	Increased awareness of energy usage	**X**			
5.2	Increased Consciousness of citizens	**X**			
5.3	User engagement	**X**			

3.1.3 Gothenburg

Table 7 Revision of the list of KPIs to be analysed in the measures in Gothenburg.

TT.IS	KPI	New	Modified	Removed	Comment
1.1	Battery Degradation Rate			X	Evaluated in TT2, measure 2.4
	Storage Capacity installed			X	Evaluated in TT2, measure 2.4
	Peak load reduction			X	Evaluated in TT2, measure 2.4
	CO_2 reduction cost efficiency			X	
1.6	Energy saving			X	The measure doesn't lead to absolute energy savings therefore this KPI has not been seen as relevant.
	CO_2 reduction cost efficiency			X	
2.1	Carbon dioxid Emission Reduction			X	
	Increase in local renewablew energy production			X	
	CO_2 reduction cost efficiency			X	
2.2	Carbon dioxid Emission Reduction			X	The low temperature DH network will be monitored and evaluated, together with the energy system of Brf (housing corporation) Viva in its entirety, primarily within the scope of TT#1 and as described in D7.3. Since it is an integral part of the energy system it is not interesting nor possible to evaluate the measure separately.
	Energy saving			X	
	Degree of energy self-supply by RES			X	
	Storage capacity installed			X	
	CO_2 reduction cost efficiency			X	
2.3	Carbon dioxide Emissions Reduction			X	
	CO_2 reduction cost efficiency			X	
	Storage energy losses	X			This KPI was added to enable evaluation of the performance of the PCM:s storage.
2.4	CO_2 reduction cost efficiency			X	
	Carbon dioxid Emission Reduction			X	Evaluated in TT1, measure 1.1
3.1	Energy saving		X		Adjusted formula so it can also be evaluated per individual.
4.1	Expiration date of open data			X	Not applicable for CIM
	Developer engagement			X	
	User engagement			X	This can only be measured for data that is shared where there is a contract. For the data

					that is shared openly it can only be measured when a user contacts the city.
	Share of RES in ICT power supply			X	Not applicable for CIM
	Platform downtime			X	Not applicable for CIM
	Data safety			X	Not applicable for CIM
	Data loss prevention			X	Not applicable for CIM
4.2	Share of RES in ICT power supply			X	
	Peak load reduction			X	
	CO_2 reduction cost efficiency			X	
	Carbon dioxide Emission Reduction			X	
	Quality of open Data	X			

3.2 Updated lists of KPIs

The revision of KPIs as stated in the tables in the former paragraph result in updated versions of the KPI list from D9.2. [1] These new lists for each city are represented in appendix A7, A8 and A9 for Utrecht, Nice and Gothenburg. The appendix shows for each Measure a table as below. This table states:

- KPI: which KPI(s) will be measured.
- Unit: In what unit the KPI will result
- Definition: A short line what is meant with the KPI
- Source: Where the KPI originates from
- Target: In case a grant agreement target is measured with the KPI, a reference to the target is made.

Table 8 Example of the tables that list all KPIs for each Measure

KPI	Unit	Definition	Source	Target
Carbon dioxide Emission Reduction	tonnes CO_2 /year	Reduction of emissions of carbon dioxide related to measure.	SCIS	
Energy savings	MWh/year	The reduction of the energy consumption to reach the same services (e.g. comfort levels) after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(iv)

3.3 Overview of all data sources

Analysis of all KPIs that are mentioned in the updated KPI lists, as described in the former paragraph, requires the measurement of many variables. These variables are listed per city in a table as presented in the format below. The columns represent:

- **TT.M**: Transition track (TT) and the measure number(M) as defined in the Measure Tracker (Appendix A2)
- **Variable name:** The name of the variable that is required as input for a KPI
- **Unit of measurement:** In what unit the variable will be measured (of applicable)
- **Collection method:** How the variable will be collected, for example a certain type of meter, or a survey.
- **Responsible partner:** Who is responsible for delivering the variable

Table 9 Overview of all data sources for the measurement of KPIs for Utrecht

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
1.1	Annual electricity generated by PV panels	kWh/y	TOON (Home Energy Management System)	Eneco

These lists are made for the following reasons:

- To make sure that all data sources are known and will be measured
- To know what kind of data needs to be collected by the KPI tool
- To have a clear overview for all responsible partners what to deliver

The overviews for each city are represented in Appendix 0

3.4 Lessons learned on KPI revisions

The long list of modifications in this paragraph illustrates that, even though much effort was put into defining the KPIs for each measure at an early stage in the project, the revision was a critical step into making a more realistic overview of the final project outcomes. The most important lessons learned in this process are:

- When it comes to setting up a physical monitoring plan, certain KPIs turn out not to be measurable. This can be due to:
  - Misunderstanding of what the KPI exactly means at the start of the project.
  - Discovering physical limits in time/space. For example, when specific measures are taken simultaneously at the same place, it is impossible to analyse their separate effects.
- From a monitoring perspective, it is very important to stay flexible during the project in order to be able to adjust the monitoring goals when necessary.
- Even though KPIs seem to be well-defined and used by others, still misunderstandings or mistakes can arise, which have to be solved for each case.
- It is of great importance to keep a comprehensive overview of how KPIs are interpreted or modified on Measure level, in order to maintain the possibility for aggregation and comparison of KPIs.

- The definition of KPIs, together with setting up a proper monitoring plan, can become a complicated and therefore, sluggish procedure. It is very important to be well prepared and keep project partners engaged during this process.
- When revising which KPIs are being monitored, make sure that goals mentioned in the grant agreement are still met.

3.5 Aggregation of KPIs

In paragraph 4.2 of D9.2, possible aggregation of KPIs to solutions and the IRIS KPI-house are presented for each city. As certain KPIs and solutions were updated in the process described in 2.1.1, these tables required revision. Revision of the aggregated KPIs is achieved by requesting updated KPI tables utilising the template for the deliverables which describe the activities of each transition track (D5.3 to 5.7, 6.3 to 6.7 and 7.3 to 7.7) as presented in Appendix A6. The information acquired from these deliverables has been cross-checked with the KPI tables as presented Appendices A8, A9 and A10. This leads to the updated tables of paragraphs 3.6 to 3.9, which show the KPIs of each transition track and their position in the IRIS-KPI-House for each city.

This chapter presents the updated tables. It shows the KPIs of each transition track and their position in the IRIS-KPI-House (figure below) for each city. For an explanation of this KPI house and its associated abbreviations, revert to paragraph 2.3.

The measures in the following tables are numbered as presented in the measure tracker, to understand what each measure means, it is recommended to have Appendix A2 present while analysing these tables.

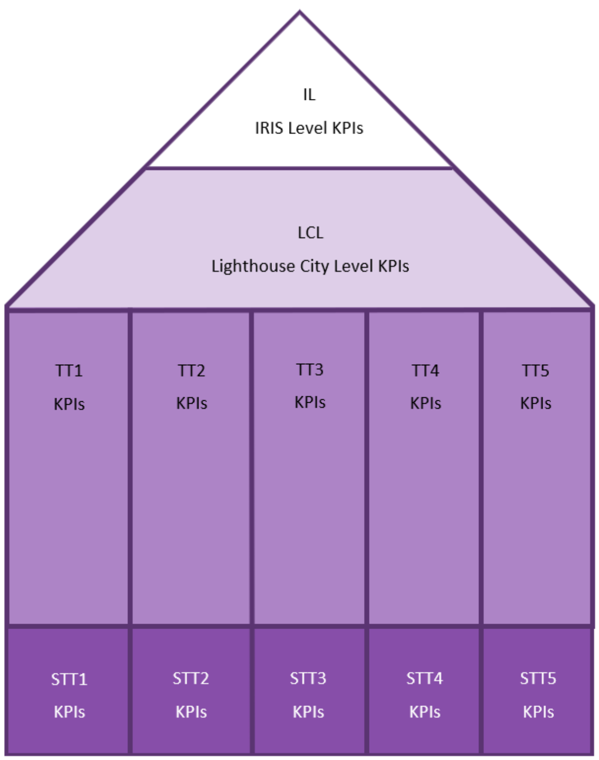


Figure 4 IRIS KPI-house. The KPIs presented the bottom part (STT1 – STT5) are, if possible, aggregated to transition track level (TT1-5) or higher

3.6 Utrecht

3.6.1 TT1: Smart renewables and closed-loop energy positive districts

TT#1 level KPIs Carbon dioxide Emission Reduction Energy savings CO2 reduction cost efficiency Reduced energy cost for consumers						
Measure 1	**Measure 2**	**Measure 3**	**Measure 4**	**Measure 5**	**Measure 6**	**Measure 7**
Carbon dioxide Emission Reduction		Increased awareness of energy usage			Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction
Degree of energy self-supply by RES					Energy savings	Energy savings
Increase in Local Renewable Energy production					CO2 reduction cost efficiency	Reduction in annual final energy consumption by street lighting

Figure 5 KPIs of UTR TT1 with the associated solutions and their position in the IRIS KPI-house

3.6.2 TT2 Smart Energy Management and Storage for Energy Grid Flexibility

TT#2 level KPIs Peak load reduction Storage capacity installed			
Measure 1	**Measure 2**	**Measure 3**	**Measure 4**
		Storage capacity installed	

Figure 6 KPIs of UTR TT2 with the associated solutions and their position in the IRIS KPI-house

3.6.3TT3 Smart e-Mobility Sector

TT#3 level KPIs	
NOx emission reduction Fine particulate matter emission Carbon monoxide emission reduction Carbon dioxide Emission Reduction	
Measure 1	**Measure 2**
NOx emission reduction	NOx emission reduction
Fine particulate matter emission	Fine particulate matter emission
Carbon monoxide emission reduction	Carbon monoxide emission reduction
Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction
Access to vehicle sharing solutions for city travel	
Yearly km driven in e-car sharing system	

Figure 7 KPIs of UTR TT3 with the associated solutions and their position in the IRIS KPI-house

3.6.4TT4 City Innovation Platform (CIP)

TT#4 level KPIs
None
Measure 5
Reduced energy cost for costumers

3.6.5TT5 Citizen engagement and co-creation

TT#5 level KPIs None				
Measure 1	**Measure 2**	**Measure 3**	**Measure 4**	**Measure 5**
Increased environmental awareness	People reached	Ease of use for end-users	Local community involvement in development process	Ease of use for end-users
People reached		Advantages for end-users		
Local community involvement in planning/ implementation phase		Local community involvement in planning/ implementation phase		

Figure 8 KPIs of UTR TT5 with the associated solutions and their position in the IRIS KPI-house

3.6.6City level

Table 10 Possible aggregation of KPIs of UTR to city level

KPIs	Position in IRIS KPI-house
Carbon dioxide Emission Reduction	LC
Energy savings	LC
Increase in local renewable energy production	LC

3.7 Nice

3.7.1 TT1 Smart renewables and closed-loop energy positive districts

TT#1 level KPIs
Energy savings
Carbon dioxide Emission Reduction
Increase in Local Renewable Energy production
Degree of energy self-supply by RES
Storage capacity installed
Battery Degradation Rate
Increased awareness of energy usage
Ease of use for end users of the solution
Data loss prevention
CO2 reduction cost efficiency

Measure 1	Measure 2	Measure 3	Measure 4
Energy savings	Energy savings	Data loss prevention	Energy savings
Carbon Dioxide Emission Reduction	Carbon Dioxide Emission Reduction	Increased awareness of energy usage	Carbon dioxide Emission Reduction
Increase in Local renewable energy production	CO2 reduction cost efficiency		Increased environmental awareness
Degree of energy self-supply by RES			Ease of use for end users of the solution
Storage capacity installed			User engagement
CO2 reduction cost efficiency			

Figure 9 KPIs of NCA TT1 with the associated solutions and their position in the IRIS KPI-house

3.7.2 TT2 Smart Energy Management and Storage for Energy Grid Flexibility

TT#2 level KPIs

Energy savings
Carbon dioxide Emission Reduction
Peak-load reduction
Degree of energy self-supply by RES
Storage capacity installed
Battery Degradation Rate
Increased system flexibility for energy players/stakeholders
Reduced energy cost for consumers
Investment cost

Measure 1	Measure 2	Measure 3
Energy savings	Energy savings	Storage capacity installed
Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction	Battery Degradation Rate
Peak load reduction	Peak-load reduction	Increased system flexibility for energy players/stakeholders
Degree of energy self-supply by RES	Degree of energy self-supply by RES	Investment cost
Storage capacity installed	Reduced energy cost for consumers	
Battery Degradation Rate	Investment cost	
Increased system flexibility for energy players/stakeholders		
Reduced energy cost for consumers		
Investment cost		
Ratio of valorised PV RES		

Figure 10 KPIs of NCA TT2 with the associated solutions and their position in the IRIS KPI-house

3.7.3 TT3 Smart e-Mobility Sector

TT#3 level KPIs	
Carbon dioxide Emission Reduction	
Measure 1	**Measure 2**
Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction
Peak load reduction	Mobility efficiency
Storage capacity installed	Fleet availability
Increased system flexibility for energy players/stakeholders	
Reduced energy cost for consumers	
Number of e-charging stations deployed in the area	

Figure 11 KPIs of NCA TT3 with the associated solutions and their position in the IRIS KPI-house

3.7.4 TT4 City Innovation Platform (CIP)

TT#4 level KPIs			
Quality of open data			
Open data-based solutions			
Measure 1	**Measure 2**	**Measure 3**	**Measure 4**
Number of connected urban objects	Quality of CIP	Usability of open data	Part of TT1 monitoring
Usage of open data	Usage of the CIP (open data)	Open data-based solutions	
Quality of open data	Quality of datasets	Quality of open data	
Open data based solutions	Usage of the dashboard		
Share of RES in ICT power supply			
Usage of open source software			

Figure 12 KPIs of NCA TT4 with the associated solutions and their position in the IRIS KPI-house

3.7.5 TT5 Citizen Engagement

TT#5 level KPIs People reached		
Measure 1	**Measure 2**	**Measure 3**
People reached	People reached	People reached
Increased environmental awareness	Increased environmental awareness	User engagement
	Increased awareness of energy usage	
	Increased consciousness of citizens	

Figure 13 KPIs of NCA TT5 with the associated solutions and their position in the IRIS KPI-house

3.7.6 City level

The following KPIs can be aggregated to city level in NCA.

Table 11 Possible aggregation of KPIs of NCA to city level

KPIs	Position in IRIS KPI-house
Carbon dioxide emission reduction	LC
Energy savings	LC
Degree of energy supply by RES	LC
Storage capacity installed	LC

3.8 Gothenburg

3.8.1 TT1 Smart renewables and closed-loop energy positive districts

TT#1 level KPIs

Carbon dioxide Emission Reduction
Degree of energy self-supply by RES
Energy savings

Measure 1	Measure 2	Measure 3	Measure 4	Measure 5	Measure 6	Measure 7
Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction
Degree of energy self-supply by RES	CO2 reduction cost efficiency	CO2 reduction cost efficiency	CO2 reduction cost efficiency	CO2 reduction cost efficiency	Increased system flexibility for energy stakeholders	CO2 reduction cost efficiency
Energy savings	Degree of energy self-supply by RES	Degree of energy self-supply by RES	Peak load reduction	Energy savings	Peak load reduction	Degree of energy self-supply by RES
				Peak load reduction	Reduced energy cost for consumers	
				Reduced energy cost for consumers		

Figure 14 KPIs of GOT TT1 with the associated solutions and their position in the IRIS KPI-house

3.8.2 TT2 Smart Energy Management and Storage for Energy Grid Flexibility

TT#2 level KPIs

Storage capacity installed

Measure 1	Measure 2	Measure 3	Measure 4
Degree of energy self-supply by RES	Peak load reduction		Battery degradation rate
Peak load reduction	Storage capacity installed		Peak load reduction
Storage capacity installed	Storage energy losses		Storage capacity installed

Figure 15 KPIs of GOT TT2 with the associated solutions and their position in the IRIS KPI-house

3.8.3 TT3 Smart e-Mobility Sector

TT#3 level KPIs Carbon dioxide Emission Reduction Energy savings Reduction in driven km by tenants and employees in the district	
Measure 1	**Measure 2**
Carbon dioxide Emission Reduction	Carbon dioxide Emission Reduction
Ease of use for end users of the solution	Ease of use for end users of the solution
Energy savings	Energy savings
Improved access to vehicle sharing solutions	Improved access to vehicle sharing solutions
Reduction in driven km by tenants and employees in the district	Reduction in driven km by tenants and employees in the district
Reduction in car ownership among tenants	Yearly km driven in e-care sharing system
Yearly km driven in e-care sharing system	

Figure 16 KPIs of GOT TT3 with the associated solutions and their position in the IRIS KPI-house

3.8.4 TT4 City Innovation Platform (CIP)

TT#4 level KPIs Open data-based solutions Quality of open data	
Measure 1	**Measure 2**
Advantages for end-users	Open data-based solutions
Ease of use for end-users of the solution	Quality of open data
Open data-based solutions	
Quality of open data	
Usage of open source software	

Figure 17 KPIs of GOT TT4 with the associated solutions and their position in the IRIS KPI-house

3.8.5TT5 Citizen Engagement

TT#5 level KPIs Local community involvement in the planning phase Increase environmental awerness			
Measure 1-4	**Measure 5**	**Measure 6**	**Measure 7**
Local community involvement in the planning phase	Local community involvement in the planning phase	Increase environmental awerness	Increase environmental awerness
User engagement		Ease of use for end-users of the solution	

Figure 18 KPIs of GOT TT5 with the associated solutions and their position in the IRIS KPI-house

3.8.6City level

The following KPIs can be aggregated to city level in Gothenburg.

Table 12 Possible aggregation of KPIs of GOT to city level

KPIs	Position in IRIS KPI-house
Carbon dioxide Emission Reduction	LC
Energy savings	LC
Increase in local renewable energy production	LC
Peak load reduction	LC

3.9 IRIS level

The following KPIs can be aggregated to IRIS level

Table 13 Possible aggregation of KPIs to IRIS level

KPIs	Position in IRIS KPI-house
Carbon dioxide Emission Reduction	LC
Energy savings	LC

4 Monitoring plans of TT1 Smart renewables and closed-loop energy positive districts

4.1 Utrecht

The data provided in the following paragraphs are extracted from deliverable D5.3: Launch of T.T.1 activities on Smart renewables and near zero energy district (Utrecht) [11]. More detailed information about these demonstrators can be found in this source.

4.1.1 Monitoring plan for measure 1.1: PV panels on the roofs of the apartment buildings and the schools

The roofs of the apartment buildings in the district will be equipped with Photovoltaic (PV)-panels. The Description of Action (DoA) [6] states that also the schools in the demonstration area are equipped with PV-panels, but this is not in the plans anymore because of technical and financial problems within the schools.

The number of PV-panels that will be placed on the roofs depends on:

(1) available and appropriate roof surface,
(2) efficiency of the PV-panels (i.e. electricity production), and
(3) energy usage of the tenants. The PV-panels produce energy and deliver this directly to the tenants.

When more PV-energy is generated than used on a specific moment, energy is delivered back to the grid provider. Currently, new regulations are under preparation by the Dutch government regarding the amount of energy delivery and the tariffs for delivering energy to the grid. The social housing cooperation Bo-Ex and the energy company Stedin work closely together to detail and plan the necessary modifications to the electricity grid and connections to host renewable energy production of the PV-panels. Figure 19 and Figure 20 provide an overview of the current (upper), and envisioned (below) integrated energy systems for individual apartment buildings.

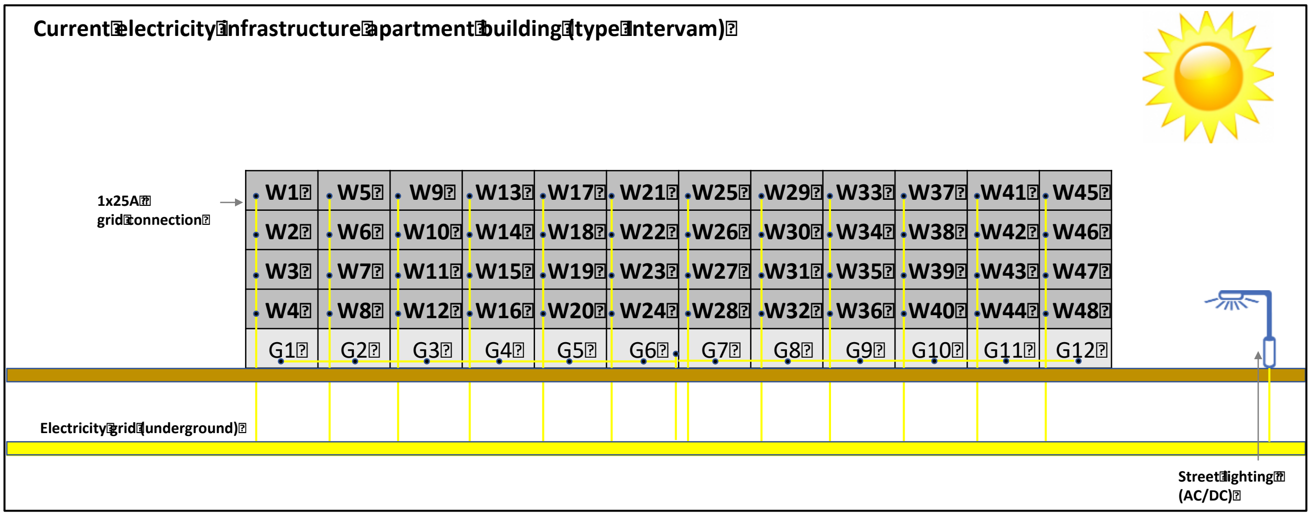


Figure 19 Overview of the current energy system, W# stands for each individual apartment connection, G# stands for each branch from the grid connection

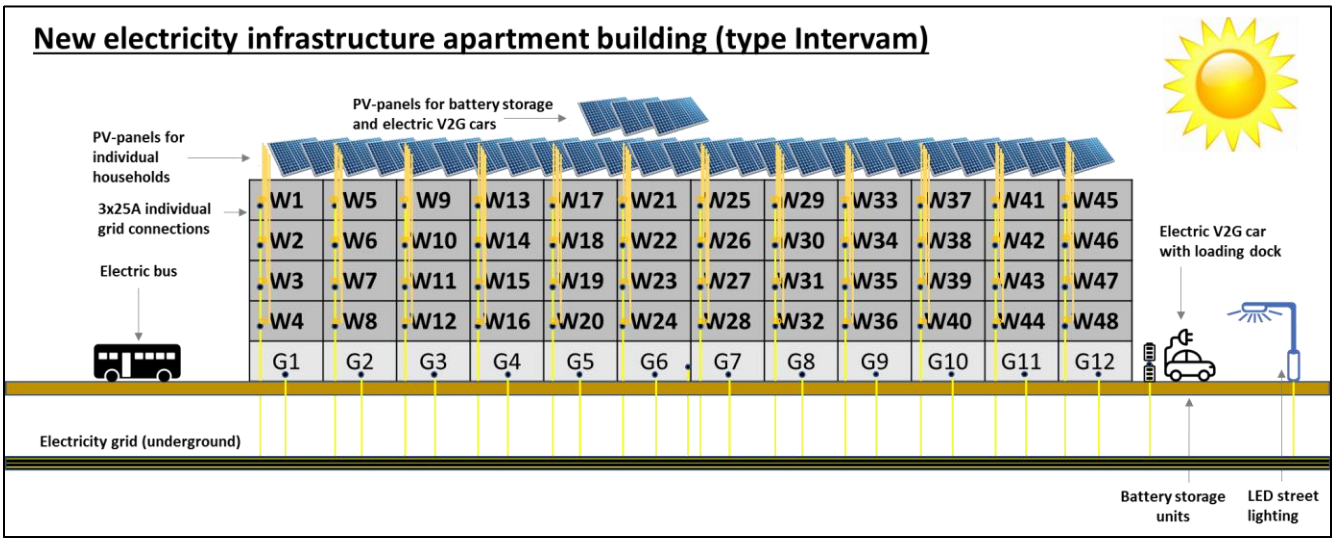


Figure 20 Overview of the envisioned energy system for an apartment building

To monitor the performance of the PV-panels and to obtain relevant data for the KPIs, the following steps are taken:

- With the use of the Home Energy Management System (HEMS) Eneco Toon, it is possible to collect data on an aggregated level without the permission of the tenants to share data. This data consists of:
    - generated solar energy per every minute/hour/day/year
    - used energy per every minute/hour/day/year
    - balance of generated and used energy per every minute/hour/day/year
- This data is collected by Quby (part of Eneco), the company that develops the HEMS Eneco Toon and collects and shares data from the end-users.
- For the objectives of this project, the mentioned data shall be aggregated per hour and at the building level to meet the required information.

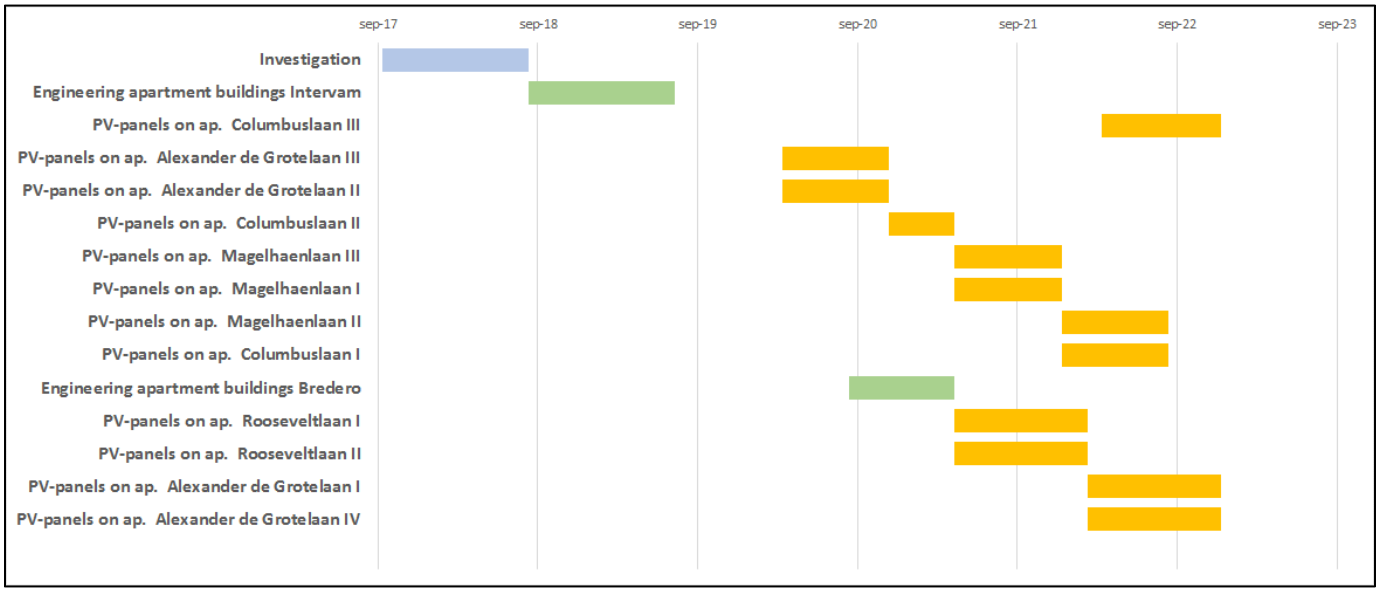


Figure 21 Timing of activities installation of PV-panels

Table 14 Summary-list of KPIs and related parameters for Measure 1.1 PV panels on the roofs of the apartment buildings and the schools

KPI	Parameter(s)	Data source	Baseline	GA- Target
Increase in Local Renewable Energy production	Annual electricity generated by PV panels	TOON	0, Before the measure, no electricity was generated by RES	60%
	Annual Electricity consumption	TOON		
Degree of energy self-supply by RES	Locally produced electrical energy = electricity generated by PV panels [kWh]	TOON	0, Before the measure, no electricity was generated by RES	30%
	Electrical energy consumption from RES [kWh]	TOON		
Carbon dioxide Emission Reduction	Annual electricity generated by PV panels	TOON	NA	600 ton CO_2 reduction / year
	CO_2 coefficient for electricity in the Netherlands	BEST table		
Installed capacity (not a KPI)	Amount of PV installed after the project	Project results	NA	0,8MWp (GA: 1,8 MWp or 100% building demand)

4.1.2 Monitoring plan for measure 1.2: Low Temperature (LT) district heating

Currently, 4 out of 12 apartment blocks are connected to the district heating (the other eight are connected to the gas infrastructure). This district heating provides hot water for space heating. The current supply temperature of the district heating is 90°C, with the implementation of a low-temperature district heating system the supply temperature will be lowered to ≈40°C. Low-Temperature district heating ('LT district heating') leads to lower energy losses in the apartment building and the district heating distribution grid.

To monitor the energy usage and to obtain relevant data for the KPIs, the following steps are taken:

- Before the refurbishment, a survey is conducted regarding the tenants' current comfort experiences of the system.
- With the use of the HEMS Eneco Toon, it is possible to collect data on an aggregated level without having the permission of the tenants to share data. This data consists of:
    - used energy per every minute/hour/day/year

  This data is collected by Qubie, the company who develops the HEMS Eneco Toon and collects and shares data from the end users.

  For the objectives of this project, mentioned data shall be aggregated per hour and at building level to meet the required information.
- After refurbishment, a survey is conducted regarding the tenants' new comfort experiences of the system.

There are no specific relevant Key Performance Indicators for this Measure, but this Measure contributes to the overall Key Performance Indicators of TT#1. The reason for aggregating the performance indicators to a higher level is that the specific impact of this Measure is hard to abstract. With the refurbishment of the apartment building, not only this measure contributes to energy savings and CO_2 reduction.

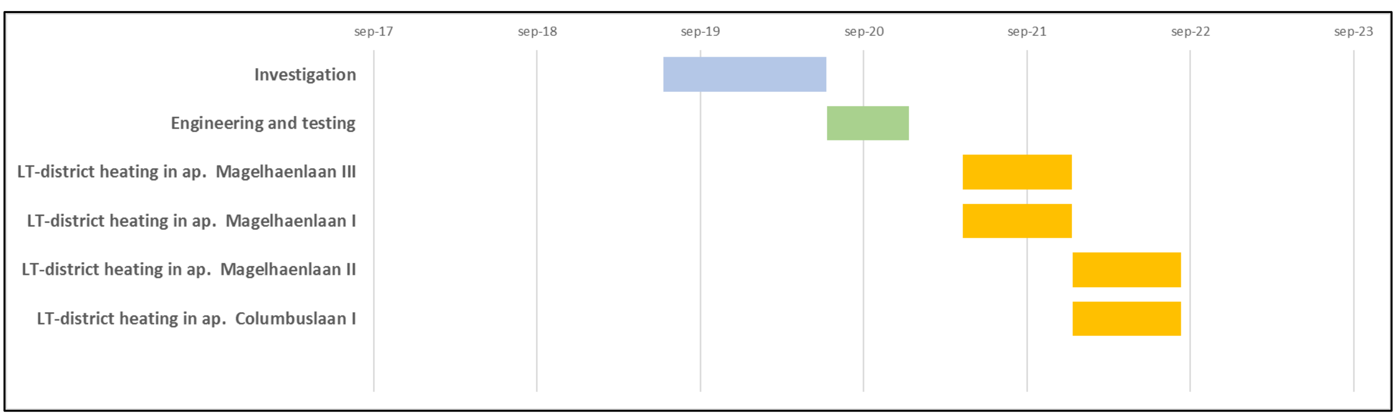


Figure 22 Timing of activities LT-district heating

Table 15 Summary-list of KPIs and related parameters for Measure 1.2 LT district heating

KPI	Parameter(s)	Data source	Baseline	GA- Target
Energy savings - for the tenants (Thermal)	Thermal energy consumption of the demonstration site [kWh/ m^2year]	TOON	Current energy consumption	-/- 50%
	Thermal energy reference demand or consumption [kWh/ m^2year]	From baseline		
	Area of demonstration site [m^2]	From building data		
Carbon dioxide Emission Reduction	Thermal energy consumption of the demonstration site [kWh/ m^2year]	TOON	Current CO_2 emission	-/- 80%
	Thermal energy reference demand or consumption [kWh/ m^2year]	From baseline		
	Emission factor for fuel combustion	Eneco		
Reduced energy cost for costumers	Energy savings	See above	Current energy cost	-/- 50%
	Current energy price	?		
CO_2 reduction cost efficiency	CO_2 emission reduction	See above	NA	To determine
	Annual costs of project	?		

4.1.3 Monitoring plan for measure 1.3: Home Energy Management Systems (HEMS) TOON

The Eneco Toon® (hereafter Toon), as mentioned in the former paragraph, is an existing device (7`` display) with proven technology. The main objective of the Toon is to provide information about the energy usage of a household. Since a couple of years, the Toon is already installed in many houses and apartments in The Netherlands, for clients and non-clients of Eneco. The user interface and hardware of the Toon have been adjusted frequently. Other functionalities were added, such as:

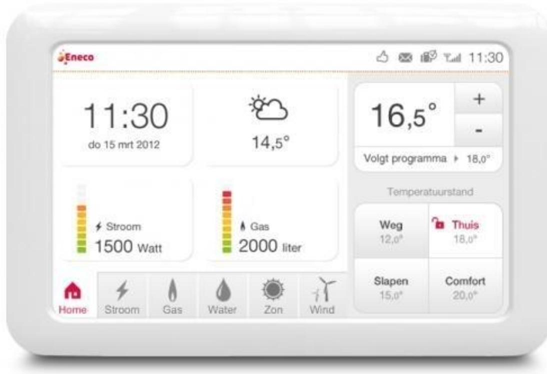


Figure 23 HEMS Eneco Toon display Source: http://www.eneco.nl

- Amount of energy produced by PV panels;
- Monthly energy bill;
- Spoilage checker;
- Weather forecast.

Eneco does the procurement of the Eneco Toon since they are the developer, patent holder and sales representative of Eneco Toon. Eneco to install and test the Eneco Toon in each apartment house. Eneco covers the costs for yearly subscriptions till the end of 2022.

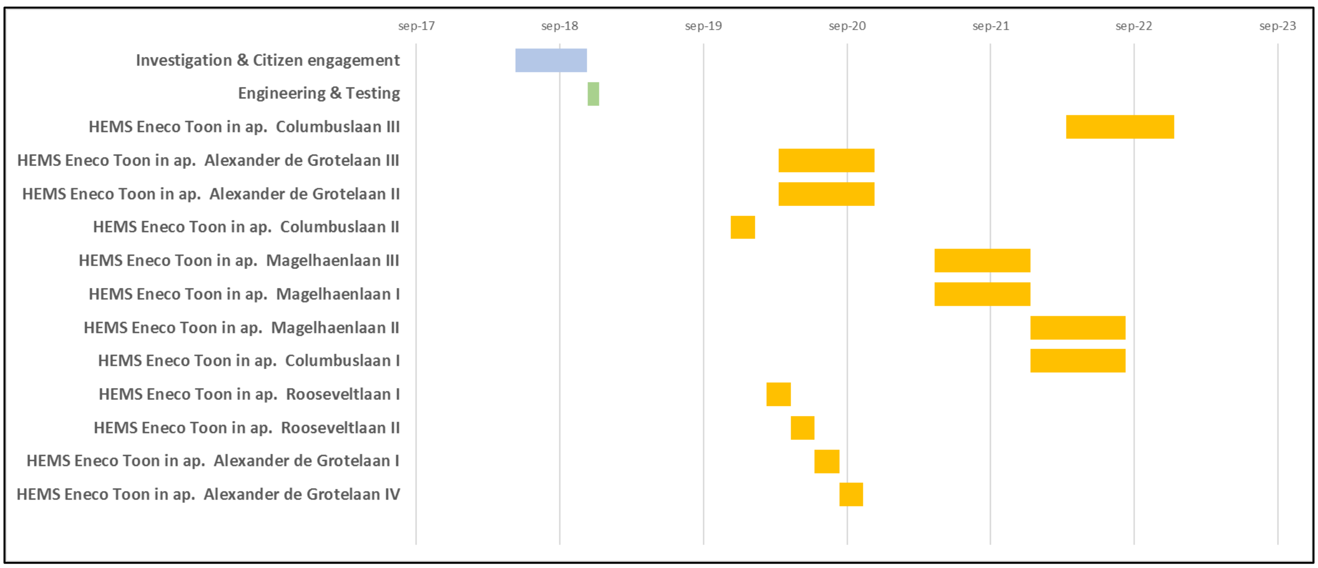


Figure 24 Timing of activities HEMS Eneco Toon

There are no specific relevant Key Performance Indicators for this Measure, but this Measure contributes to the overall Key Performance Indicators of TT#1.

To monitor the user-friendliness and comfort experiences, the following steps are taken:

- Short after installation in every household, the tenants get introduced to how the device works and what the reasons of this initiative are. A short survey is also conducted amongst the tenants regarding the user and comfort experiences.
- A couple of weeks after installation, the tenants are visited again on an individual basis and provided with help on how to use the Toon (again) and reminded of the possible benefits of it.
- After a year, the saved energy of our tenants is measured on an aggregated level. This metric is easy to monitor when the refurbishment has not been executed yet because of the same comfort situation. When measuring the saved energy after refurbishment, the comfort situation is different to the situation before and therefore harder to measure.

Table 16 Summary-list of KPIs and related parameters for Measure 1.3 Home Energy Management Systems (HEMS) TOON

KPI	Parameter(s)	Data source	Baseline	GA- Target
Increased awareness of energy usage	Increased awareness of energy usage	Survey	NA	4 on a scale of 1-5

4.1.4 Monitoring plan for measure 1.4: Energy savings as a result of refurbishing towards near zero energy building

Currently, the apartment buildings experience high heat losses due to poor insulation. As part of the refurbishment activities to increase energy efficiency, the following measures will be implemented:

- New window frames and glazing (double or triple glazing)
- Insulation of outer walls and the ground floor ceiling
- Improvement of chinks (especially at the connection of the façade with the window frames)
- Mechanical ventilation (with natural or mechanical supply)

The following figure shows the parts which will be renewed or added in every apartment (living room).

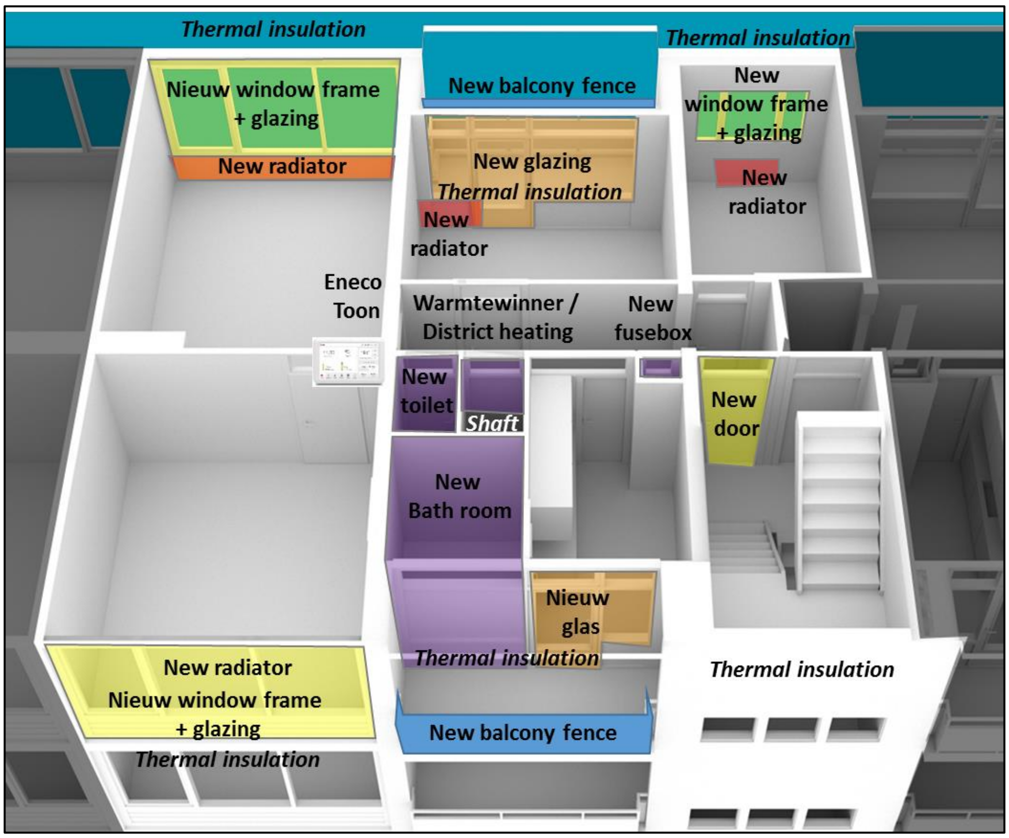


Figure 25 Schematic view of the measures in every apartment house

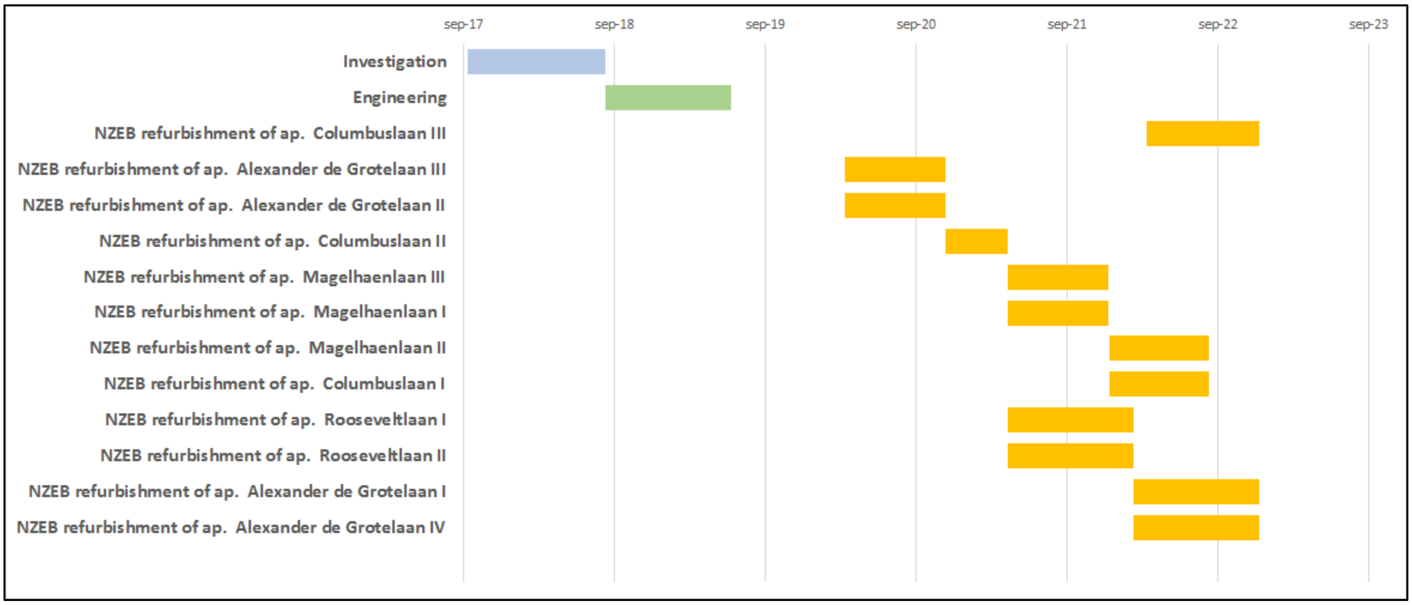


Figure 26 Timing of activities near zero energy building (NZEB) refurbishment

There are no specific relevant Key Performance Indicators for this Measure, but this Measure contributes to the overall Key Performance Indicators of TT#1. The reason for aggregating the performance indicators to a higher level is that the specific impact of this Measure is hard to abstract. With the refurbishment of the apartment building, not only this Measure contributes to energy savings and CO_2 reduction.

Monitoring the energy performance is currently done by measuring the energy performance meters before and after the refurbishment. With this information, the old and new energy performance and energy label can be determined easily. Besides this, the data coming from the HEMS Eneco Toon is also used on an aggregated level. With these two meters, it's possible to obtain relevant and reliable data.

Monitoring the impact on energy usage is a quite difficult story. It's difficult because of two reasons:

- Within the refurbishment, the comfort of the apartment houses will increase: better refreshment of air (better air quality inside), active mechanical ventilation, a better-insulated house, more heating heaters inside to provide heat. Actually, the energy usage could increase instead of decrease despite all the measures.
- Because of the implementation of Measure 1 (PV-panels), energy usage is also influenced. This is why focus is on the total amount of generated and used energy of the apartment houses, not only what's influenced by this measure.

Table 17 Summary-list of KPIs and related parameters for Measure 1.4 Energy savings as a result of refurbishing towards near zero energy building

KPI	Parameter(s)	Data source	Baseline	GA- Target
Energy savings - for the tenants (Thermal)	Thermal energy consumption of the demonstration site [kWh/ m^2year]	TOON	Current energy consumption	-/- 50%
	Thermal energy reference demand or consumption [kWh/ m^2year]	From baseline		
	Area of demonstration site [m^2]	From building data		
Carbon dioxide Emission Reduction	Thermal energy consumption of the demonstration site [kWh/ m^2year]	TOON	Current CO_2 emission	-/- 80%
	Thermal energy reference demand or consumption [kWh/ m^2year]	From baseline		
	Emission factor for fuel combustion	Eneco		
Reduced energy cost for costumers	Energy savings	See above	Current energy cost	-/- 50%
	Current energy price	?		
CO_2 reduction cost efficiency	CO_2 emission reduction	See above	NA	To determine
	Annual costs of project	?		

4.1.5 Monitoring plan for measure 1.5: Smart (hybrid) electric heat pumps

The smart hybrid e-heating systems consists of devices which will provide heat and hot tap water for the tenants, in 8 of the 12 apartment buildings. The concept of the smart system consists of a central gas-heating device in combination with a ventilation heat pump. The ventilation heat pump uses the heated ventilation air in an apartment to provide heat for space heating. The ventilation air comes from outside or inside, depending on the choice of the ventilation principle applied. This is a hybrid system since it combines electrical and gas-fed devices.

The smartness of this system consists of the ability to switch between gas and electrical heat. In principle baseload demand for space heating is supplied by the electrical system, whereas peak load is supplied by the gas-fed part of the system. Furthermore, the hybrid heat pump can provide flexibility in for the electricity grid, by switching to gas-mode in times of high demand for electricity in the area and potential grid stress.

The heat pump either will be installed as an individual solution or as a centralized solution. Eventually, every apartment will be equipped with heat pumps combined with a central gas-heating device. But, it's possible – and worth a research – to find out whether it is possible to make use of centralized heat pumps instead of individual heat pumps. A centralized solution is much more efficient but also requires an administrative solution to let tenants pay for the individual consumption of the heat pumps. During the design and engineering of every apartment building, both options will be examined.

The following figure shows the current situation regarding utility facilities for the apartment buildings heated with natural gas, and the possible utility facilities after the renovation.

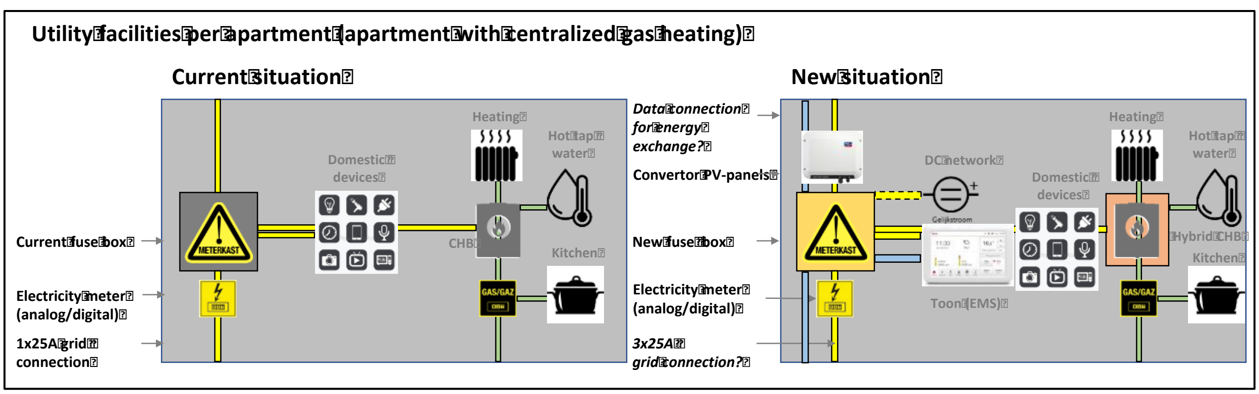


Figure 27 Current situation and potential situation after installation of a smart hybrid heat pump for apartment building currently equipped with centralized gas heating systems.

The following figure shows the position of the Eneco Warmtewinner in every apartment (heating cabinet next to the toilet, kitchen and bathroom) including the air inlets.

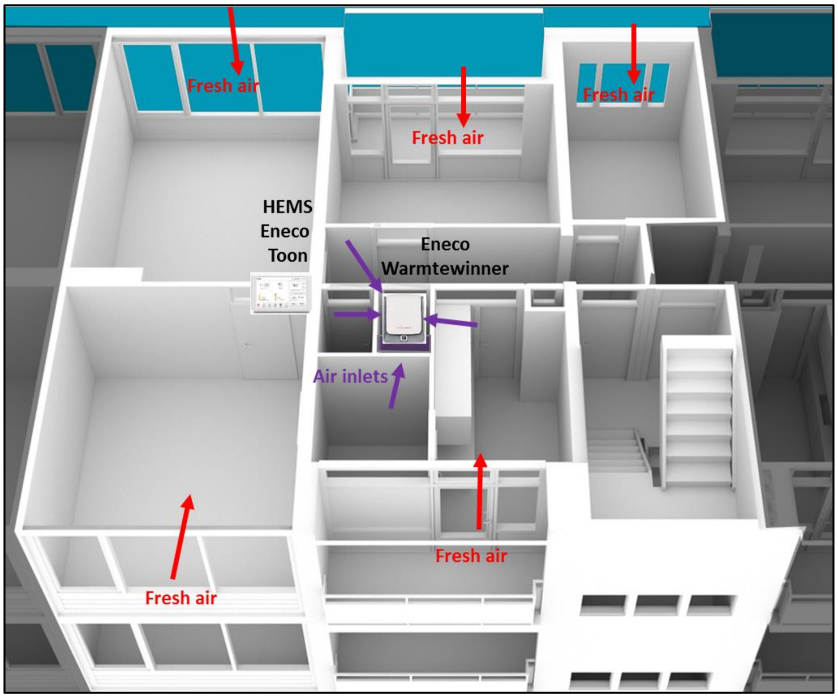


Figure 28 Schematic map of an apartment with the position of the HEMS Eneco Toon

The following figure shows the programme for the scheduled activities for this measure:

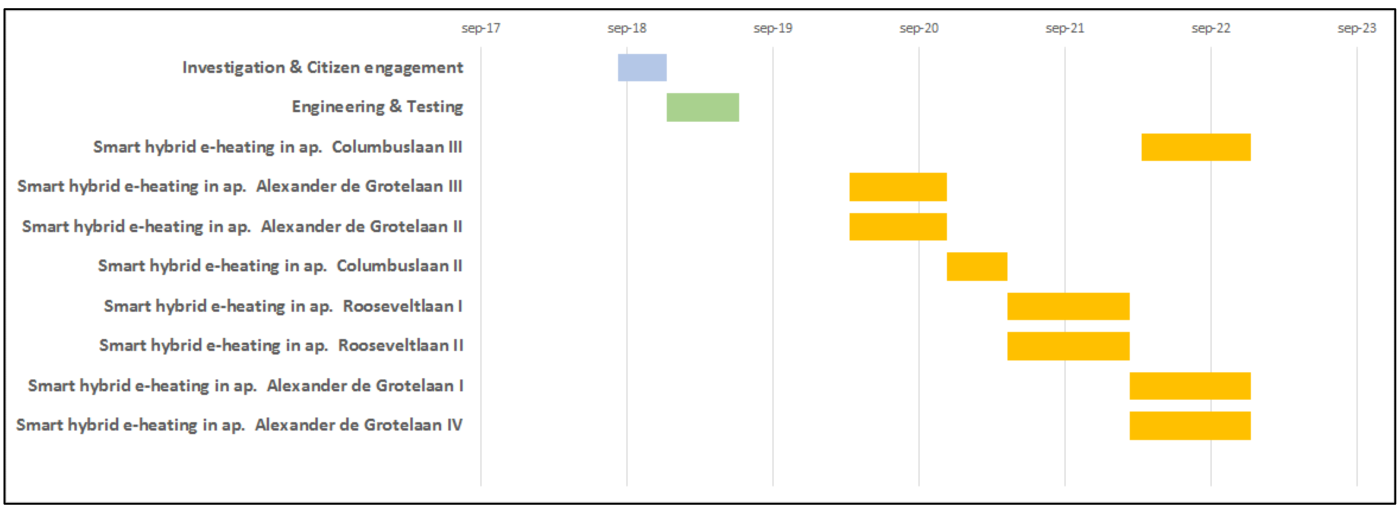


Figure 29 Timing of activities smart hybrid e-heating

There are no specific relevant Key Performance Indicators for this Measure, but this Measure contributes to the overall Key Performance Indicators of TT#1. The reason for aggregating the performance indicators to a higher level is that the specific impact of this Measure is hard to abstract. With the refurbishment of the apartment building, not only this Measure contributes to energy savings and CO_2 reduction.

To monitor the performance of the WarmteWinner and to obtain relevant data for the KPIs, the following steps are taken:

- With the use of the HEMS Eneco Toon, it is possible to collect data on an aggregated level without having the permission of the tenants to share data. This data consists of:
  - used gas and electricity per every day/year
  - saved gas usage and additional electricity usage per every day/year
- This data is collected by Qubie, the company who develops the HEMS Eneco Toon and collects and shares data from the end-users.
- For the objectives of this project, the mentioned data shall be available at most per hour to meet the required information.

Table 18 Summary-list of KPIs and related parameters for Measure 1.5 Smart (hybrid) electric heat pumps

KPI	Parameter(s)	Data source	Baseline	GA- Target
Energy savings - for the tenants (Thermal)	Thermal energy consumption of the demonstration site [kWh/ m^2year]	TOON	Current energy consumption	-/- 50%
	Thermal energy reference demand or consumption [kWh/ m^2year]	From baseline		
	Area of demonstration site [m^2]	From building data		
Carbon dioxide Emission Reduction	Thermal energy consumption of the demonstration site [kWh/ m^2year]	TOON	Current CO_2 emission	-/- 80%
	Thermal energy reference demand or consumption [kWh/ m^2year]	From baseline		
	Emission factor for fuel combustion	Eneco		
Reduced energy cost for costumers	Energy savings	See above	Current energy cost	-/- 50%
	Current energy price	?		
CO_2 reduction cost efficiency	CO_2 emission reduction	See above	NA	To determine
	Annual costs of project	?		

4.1.6 Monitoring plan for measure 1.6: Energy savings as a result of smart AC/DC power grid in apartments

Energy savings will also be realised through a direct current (DC) network in a small-scale pilot of 8 houses. Direct current electricity produced with the PV panels on the roof will be directly used in the homes. Usually, a transformer transforms the generated DC electrify into 230 Volt alternating current (AC). This transformation causes energy losses, and by directly using DC these losses are avoided.

Because of the fact that many domestic devices operate on low voltage AC/DC, the question is whether it's interesting to implement a (parallel running) DC network in a house to provide energy for a certain number of devices.

A research project on this Measure, done by students of Utrecht University in the first half of 2018, shows that there are technical and financial possibilities to make a direct current network in an apartment. Basically, there are two options that are interesting for the tenants:

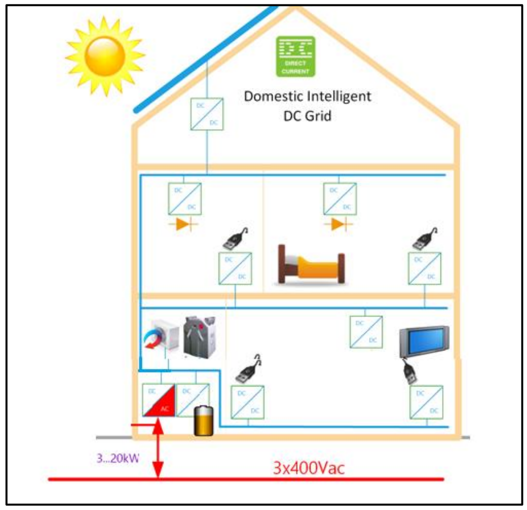


Figure 30 Possible direct current network in a house
Source: http://www.directcurrent.nl

- A full direct current network within an apartment building instead of the existing alternating current network;
- A partially direct current network within an apartment building, parallel to the existing alternating current network.

The research concluded that a full DC network delivers more energy savings but is more expensive and more complex to incorporate in the existing apartments. Since the pilot will be done in an existing apartment with existing tenants, the choice of a partially direct current network looks most sensible. The success of a partially direct current mainly depends on the attitude of residents.

To implement a DC network, it's necessary to have insight in the domestic devices of a (generic) household: which devices can be connected to a DC network directly and what is the impact for the user? To answer these questions, it's necessary to have insight into the tenant's kind and usage of devices. This information enables investigation of the possibilities for implementing a DC network and guiding the tenants.

This solution will be implemented in 8 individual homes because the technology is still very innovative and results from practical experiences are very limited. Part of this engagement activity is to find 8 volunteers who provide the ability to implement a DC network in their house.

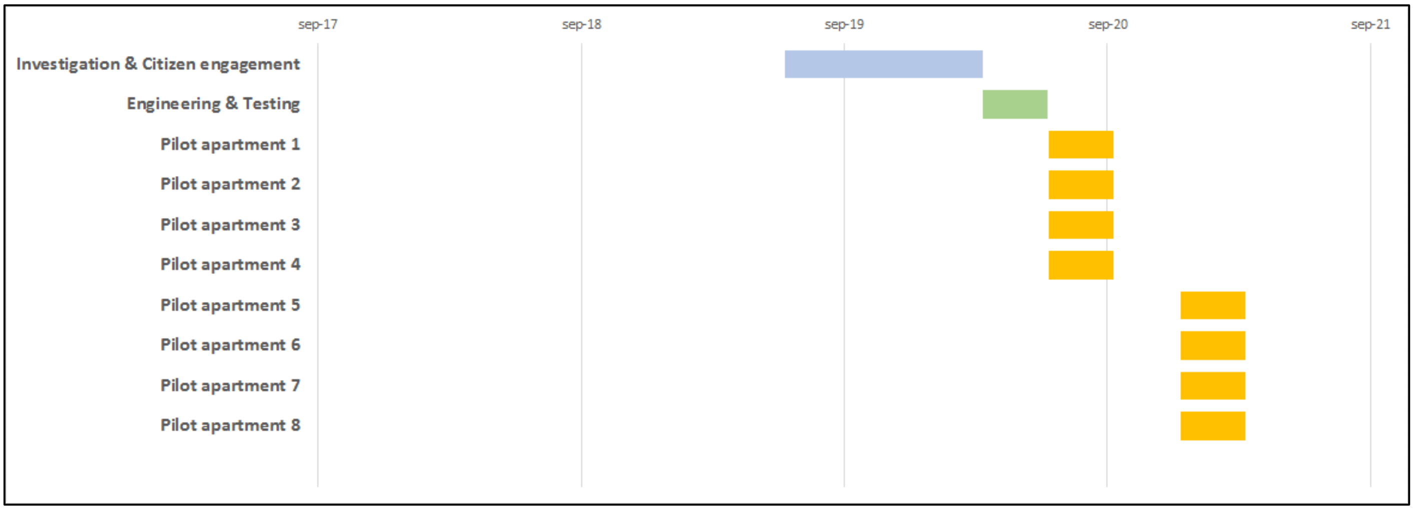


Figure 31 Timing of activities DC pilot 8 apartment dwellings

To monitor the performance of the Direct Current network and to obtain relevant data for the KPIs, the following steps are taken:

- The monitoring of DC-energy usage data depends on the connectivity of the hardware with (existing) software applications.
- In case there's no application available for this objective, existing monitoring data generated by the smart meter can be used, with the permission of the tenants. With this permission it is possible to measure the difference between an alternate current and direct current network and linked hardware.

Table 19 Summary-list of KPIs and related parameters for Measure 1.6 Energy savings as a result of smart AC/DC power grid in apartments

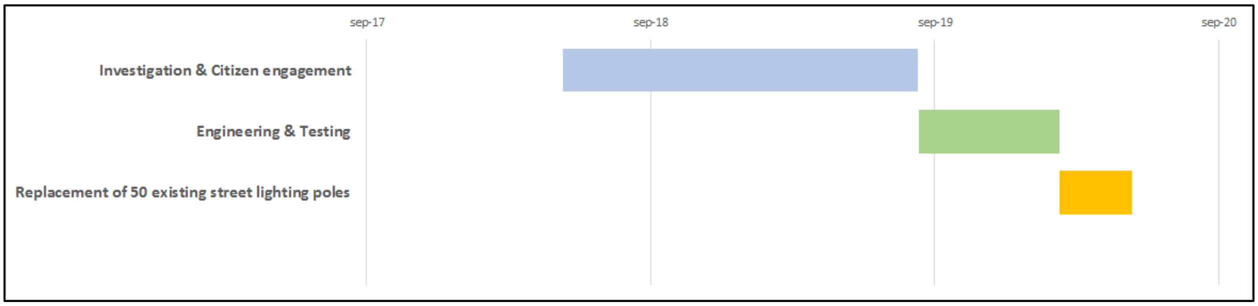
KPI	Parameter(s)	Data source	Baseline	GA- Target
Energy savings - for the tenants	Annual Electricity consumption before solution	Information from tenant?	Current energy consumption	-/- 10%
	Annual Electricity consumption after solution	TOON?		
Carbon dioxide Emission Reduction	Energy savings	See above	NA	-/- 20%
	CO_2 coefficient for electricity in the Netherlands	BEST table		

4.1.7 Monitoring plan for measure 1.7: Smart DC street lighting at district level

This measure compromises energy efficient smart street lighting powered by renewables. Not only the energy efficiency of the Smart street lighting increases by using LED lighting bulbs and direct current (DC). Two poles will be equipped with other functionalities such as a lighted zebra crossing and smart tele management. These additional functionalities are investigated together with citizens of the district. In total, 50 existing street lighting poles in the district will be replaced by the smart street lighting and two smart street poles will be installed.

Table 20 Properties of the two different options for street lighting in UTR

	Energy efficient streetlighting	**Smart street lighting**
Hardware	Osram Streetlight mini led high power luminous flux 3060 lm. Warm/white colour temperature. Control gear power reduction and digital communication interface. Power consumption average lifetime 23 W	An interactive lighted pedestrian road crossing with two dynamic signalling poles with sensors for measuring speed, air quality and environment sound. The two smart lighting poles (brand Korner) are provided with PV cells and communication interfaces. It contains a lighted zebra crossing with led stripes 4000x500 mm at both sides of the street. The height of these poles are 5meters. The manufacturer is Eclatec
Software	Programmable Logic Controller (PLC) lineswitch 100/50, Luminext Luminizer tele management system: https://www.luminext.eu/en/connect-control/	Dali control, with a 4G/5G data connection, Luminext Luminizer tele management system: https://www.luminext.eu/en/connect-control/.
	 *Figure 32 Osram streetlight*	 *Figure 33 Eclatec smart lighting pole*



For the monitoring and control of the street lighting, Luminext Luminizer telemanagement is used. This system gives insight in the energy usage and the information coming from the other functionalities.

Table 21 Summary-list of KPIs and related parameters for Measure 1.7 Smart DC street lighting at district level

KPI	Parameter(s)	Data source	Baseline	GA- Target
Reduction in annual final energy consumption by street lighting **(Energy savings)**	Annual Electricity consumption of street lighting	Luminext Luminizer telemanagement	Electricity consumption for street lighting before measure.	-/- 70%
	Electricity consumption for street lighting before measure.	?		
CO2 emission reduction	Annual Electricity consumption of street lighting	Luminext Luminizer telemanagement	NA	-/- 70%
	Electricity consumption for street lighting before measure.	?		
	CO_2 coefficient for electricity in the Netherlands	BEST table		

4.1.8 Remarks

All ISs of TT1 of Utrecht represent a comprehensive monitoring program which has a firm basis in the use of the HEMS Toon, which is an online meter which presents data on a frequent level. This enhances automation of the data input for calculation of the KPIs.

Most of the IS of this TT are implemented simultaneously at the same buildings. It is therefore impossible to measure the effect of separate ISs on the same KPI. For this reason, a large part of the KPIs that have to do with the refurbishment of buildings in TT1 is aggregated to TT level. A comprehensive monitoring plan is presented for each KPI and the related measurements.

Due to a drawback in the collaboration with the tenants, part of the refurbishments is slightly behind track. For this reason, there might be room for implementing ISs separately. For example, the installation of HEMS Toon (measure 1.3) could take place before the refurbishment of the building. It should be further examined if this allows to measure the isolated effect of this solution.

4.2 Nice

The data provided in the following paragraphs are extracted from deliverable D6.3: Launch of T.T.1 activities on Smart renewables and near zero energy district (Nice) [12]. More detailed information about these integrated solutions can be found in this source.

4.2.1 Monitoring plan for measure 1: Collective self-consumption at building scale

Collective self-consumption at building scale is a new concept for commercial and residential customers in France while only a small number of projects have been done in Europe so far. This concept will be tested in Nice Meridia on two positive energy buildings under construction.

The main objective of this use case is to assess the benefits and analyze the barriers (legal, financial, technical) that prevent the development of the collective self-consumption market at building scale. One sub-objective will be to experiment with different technologies to increase the ratio of PV self-consumption.

Monitoring plan aims at calculating KPIs above mentioned.

KPIs deal with services provided by the battery. For PALAZZO MERIDIA and IMREDD buildings, battery storage system is foreseen to increase natural self-consumption of the building (communal parts of the building for PALAZZO MERIDIA). Therefore, the monitoring plan is based mainly on electrical power measurements located at convenient places.

Also, it is appropriate to measure the real battery efficiency (auxiliary consumption, non-ideal inverter and non-ideal discharge/charge behaviour) but also to evaluate KPIs for the whole building.

The metering system will be made of electric meters (electronic) measuring voltage and current at 10-minute timestep (10 min averaged power). In addition, electric meter for the total building electricity demand (measured at the electrical transformer every 10-minute timestep) and energy meter for the total building heat and cool demand (measured at the DHC (District Heating Cooling) network substation on a monthly basis) will complete the monitoring plan.

Table 22 Summary-list of KPIs and related parameters for Measure 1.1 Collective self-consumption at building scale

KPI	Parameter(s)	Data source	Baseline	Target
Increase in Local renewable energy production	Locally produced electrical energy (electricity generated by the PV panels)	Digital smart electricity meter	there is no prior state as buildings are new. The baseline will use reference data, i.e. values stipulated by national regulations	360
Degree of energy self-supply by RES	Electrical energy consumption	Digital smart electricity meter	there is no prior state as buildings	80%

			are new. The baseline will use reference data, i.e. values stipulated by national regulations	
Storage capacity installed			there is no prior state as buildings are new. The baseline will use reference data, i.e. values stipulated by national regulations	300
Carbon dioxide emission reduction	Electrical energy consumption	Digital smart electricity meter	there is no prior state as buildings are new. The baseline will use reference data, i.e. values stipulated by national regulations	24
	Thermal energy consumption	Digital smart thermal meter		
Energy savings	Electrical energy consumption	Digital smart electricity meter	there is no prior state as buildings are new. The baseline will use reference data, i.e. values stipulated by national regulations	340
	Thermal energy consumption	Digital smart thermal meter		
CO_2 reduction cost efficiency	Electrical energy consumption	Digital smart electricity meter	there is no prior state as buildings are new. The baseline will use reference data, i.e. values stipulated by national regulations	Not fixed yet
	Thermal energy consumption	Digital smart thermal meter		

4.2.2 Monitoring plan for measure 2: Optimization of heating load curve

Renovation of existing buildings is generally limited to the refurbishment of the means of production or insulation of buildings. Heating control remains centralized according to a single heating scheme for the entire building, which depends only on the outside air temperature and on an internal room measurement. Some houses are overheated while others are underheated, leading to overconsumption (overheating, opened-windows, etc.) and discomfort.

As part of the renovation of existing buildings, the aim of Measure 2 is to integrate a smart control system within the district heating distribution, giving the possibility to adjust heat supply to the individual demand in each apartment according to their sun/wind exposures but also considering accurate indoor temperature.

Each substation is already equipped with a thermal counter which permits to define the historical heating consumption (consumption in MWh). Historical data are based on winter 2018/2019 (from 25/10/2018 to 14/05/2019).

Table 23 Summary-list of KPIs and related parameters for Measure 1.2 Optimization of heating load curve

KPI	Parameter(s)	Data source	Baseline	Target
Energy savings	Electrical energy consumption Thermal energy consumption	Existing smart meter	Heating energy for previous year(s) (e.g. 2018) times CO_2 factor for natural gas	
Solution 1 (station 14)				5%
Solution 1+2 (station 13)				20%
Solution 1+3 (station 14)				15%
Carbon Dioxide Emission Reduction	Electrical energy consumption Thermal energy consumption	Existing smart meter	Heating energy for previous year(s) (e.g. 2018) times CO_2 factor for natural gas	
Solution 1 (station 14)				9
Solution 1+2 (station 13)				45
Solution 1+3 (station 14)				27
Return on investment		Smart Meter, Energy Bill	*PGO = 39,62€/MWh* *PH0 = 61,8€/MWh*; PH includes the heating losses between the boiler room and the substation	

			Invoices of January 2019 for energy price	
Solution 1 (station 14)				N/A
Solution 1+2 (station 13)				N/A
Solution 1+3 (station 14)				N/A
CO_2 reduction cost efficiency	Electrical energy consumption Thermal energy consumption	Smart Meter, Energy Bill	*PGO = 39,62€/MWh* *PH0 = 61,8€/MWh*; PH includes the heating losses between the boiler room and the substation Invoices of January 2019 for energy price	
Solution 1 (station 14)				N/A
Solution 1+2 (station 13)				N/A
Solution 1+3 (station 14)				N/A

4.2.3 Monitoring plan for measure 3: Commissioning process from the design to the operation

The REPERE service is a dedicated commissioning process elaborated to check from the design to the operation that energy efficient measures have been correctly implemented in refurbished apartment buildings. This service is based on monitoring and measurement data acquisition. Measurements are performed both before and after refurbishment and used to build an energy model of the building. This model is then processed to compare the performance after refurbishment with the performance or bills before refurbishment (bills are used when measurement before refurbishment, called the baseline, is not available).

The monitoring is managed by COFELY and is the same as the one described for optimization of the heating load curve.

Table 24 Summary-list of KPIs and related parameters for Measure 1.3 Commissioning process from the design to the operation

KPI	Parameter(s)	Data source	Baseline	Target
Data loss prevention				< 2%
Increased awareness of energy usage.				4 – Good capacity

4.2.4 Monitoring plan for measure 4: Dashboard providing real-time energy balance

The demonstration leans on a waste heat recovery system that is conceived as a low temperature district heating/cooling network. Nevertheless, the project is not financed by IRIS, as it is a completely private project lead by DALKIA. To be precise, the District Heating Cooling Network (DHCN) project does not rely on a public call for tender but is fully invested and deployed on the initiative of the company. So the project is strongly dependent on the commercialization success in acquiring customers. Those are mostly the new real estate companies developing the new construction projects on-site but also existing buildings within the network's planned catchment area. The future customer pool will thus be mostly office, commerce, hotel and educational buildings.

For the monitoring of the DHCN performances (not financed by IRIS, neither owned by any of the consortium partners): the Dashboard will display and monitor the global energy and environmental performances of the connected DHCN in a continuous manner. Thus, monitoring of the DHCN will be an integral part of the Dashboard.

Concerning the survey: based on the Dashboard of ReUseHeat, a first reference survey should be available from this project. This will create a baseline by first semester 2021. For the new additional developments of the Dashboard within IRIS, the improvement will be measured by mid-2022.

Table 25 Summary-list of KPIs and related parameters for Measure 1.4 Dashboard providing real-time energy balance

KPI	Parameter(s)	Data source	Baseline	Target
Energy savings				N/A
Carbon dioxide Emission Reduction				N/A
Increased environmental awareness				N/A
Ease of use for end users of the solution				N/A
User engagement				N/A

4.2.5Remarks

In PALAZZO MERIDIA and IMREDD buildings (Measure 1) the monitoring phase will start on May 2020 in order to fulfil the two years data measurement period. Data analysis will be performed for the 2 buildings on a regular basis (every 3-months), and data will be processed and stored to the KPI tool.

The monitoring phase in towers 13 & 14 (measure 2) for solutions 1 & 2 has already been started. The monitoring phase for the solution 3 will start on November 2020.

The monitoring phase of the REPERE service (Measure 3) follows the monitoring phase of the Measure 2 as it uses data produced from solutions 1 to 3.

The Dashboard (Measure 4) will be implemented in the IRIS demonstration area by mid-2022, due to the delay in the contraction of the DHCN (not financed by IRIS, neither owned by any of the consortium partners). For this reason, the dashboard will be in initially implemented in another area. So, the monitoring of the dashboard's operations will be in the beginning outside the IRIS demonstration area, and in the end in the IRIS area. Both areas (external and internal) share common features, so the results from the external area will be used in conjunction with the results from the IRIS demonstration area.

4.3 Gothenburg

The data provided in the following paragraphs is extracted from deliverable D7.3: Launch of T.T.1 activities on Smart renewables and near zero energy district (Gothenburg) [13]. More detailed information about these integrated solutions can be found in this source.

4.3.1 Monitoring plan for measure 1.1: 200 kWh electricity storage in 2nd life batteries powered by 140 kW PV

In the direct vicinity to Chalmers campus Johanneberg in Gothenburg, Riksbyggen has just finished the construction of a new housing cooperative, Viva, with a total of 132 apartments. Electricity is generated on the roof of four of the six buildings in Viva; the three high ones and the southmost low one.

This measure is exploring the re-usefulness of vehicle batteries in stationary applications, together with solar PVs. The electricity is either used directly in Viva or stored in the batteries to be used later. When the electricity in the grid has particularly low price or low carbon intensity, it could be desirable to charge the batteries from the grid. That way, the energy storage can contribute to an increased flexibility in the surrounding grid and further the development of the smart power grids of the future.

Figure 34 The housing cooperation Brf Viva as seen from Johanneberg Science Park

The batteries are taken from their mobile service in buses, when roughly 80% of original capacity remains, and given a second life in a stationary application. This leads to an improved efficiency in the use of resources as well as a reduced environmental impact.

The monitoring will be carried out in close cooperation with the utility company Göteborg Energi who has access to most of the data through their work with the overall energy management system of Viva, see measure 1.6. They are also part in IRIS and another cooperative research project dealing specifically with advanced energy management.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A10.

Table 26 Summary-list of KPIs and related parameters for Measure 1.1 200 kWh electricity storage in 2nd life batteries powered by 140 kW PV

KPI	Parameter(s)	Data source	Baseline	Target
Carbon dioxide Emission Reduction	Hourly load curve from the apartments [Wh],	Smart meters	Baseline is the load curve from the apartments, unassisted by either batteries or PVs, times the carbon intensity with hourly resolution on the imported electricity.	15-20%, or 10 metric tonnes.
	Hourly electricity production from PVs [Wh]	Smart meters		
	Hourly electricity delivered from the grid [Wh]	Smart meter		
	Hourly carbon intensity of the grid electricity [g CO_2 -e/Wh]	N/A		
Degree of energy self-supply by RES	Monthly electricity production from PVs [Wh]	Smart meter	Zero percent self-supply.	Brf Viva's degree of self-supply for **electrical** energy is expected to vary between 10% and 60%.
	Monthly electricity delivered from the grid [Wh]	Smart meter		
Energy savings	Hourly load curve from the apartments [Wh],	Smart meters	The electricity demand of Viva.	25-40% annual electric energy savings.
	Hourly electricity production from PVs [Wh]	Smart meters		
	Hourly electricity delivered from the grid [Wh]	Smart meter		

4.3.2 Monitoring plan for measure 1.2: Heating from geo energy with heat pumps

This measure introduces heating of Viva by heat pumps drawing geothermal energy from deep boreholes.

The temperature in the boreholes stays relatively constant around the average annual temperature which is eight degrees in Gothenburg. Heat pumps are used to raise the temperature of the water coming up from the holes to 45 degrees. This is then led from the main energy central to the three sub-centrals, one for each high-low pair of buildings in Viva, where a heat exchanger brings the heat into the radiator system. Each sub-central also brings the temperatures up to 60 degrees for hot tap water. The geo energy system is designed and sized to be able to provide hot water during also the coldest days of the year without direct use of electric heaters.

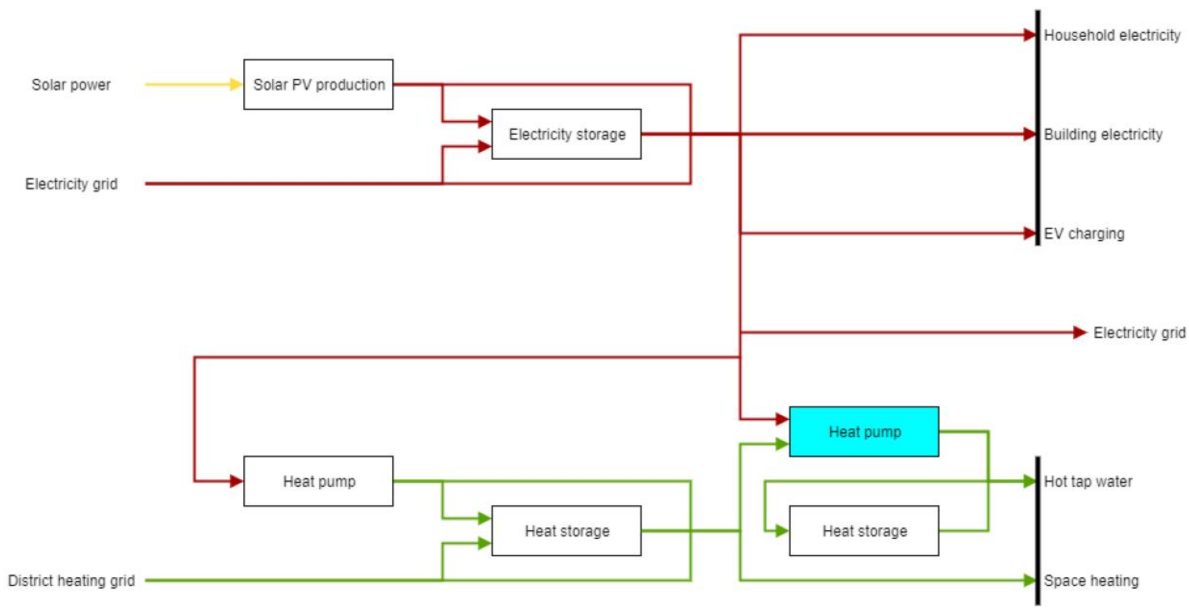


Figure 35 The overall schematic of the energy system in Viva. Note the Heat pump, marked in teal, which is where the heat from the geothermal energy enters the system.

The monitoring will be carried out by Riksbyggen in close cooperation with the utility company Göteborg Energi who has access to most of the data through their work with the overall energy management system of Viva, see measure 1.6. They are also part of IRIS and another cooperative research project dealing specifically with advanced energy management.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below, and related parameters are described in detail in Annex A13.1.

Table 27 Summary-list of KPIs and related parameters for Measure 1.2 Heating from geo energy with heat pumps

KPI	Parameter(s)	Data source	Baseline	Target
Degree of energy self-supply by RES	Monthly produced thermal energy in Viva [Wh]	Smart meter	Zero self-supply.	Varying between 0% and 100% for **thermal** energy.[2]
	Monthly used thermal energy [Wh]	Smart meters		
Carbon dioxide Emission Reduction	Hourly thermal load curve from the apartments [Wh],	Smart meters	0% reduction	90% reduction.
	Hourly thermal energy production in Viva [Wh]	Smart meters		
	Hourly thermal energy delivered from the grid [Wh]	Smart meter		
	Hourly carbon intensity of the DH grid [g CO_2-e/Wh]	N/A		
CO_2 reduction cost efficiency	Yearly carbon dioxide Emission Reduction [tonnes/year]	Calculation	N/A	400 €/tonne CO_2 e*y
	Investment cost [€]	Calculation		
	Service life [years]	N/A		
	Running costs [€/year]	Calculation		

[2] More self-supply is not always better. Remember that DH in Sweden is largely comprised of waste heat, and thus has a very low carbon intensity. It is in many cases more beneficial from an emissions point of view to use DH.

4.3.3 Monitoring plan for measure 1.3: Cooling from geo energy without chillers

This measure is a system which circulates return water from the comfort cooling system of the office building CTP to the heating system in Brf Viva, thereby transferring cooling to CTP. The boreholes are part of Vivas heating system, and cold water is transferred from them to the office building CTP where it is used to provide a more comfortable and cooler indoor environment. Without this measure, Viva and CTP purchase electricity to produce heating and cooling, respectively. With this measure, the opposing demands would be short circuited, and the amount of purchased electricity reduced. Additionally, with the inclusion of this measure in the energy balance of Viva, it is expected to make it a positive energy building.

The monitoring will be carried out by Riksbyggen in close cooperation with the utility company Göteborg Energi who has access to most of the data through their work with the overall energy management system, see measure 1.6.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.1.

Table 28 Summary-list of KPIs and related parameters for Measure 1.3 Cooling from geo energy without chillers

KPI	Parameter(s)	Data source	Baseline	Target
Degree of energy self-supply by RES	Current levels of cooling used in CTP. [Wh]	Smart meter	The current annual cooling demand of CTP is entirely provided by purchased energy, thus baseline is 0%.	A substantial amount, hopefully up to 80%
	Supplied amount of cooling by Viva. [Wh]	Smart meters		
Carbon dioxide Emission Reduction	Current levels of cooling used in CTP. [Wh]	Smart meter	The CO_2 -emissions to fulfil the current annual cooling demand of CTP, before this measure is deployed.	A substantial amount, hopefully **up to 80 %** of the annual CO_2 -emissions associated with providing the cooling needed in CTP can be reduced by the cooling suppplied by Viva.
	Associated energy usage [Wh]	Smart meters		
	Supplied amount of cooling by Viva. [Wh]	Smart meters		
	Hourly carbon intensity of the electricity grid [g CO_2-e/Wh]	N/A		
CO_2 reduction cost efficiency	Yearly carbon dioxide Emission Reduction [tonnes/year]	Calculation	N/A	59 000€/tonne*y
	Investment cost [€]	Calculation		
	Service life [years]	N/A		
	Running costs [€/year]	Calculation		

4.3.4 Monitoring plan for measure 1.4: Local energy storages consisting of water buffer tanks, structural storage and long-term storage in boreholes

This measure incorporates a couple of different thermal energy storages into the overall energy system of Viva. There are accumulator tanks in four places in Viva. In the main energy centre, that services the entire group of buildings, there are 2 tanks to relieve the heat exchangers from turning on and off too often. Each of these tanks holds 2000 litres which brings a storage capacity of 160 kWh, working with a temperature difference of 30 degrees. Additionally, there are 9 tanks in each of the 3 sub-centres, that store hot tap water. Each of these tanks holds 500 litres which brings a storage capacity of 810 kWh, working with a temperature difference of 52 degrees. The total thermal energy storage in the accumulator tanks is 970 kWh. In addition, the thermal inertia of Viva's concrete building structure effectively acts as a short-term passively controlled energy storage. Once measure 1.3 and 1.5 are in operation long-term storage in boreholes can be considered.

The monitoring will be carried out by Riksbyggen in close cooperation with the utility company Göteborg Energi who has access to most of the data through their work with the overall energy management system, see measure 1.6.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.1.

Table 29 Summary-list of KPIs and related parameters for Measure 1.4 Local energy storages consisting of water buffer tanks, structural storage and long-term storage in boreholes

KPI	Parameter(s)	Data source	Baseline	Target
Storage capacity installed	Volume of accumulator tanks [m^3]	N/A	The baseline is 0 kWh.	970 kWh in tanks. N/A for boreholes and structure.
	Temperature interval of accumulator tanks [K]	N/A		
	Conditioned floor area of Viva [m^2]	N/A		
	Storage capacity in the structure [Wh]	N/A		
Peak load reduction	Space heating demand [Wh]	Smart meters	The baseline is the consumed heat in the building.	The thermal peak load will be reduced.
	Hot tap water demand [Wh]	Smart meters		
	Heat produced by heat pumps [Wh]	Smart meter		
	Purchased DH [W]	Smart meter		
Carbon dioxide Emission Reduction	Space heating demand [Wh]	Smart meters	The thermal demand curve from the apartments, including hot tap water, multiplied by carbon intensity values. Both with hourly resolution.	A rough and enthusiastic estimate is that the emission reductions should be around 3 tonnes per year.
	Hot tap water demand [Wh]	Smart meters		
	Hourly carbon intensity of the DH grid [g CO_2-e/Wh]	N/A		
CO_2 reduction cost efficiency	Yearly carbon dioxide Emission Reduction [tonnes/year]	Calculation		4 000 €/tonne*y
	Investment cost [€]	Calculation		
	Service life [years]	N/A		
	Running costs [€/year]	Calculation		

4.3.5 Monitoring plan for measure 1.5 Seasonal energy trading with adjacent office block

This measure is a system which trades heated cooling water from the office building CTP, with cooled water from the boreholes in Viva. More details about the motivation of energy trade can be found under the description of measure 1.3 Cooling from geo energy without chillers.

The monitoring will be carried out by Riksbyggen in close cooperation with the utility company Göteborg Energi who has access to most of the data through their work with the overall energy management system of Viva, see measure 1.6. They are also part of IRIS and another cooperative research project dealing specifically with advanced energy management.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.1.

Table 30 Summary-list of KPIs and related parameters for Measure 1.5 Seasonal energy trading with adjacent office block

KPI	Parameter(s)	Data source	Baseline	Target
Peak load reduction	Purchased power to CTP [W]	N/A	Current peak power to meet the demand for **cooling in CTP**, and first peak power to meet the demand for **heating in Viva.**	With a successful deployment of the solution, the peak power load reduction could be 25% in CTP and 0% in Brf Viva.
	Purchased power to Viva [W]	Smart meter		
	Annual peak power in CTP [W]	N/A		
	Annual peak power in Viva [W]	Smart Meter		
	First Annual peak power in Viva [W]	Smart meter		
Reduced energy cost for consumers	Monthly costs in CTP [€]	Calculation	For the office building CTP: the current annual cost for cooling. For the apartment buildings Viva: 0.	Chalmers fastigheter saved 70% annually on cooling costs from the energy trading. Viva gains 30 000 SEK annually from running the energy trading.
	Monthly costs in Viva [€]	Calculation		
Carbon dioxide emission reduction	Hourly purchased electricity curves in CTP [Wh]	Smart meter	The CO_2 -emissions to fulfil the current annual cooling demand of CTP and heating demand of Viva, before this measure is deployed.	With a successful deployment of the solution the CO_2 emissions reduction could be: • 50% (0,46 t) in CTP • 10% (0,35 t) in Viva.
	Hourly purchased electricity curves in Viva [Wh]	Smart meter		
	Hourly purchased heating curves in Viva [Wh]	Smart meter		
	Monthly energy use during the first service year in Brf Viva before the seasonal energy trading is deployed. [Wh]	Smart meter		
	Hourly carbon intensity of the DH grid [g CO_2-e/Wh]	N/A		
	Hourly carbon intensity of the electricity grid [g CO_2-e/Wh]	N/A		
CO_2 emission reduction cost efficiency	Yearly carbon dioxide Emission Reduction [tonnes/year]	Calculation	N/A	33 k€/tonnes*y
	Investment cost [€]	Calculation		

	Service life [years]	N/A		
	Running costs [€/year]	Calculation		
Energy savings	Monthly purchased electricity in CTP [Wh]	N/A	Current monthly electric energy use to meet the demand for **cooling in CTP**, and monthly energy during the first service year use to meet the demand for **heating in Viva**.	With a successful deployment of the solution: • the thermal energy savings should be 0% in CTP • the thermal energy savings should be near 0% in Viva. • the electric energy savings could be 50% in CTP • the electric energy savings could be 10% in Viva
	Monthly purchased electricity in Viva [Wh]	Smart meter		
	Monthly purchased heating in Viva [Wh]	Smart meter		
	Monthly energy use during the first service year in Brf Viva before the seasonal energy trading is deployed. [Wh]	Smart meter		

4.3.6 Monitoring plan for measure 1.6 Advanced Energy Management System to achieve peak shaving and minimal environmental impact

This demonstrator introduces an intelligent control system which will be installed and manage the power flows within the energy system in Viva. The figure below presents an overview of installations in Viva. The measure aims to provide a better understanding of how the energy system can be optimized from a residential housing perspective and as part of the larger energy systems in Gothenburg. The battery storage will be used to store locally produced solar energy, and this energy can be used within the residential block, for charging electrical vehicles and in connection to the external power grid. During the ongoing parallel research project, the electricity storage is one part of the energy system that also includes the photovoltaic cells, the electricity network connection, boreholes, heat pumps, accumulator tanks and district heating. The optimization and control of the whole system aim to minimize the overall energy costs and environmental impact as well as improve energy efficiency.

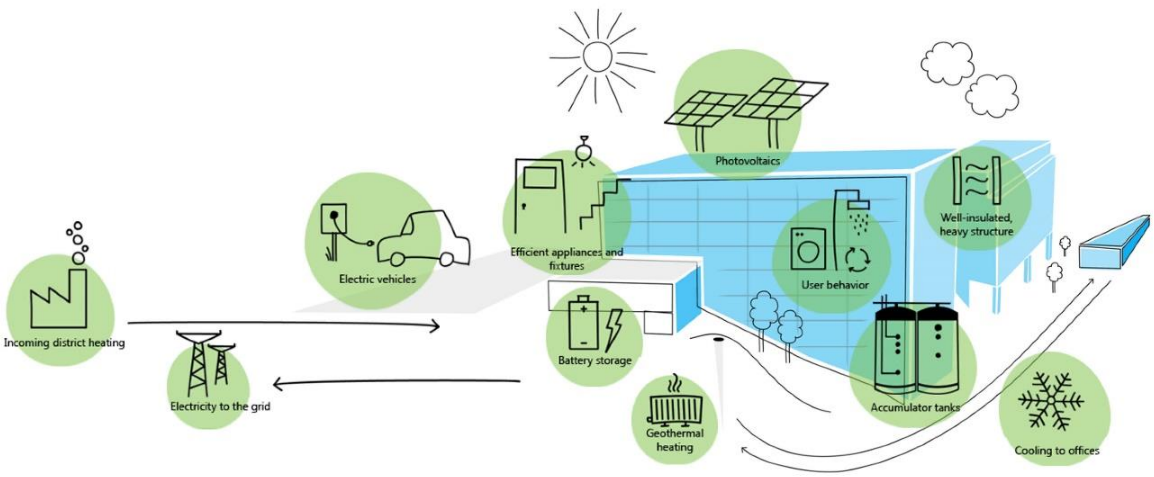


Figure 36 The components of the energy system in Riksbyggen's housing association Viva

The monitoring will be carried out by Riksbyggen in close cooperation with the utility company Göteborg Energi who has access to most of the data through their work with the overall energy management system of Viva.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.1.

Table 31 Summary-list of KPIs and related parameters for Measure 1.6 Advanced Energy Management System to achieve peak shaving and minimal environmental impact

KPI	Parameter(s)	Data source	Baseline	Target
Degree of energy self-supply by RES	Thermal energy demand [Wh]	Smart meter	The first service year of brf Viva.	The optimization will probably reduce the thermal self-sufficiency from 100% to 50 %, and increase electrical self-sufficiency from 25% to 35%.
	Purchased thermal energy [Wh]	Smart meter		
	Electricity demand [Wh]	Smart meter		
	Purchased electricity [Wh]	Smart meter		
Peak load reduction	Purchased thermal energy [Wh]	Smart meter	The baseline is the peak electricity consumption plus heat consumption (divided by mean COP).	By using DH, the electricity peak can be diminished although the DH peak is unaccounted for. The system might not be programmed to lower the peaks.
	Mean CoP in the heat pumps [-]	Smart meters		
	Electricity demand [Wh]	Smart meter		
	Purchased electricity [Wh]	Smart meter		
Reduced energy cost for consumers	Purchased thermal energy [Wh]	Smart meter	Costs without acting EMS. This will be calculated continuously.	Viva will save money each year.
	Cost rates of purchased thermal energy [€/Wh]	N/A		
	Purchased electricity [Wh]	Smart meter		
	Cost rates of purchased electricity [€/Wh]	N/A		
Carbon dioxide emission reduction	Electricity demand [Wh]	Smart meter	Carbon emissions from all bought energy during the first service year.	This is a bit complicated, work is ongoing to have a rough estimate in fall.
	Purchased thermal energy [Wh]	Smart meter		
	Purchased electricity [Wh]	Smart meter		
	Produced electricity in PVs [Wh]	Smart meter		
	Hourly carbon intensity of the DH grid [g CO_2-e/Wh]	N/A		

	Hourly carbon intensity of the electricity grid [g CO_2-e/Wh]	N/A		
Increased system flexibility for energy players stakeholders	Peak purchased thermal energy [W]	Smart meters	Zero flexibility.	The system flexibility might increase to 155% for district heating, and to 150% for electricity.
	Peak purchased electricity [W]	Smart meters		
	Installed capacity of flexibility providers: - Heat pumps - Battery storage - Accumulator tanks [W]	N/A		

4.3.7 Monitoring plan for measure 1.7 Building Integrated Photovoltaics (BIPV) in façade

The real estate company HSB has its Living Lab placed at campus Johanneberg. The Living Lab is the home for some 50 students but at the same time a research, test and demonstration environment (e.g. energy efficiency, resource optimization, electricity generation, laundry habits, cooking possibilities and so on).

In IRIS, HSB Living Lab contributes with a demonstration and evaluation of so-called BIPV, Building Integrated Photo Voltaics. This means solar panels for renewable electricity generation that can be mounted on houses instead of other construction material in newly built houses or in connection to the renovation of the facade or roof exchange. This demonstrator focuses on the situation at the end of the service life of the facade and roof materials.

The installation was designed based on budget, available space, HSBs wishes and aspects of research. There were 5 BIPV facilities with two different solar cell technologies on three facade sides and one BIPV plant on the roof. During the work, interest from HSB was made to include a battery in the installation, which was also incorporated. In the figures below the installed solar panels and their orientation on the building can be seen.

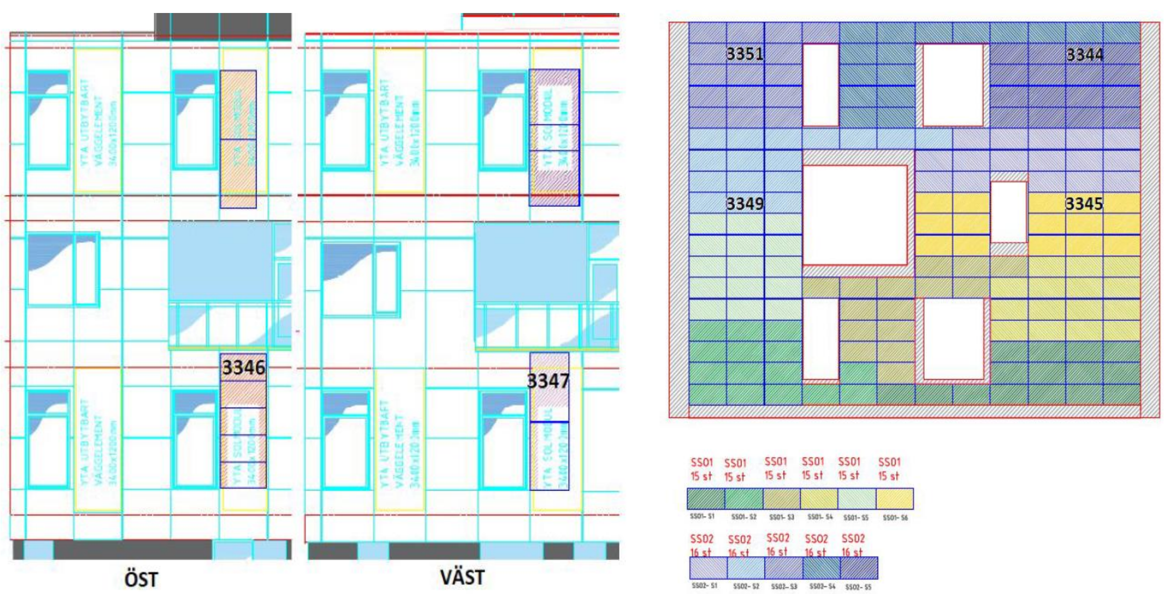


Figure 37 Solar panels (A-Si and mono-Si) at the façade east(öst)/west(väst) on the left and solar panel (A-Si) at the façade south on the righ).

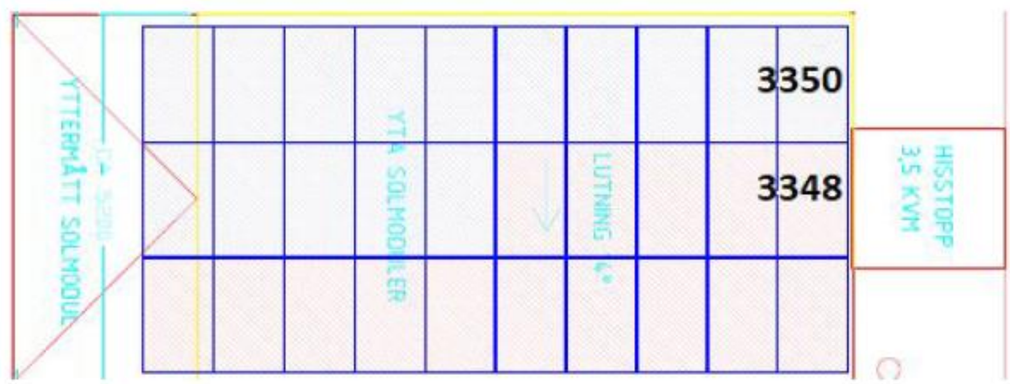


Figure 38 Solar panels (Mono-Si) on the roof.

Monitoring of this measure is conducted continuously until 2025. Energy production will be evaluated from different perspectives, such as: 1. Production compared to different weather conditions such as solar radiation/temperature. 2. Eventual decreased production caused by the age of the system. The monitoring is done by HSB.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.1.

Table 32 Summary-list of KPIs and related parameters for Measure 1.7 Building Integrated Photovoltaics (BIPV) in façade

KPI	Parameter(s)	Data source	Baseline	Target
Increase in local renewable energy production	Electricity production by BIPV in HSBLL [Wh]	Smart Meter	0 MWh per average year	14 MWh
	Electricity usage in HSBLL [Wh]	Smart Meter		
Degree of energy self-supply by RES	Electricity production by BIPV in HSBLL [Wh]	Smart Meter	0 %	19 % of electricity used in the building
	Electricity usage in HSBLL [Wh]	Smart Meter		
Carbon dioxide emission reduction	Electricity production by BIPV in HSBLL [Wh]	Smart Meter	0 tonnes	0,525 tonnes CO_2 reduction
	Electricity usage in HSBLL [Wh]	Smart Meter		
	Carbon intensity of the electricity grid [g CO_2-e/Wh]	N/A		
CO_2 reduction cost efficiency	CO_2 Emission Reduction [tonnes/year]	Calculation	N/A	N/A
	Investment cost [€]	Calculation		
	Service life [years]	N/A		
	Running costs [€/year]	Calculation		

4.3.8 Remarks

In the demonstrations related to Brf Viva all measures in TT1 and TT2, except IS1.3 and IS1.5, have gone as smooth as the partners hoped. Demonstrations IS1.3 and IS1.5 have run into problems and are still not finalized. The problems are linked to the fact that these demonstrations are planned in cooperation with another real estate owner and that issues have arisen making the demonstrations substantially more expensive than anticipated. Apart from this, the project has seen minor issues like miscommunications, unclear divisions of responsibilities, and other things that have been possible to deal with accordingly as the production of Viva progressed.

The next steps include monitoring and evaluation to answer questions such as:

- What are the experiences of the demonstrated solutions in Viva?
- What is necessary to achieve dissemination, replication or scaling up?
- How to continue the work with the underlying issues that these demonstrators are an effort to find solutions to?

For demonstrations IS1.7, in HSB Living Lab, the main conclusion is that this kind of thin-film BIPV facade is not more expensive than an ordinary facade material, and it is also better for the environment according to life cycle analysis. The continuous electricity generation is indeed a sound argument for the investment decision. Also, a BIPV solution on the roof is possible with relatively simple mounting methods. The next steps include monitoring, moisture and other types of evaluation, creation of business models and replication activities.

5 Monitoring plans of TT2 Smart Energy Management and Storage for Energy Grid Flexibility

5.1 Utrecht

The data provided in the following paragraphs are extracted from deliverable [14]. More detailed information about these integrated solutions can be found in this source.

5.1.1 Monitoring plan for measure 2.1: Solar V2G charging points for e-cars/e-vans

Locally produced solar energy from the PV-panels at the roofs of the apartment buildings can be stored in cars via Vehicle to Grid (V2G) technology: a smart and dynamic quick load and storage system. This creates flexible storage capacity that can reduce peak loads on the power grid. The stored energy is being used in the cars or released to the district at a later time, when energy demand is high.

A total of 18 solar V2G charging points for e-cars will be deployed in the demonstration area Kanaleneiland-Zuid.

Figure 39 Two V2G charging points and We Drive Solar shared E-car at the Krachtstation, Utrecht

The charging points are operated by the V2G smart charging software operated by LomboXnet. The charging points will be operated in such a way that evening peak loads are avoided and that the potential market value of V2G shared cars will be maximized.

The monitoring plan for the KPI Peak Load Reduction is being developed as follows:

- Stedin as the Distribution System Operator (DSO) for the district will monitor and store the peak load in all relevant transformer stations in the district, using additional monitoring equipment and data collection systems as part of the need to enhance more detailed insights on utilisation of the

grid under the influence of the energy transition and the potential for grid stress reduction by applying flexibility. The exact transformer stations are not entirely clear yet; at the time of writing this report, Stedin is planning the detailed monitoring system, in synchronization with the progress of the renovation of the apartments buildings. The peak load data will become available as peak load per hour or quarter.

- As a DSO, Stedin has shown significant interest in the peak load reductions, in order to obtain more insight into the potential that the IRIS technologies demonstrated will have to avoid future investments in grid reinforcement. Therefore, a pilot data service is planned to be established in the City Information Platform to supply that insight. In that data service, the peak load can be monitored, the reduction against the baseline determined, and the calculated reduction offered as a service to the DSO.
- In order to determine the baseline, the peak load at each transformer will be estimated based on equivalent hardware (houses, heat pumps, PV, charging stations) without smart energy management. Stedin will do this according to their usual methods for doing this so that the most realistic and commonly used baseline will be calculated.

The monitoring plan is being finalised and is expected to start monitoring in the second quarter of 2020 until the end of the project. Monitoring at the charging points begins immediately after the point has been taken into usage. Monitoring includes charging point usage, currents and powers. The monitoring data contributes to the monitoring plan to calculate the KPIs. From the monitoring at the charging points, no personal information is stored. Monitoring and data handling are the General Data Protection Regulation (GDPR) compliant.

The Peak Power will be measured using a set of electricity meters in the district, measuring powers of:

- Apartment buildings (apartments, solar power systems)
- V2G E-car charging stations
- Stationary battery
- Transformers in the district.

All these meters will be owned and operated by Stedin using their normal hard- and software. Exactly what meters will appear where is currently being engineered. A table with details for the data of a generic electricity meter is shown in appendix 0.

Table 33 Summary-list of KPIs and related parameters for Measure 2.1 V2G charging points for e-cars/e-vans

KPI	Parameter(s)	Data source	Baseline	GA- Target
Peak load reduction	Peak load at all transformer stations in the district; peak load / load reduction at meter of storage; PV load (and effect of curtailment)	Monitoring equipment Stedin	Baseline: the same measures (renovations, heat pumps, PV, e-cars, buses) without smart DEMS measures.	No target specified, because this KPI was formulated for research purposes. However, the hope is to achieve a peak load reduction of over 10%.

5.1.2 Monitoring plan for measure 2.2: Solar V2G charging point for e- buses

IRIS partner QBuzz is relocating its bus depot from the Europalaan in Utrecht to Westraven, a district just south of the IRIS district in Kanaleneiland-Zuid, and at the Remiseweg, across the Amsterdam-Rijn channel from Westraven. In this location, QBuzz will investigate smart charging options at its new bus-depot with the objective to demonstrate and optimize smart charging. At this moment, 13 e-buses are in operation by QBuzz and by summer 2020, this number is expected to have grown to 68. In the DoA implementation of the 10 V2G charging points was anticipated, but the necessary V2G-technology for e-buses is not yet available, which means that the charging stations will not be V2G. The actual implementation of 68 buses on the city level is now planned for 2020.

Main component	Technical specification
Qbuzz: electric bus chargers	• Fast charging power: 450 kW at 400V, using roof pantographs, connected to medium voltage grid • Normal chargers 30 to 100 kW, using plugs, connected to medium voltage grid • Charging time: 1 to 4 hours • Charging capacity at Westraven: 20 buses • Charging capacity at Remiseweg: 48 buses

The chargers feature monitoring and data storage equipment, monitoring voltage, currents. QBuzz has appointed a Data Scientist to analyse the data being generated.

Main component	Technical specification
Qbuzz: software	• Monitoring of many parameters including voltage, current, State of Charge, operation of the accelerator and (for some buses) parameters per battery cell. • Collection and processing on ViriCiti data platform for monitoring of charging power, past charging transactions, amount charged by each charger • Smart charging: peak shaving and load shifting

The buses feature detailed monitoring and data storage equipment based on the ViriCiti platform, which continually monitors many parameters including voltage, currents, state of charge, accelerator usage and others. QBuzz has appointed a Data Scientist to analyse the data being generated.

QBuzz will cooperate with Utrecht University, USI and LomboXnet to research monitored data.

Table 34 Summary-list of KPIs and related parameters for Measure 2.2 Solar V2G charging point for e- buses

KPI	Parameter(s)	Data source	Baseline	GA- Target
Peak load reduction	Peak load at all transformer stations in the district; peak load / load reduction at meter of storage; PV load (and effect of curtailment)	Monitoring equipment Stedin	Baseline: the same measures (renovations, heat pumps, PV, e-cars, buses) without smart DEMS measures.	No target specified, because this KPI was formulated for research purposes. The hope is to achieve a peak load reduction of over 10%.

5.1.3 Monitoring plan for measure 2.3: Stationary storage in apartment buildings

The third measure in Transition Track 2 is the establishment of stationary electricity storage. As will be explained below, after a first tender for batteries in the garage boxes did not deliver acceptable results, a battery outside one of the building has been procured.

Figure 40 Planned new location for the stationary battery

Main component	Technical specification
Stationary batteries	Type: lithium-ion battery pack in outdoor enclosure Capacity: 845 kWh Power: 590 kW / 630 kVA Grid connection: new, in transformer house Inverters: bi-directional with DC-to-DC converter System warranty: 10 years, extension up to 15 years Safety: system complies to IEC 62109, UL 9540, UL 1741 and others.

LomboXnet and Bo-Ex are setting up the exploitation plan for the battery. The battery will deliver a mix of flexibility to the Transmission System Operator (TSO), local flexibility and storing PV-power, which will be tailored to the research and development needs of the project. The battery software will be able to respond to flexibility requests from the Distribution System Operator (DSO) Stedin with flexibility and price offers so that that flexibility negotiations can be made with the DSO on the Universal Smart Energy Framework (USEF)/Gopacs platform.

Main component	Technical specification
Battery software	Tesla Powerpack Controller coordinating the operation of the battery system with ability to communicate with external controllers Onsite monitoring of Site power, Site reactive power, Battery power, Energy available, Energy remaining, Energy exported/imported @ battery meter, Voltage, Current, Power targets. Telemetry for Powerpack, solar PV, net load at grid interconnection, and 3rd party generation assets, for a fully-integrated view of the site Compatible with LomboXnet system and District Energy Management System Able to make flexibility offers to DSO upon request

The selection of the bid in the second tender took place in November 2019. The battery is expected to be realized in spring 2020; the electrical connection is expected to be installed as soon as possible; depending on the current lead time at the DSO this might occur later in the year.

From this moment on the battery is fully operational and will be operated, thus being able to provide flexibility while other parts of the projects (building renovations, e-cars and charging points, PV, e-buses) are being realized.

Table 35 Summary-list of KPIs and related parameters for Measure 2.3 Stationary storage in apartment buildings

KPI	Parameter(s)	Data source	Baseline	GA- Target
Storage capacity installed	kWh storage capacity installed	Technical specification stationary battery	Present storage capacity (zero)	845 kWh
Peak load reduction	Peak load at all transformer stations in the district; peak load / load reduction at meter of storage; PV load (and effect of curtailment)	Monitoring equipment Stedin	Baseline: the same measures (renovations, heat pumps, PV, e-cars, buses) without smart DEMS measures.	No target specified, because this KPI was formulated for research purposes. The hope is to achieve a peak load reduction of over 10%.

5.1.4 Monitoring plan for measure 2.4: Smart Energy Management System (EMSs)

In the demonstration area an integrated smart energy management system will be realised. The district energy system will interconnect energy consumers, energy producers and energy storage providers, including the following components:

- PV panels and hybrid heat pumps (in TT#1)
- Solar V2G charged e-cars
- Stationary battery
- Public street lighting
- Smart ICT to interconnect EMSs at home, building and district level, for the integration of maximal renewables production.

The local electricity grid in the demonstration area was designed in the sixties and will, during the building period of the demonstration, be adapted to fit in all elements as summarized above. In the new situation three additional transformer stations, transforming the voltage from medium voltage to low voltage will be added to the existing three stations in the local low voltage grid. These three additional transformer stations are necessary due to the foreseen feed-in of large amounts of solar power produced on the apartment buildings, additional electricity demand due to the hybrid heat pumps replacing natural gas boilers and charging of electric vehicles. The locations of all 6 transformer-stations are indicated on the map in Figure 41.

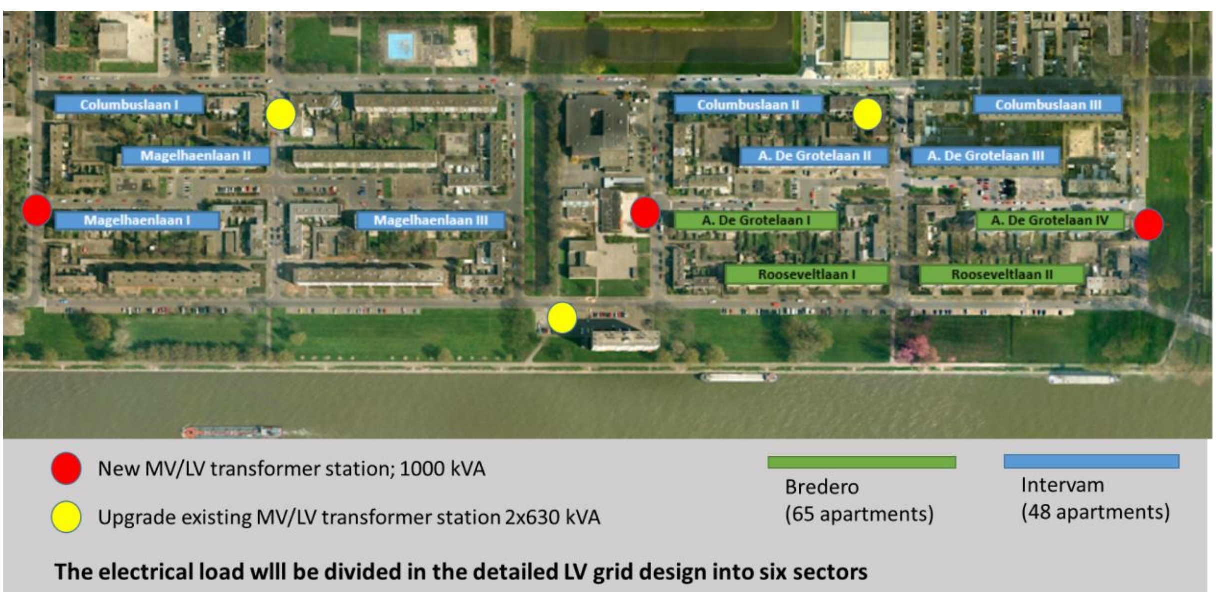


Figure 41 Location of the 6 medium voltage station to be used as test bed to solve congestion points.

The transformer stations will be equipped with additional special measuring sensors to measure transformer and cable loads to feed the smart energy management system to optimize the energy flows in the demonstration area. A district energy management system will interconnect the EMSs at home, building and district level.

The transformation of the district energy system into a smart district energy system will have serious impact on the energy flows. The apartment buildings are planned to be fed by six medium voltage to low voltage transformation stations. The district energy management system will have a double function:

- During the transformation of the apartment buildings, including installing solar panels, and the introduction of the charging points for electrical vehicles the changes in energy flows will be measures and can be analysed to also estimate the effect on the electricity system when, due to replication, the solutions in the demonstration area are duplicated on a large scale at other places.
- The real time measurements of the electricity flows will be essential input for the aggregator for using flexibility to help Stedin keep the maximum flow within acceptable values and monitor the status of the grid.

In order to be able to control the load in the electricity distribution grid, accurate data on the status of this grid is essential. Therefore, homes and transformer stations will be equipped with telemetric systems.

Main Component	Technical Specifications
Smart meters	One of the standard smart meters is distributed by Stedin among its households https://www.stedin.net/slimme-meter/overzicht-handleidingen • Is able to monitor consumption and delivery of electricity into the grid • Storage of measurements every 15 minutes 
Telemetrics systems for the trafo stations	Technical specification will be further elaborated in the coming months.

Data that will be collected within the demonstration area Kanaleneiland Zuid and Westraven include:

- Real time energy consumption on the household level. Data collection through the Toon. Because of Privacy legislation, permission of the tenants to obtain this data is required.
- Real time energy consumption and production on the apartment building level. Data collection through the district energy monitoring system.
- Real time electricity production of the PV panels on the homes and bus depot. Data collection through electricity (sub)meters.
- Real time energy consumption and production by the stationary battery. Data collection through the battery energy monitoring system and network connection meter.
- Real time consumption of locally produced electricity with the PV panels. Data collection through 'TOON' devices (with the permission of the tenants).
- Real time load demand at the LV/MV station that will service the first renovated buildings.

The details of the USEF/Gopacs implementation in terms of exact measurement plan are still in elaboration.

Table 36 Summary-list of KPIs and related parameters for Measure 2.4 Smart Energy Management System (EMSs)

KPI	Parameter(s)	Data source	Baseline	GA- Target
Peak load reduction	Peak load at all transformer stations in the district; peak load / load reduction at meter of storage; PV load (and effect of curtailment)	Monitoring equipment Stedin	Baseline: the same measures (renovations, heat pumps, PV, e-cars, buses) without smart DEMS measures.	No target specified, because this KPI was formulated for research purposes. The hope is to achieve a peak load reduction of over 10%.

5.1.5 Remarks

In general, activities of TT2 progressing according to plan. There are some deviations, but the overall ambitions of TT#2 of demonstrating smart energy management and storage are not affected.

Important lessons learned include:

- Energy and flexibility systems are developing on the city level, as well as e-bus and V2G shared e-car roll-out. IRIS is the main driver towards the quick development of a city-wide flexibility and e-mobility ecosystem.
- The realisation of stationary batteries in garage boxes has proven to be more difficult, with respect to spatial restrictions and electrical / fire safety concerns, than the realisation of a stationary battery outside.
- Second life batteries are presently significantly more expensive than new batteries, which appears to be due to quick price drops and production growth, and the low number of used e-car batteries available. This is expected to change in the next years.
- The interest in the demonstration of smart energy management from related parties such as authorities, DSO and other power network parties is large, but because developments in the field of flexibility management are fast in the Netherlands, the interest of partners and external parties in the innovative solutions in the project also changes. An example is the intention to use USEF – in the meanwhile, the newer Gopacs platform has started to develop, which means that it is now intended to use the two platforms together to establish the flexibility mechanisms.

Next steps are:

- Continue realisation of V2G chargers in a demand-driven way, with support of citizen engagement activities and the involvement of local entrepreneurs.
- Research on the practical feasibility of V2G e-bus charging
- Realisation and exploitation of the stationary battery and develop the flexibility request handling systems so that the actual value of local flexibility services on the Dutch market can be investigated
- Realisation of the smart energy management system and quick extension towards virtual power plant and a city-wide ecosystem of green mobility and sustainable energy management.

For TT2 a large part of the monitoring infrastructure is already placed or about to be installed very soon. Next step is to connect the monitoring to the CIP, to collect the data into the KPI tool.

The monitoring plan for the KPI Peak load reduction is currently being finalised and is expected to start monitoring in the second quarter of 2020 until the end of the project. This plan will be incorporated into the updated version of D9.5.

5.2 Nice

The data provided in the following paragraphs are extracted from deliverable D6.4: Launch of T.T2 activities on Smart energy management and storage for flexibility (Nice) [15]. More detailed information about these integrated solutions can be found in this source.

5.2.1 Monitoring plan for measure 2.1: Flexible electricity grid networks (PV // batteries // lighting network)

In the first place, the ambition to be satisfied with the deployment of the EMS under IS 2.1, is to ensure a system capable of optimising the economic benefit for self-consumption endeavours. This ensures the individual buildings and their regulated contracts as by French law and further other constrains (like energy performance contracting (EPC) with subcontractors or service providers) are considered, constrains respected and revenues maximised. This EMS will then be left in place after the project duration and will ensure the long lasting impact on the operation of the buildings (at least 10 years are the contract duration for the feed in tariffs from with the Regulator for self-consumption endeavours). This aspect is formalised by a "property transfer contract".

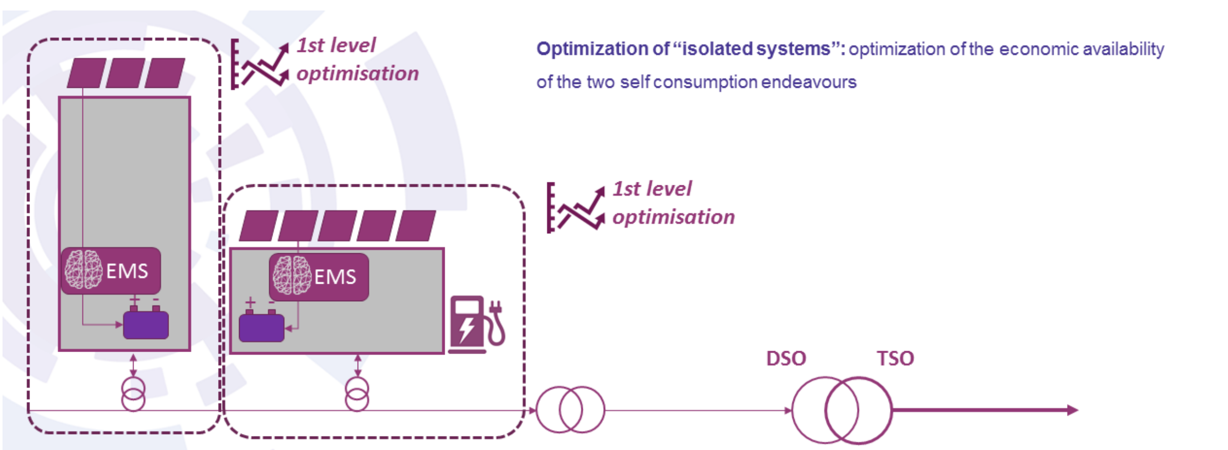


Figure 42 First level optimisation: the EMS ensures to fulfil all constrains imposed to each and every building (source: EDF).

In a second step, the EMS will be opened towards the energy markets via an aggregator and thus, enable to provide, in addition to its core functionalities, grid services to be traded on the market.

It has to be clarified here that no DSO services are foreseen to be provided under TT#2, except for IS 3.1 where a technical use case (not business UC) might be foreseen for a proof of concept (POC) regarding flexibility provision potential via Smart Charging, as peak shifting for the DSO (see UC 3.3 under IS 3.1 in D6.5). This is due to the fact that at the time being no DSO market exists, nor is it foreseen to be created in the short-term following publicly accessible information. Thus, it is highly improbable to have any concrete business use case for DSO level flexibility activation needs in the near future, which could provide any revenue stream for the end-users and justify a TRL 8 development.

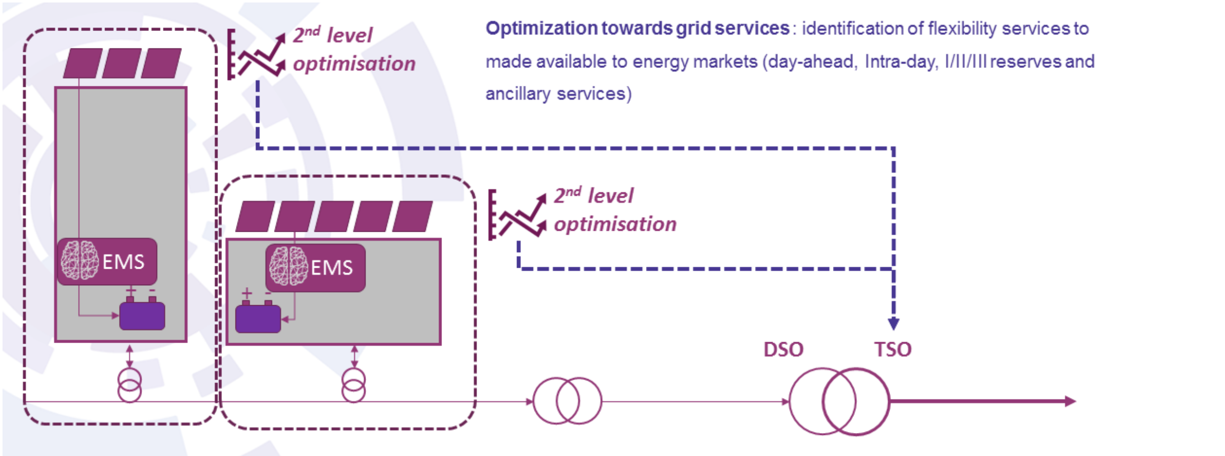


Figure 43 Second level optimisation: the EMS enables to communicate with an aggregator platform and provide flexibility services to the grid (TSO level) (source: EDF)

In a final step, the individual EMSs are enabled to communicate among them and further EMSs are emulated by using historical data. Through this exercise, it will be explored if any synergy can be found that would enable to provide any additional profitability or service quality of the local energy management system under current regulation and market conditions. So, the realization and demonstration of this latter step is dependent on the bankability of the previous UC.

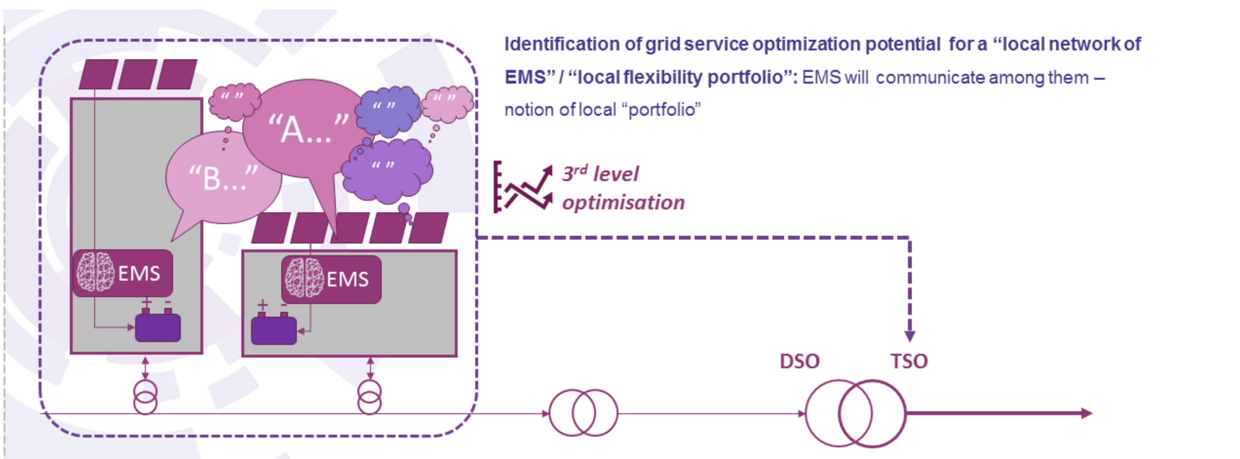


Figure 44 Third level optimisation: it is explored in how far, a local portfolio of assets could ameliorate the flexibility availability for the energy markets, as by integrating higher level optimization constrains and strategies, compared to the individual, distributed, optimization (source: EDF).

At the time being the macro UC are stabilized, so they provide more visibility on roles and responsibilities among involved parties. Their detailing in sub-UC as are important for nourishing the contractual arrangements which have been foreseen to enable the demonstration activity. More specifically, it is foreseen to integrate those elements into an "experimentation contract" to be signed among all directly involved partners and third parties for each of the IS and related UC. This concerns IS 2.1 and 2.3 and partially IS 3.1. For the time being, an exclusivity contract has been signed with NEXITY and other involved parties for the procurement and delivery of the EMS via EDF S&F on NEXITY's buildings. All other contractual arrangements are in the starting blocks as the exact definition of their contents, objectives and each party's role is almost achieved.

What could be stated in addition to what already reported via the previous deliverables, a main ambition for IS 2.1 is also to identify if, a yet not viable business case represented by the integration of Battery Energy Storage Systems (BESS) for self-consumption maximisation, can be made viable via grid service provision to the grid. In other words, proof under which conditions, grid services can justify the integration of BESS in buildings by adding a revenue flow coming from the energy markets, capable of providing an acceptable IRR (Internal Rate of Return) or ROI (Return of Investment).

The overall monitoring of the achievements of the actions will be mainly granted by the centralization of information via EDF S&F and AGREGIO and its post-processing for nourishing WP9 tasks. The details about the monitoring period of the different measures are given by the implementation plan described for each sub UC.

For the overall volumes and peak energy consumption and injection metering on the electric grid, ENEDIS will provide the aggregation of the information stored in their data centres.

For the assessment of the detailed information “behind the meter”, EDF S&F and also AGREGIO, will systematically collect the information and store it on their servers (however, the agreement of the data owners will have to be provided for their exploitation). This will enable the tracing of globally all KPIs that are needed for the impact and objective assessment as by WP9.

Table 37 Summary-list of KPIs and related parameters for Measure 2.1 Flexible electricity grid networks (PV // batteries // lighting network)

KPI	Parameter(s)	Data source	Baseline	Target
Energy savings	PV production [MWh/year] Energy injected into the grid [MWh/year] Defines the energy efficiency achieved by operating the PV+BESS+EV charging system at building level in an efficient manner and reduce thus the energy withdraw from the grid, albeit exogenous factors as grid services or economical optimization within current self-consumption regulation boundaries. This is directly proportional to the PV production which is not injected into the grid.	Inverter	There is not actual measurable “baseline”. This can be achieved by the retro-calculation of the building electricity withdraw, without PV, BESS and EMS system.	The contribution of this IS to the overall achievement of the TT level KPI will be minor, compared to IS 2.2.
Carbon Dioxide Emission Reduction	PV production [MWh/year] REF electricity CO2 [tCO2eq/MWh] PV CO2 content [tCO2eq/MWh]	Inverter	The baseline is as in the previous case the retro calculation of the emission volumes which would have	The contribution to the TT level indicator might be consistent together with the saving achieved by IS 2.2.

	This provides Electricity CO2 savings due to PV production, as the difference between the same volume provided via the grid and via PV installation. REF electricity CO2 CHP plant [tCO2eq/MWh] Flexibility volume [MWh] **This provides Electricity CO2 savings from flexibility provision via the "replacement method" so expressed as the electricity CO2 saving between producing the same service volume with a gas CHP plant as compared to PV installations for UC 1 and 2 and from the grid as by UC 3.**		been achieved without the PV installation. To this, it has to be added in the same way, the volume of carbon emission that would have been produced by Gas fired CHP plants to provide the same power and volume of flexibility services as under IS 2.1	
Peak load reduction	MAX electric peak [MW] REF electric peak [MW] **By diving the measured peak load by its reference electricity peak load, the % of peak load reduction can be calculated**	Smart meter	The baseline to be taken, is the electric substation sizing and subscribed maximal power supply as by energy retail contract from each UC. However, the indicator might be misleading in the first period of the demonstration, as far as the case studies reach full occupation and utilization ratio.	The combined effect of all UC will be used TO identify the maximal peak load reduction among IS 2.1 and will together with IS 2.3 provide the reached impact on TT level.
Degree of energy self-supply by RES	PV production [MWh/year] Elec consumption [MWh/year] **By dividing these two metered indicators, the ratio of RES self-supply can be estimated.**	Inverter	To assess the improvements from a reference scenario would not be meaningful, as it would result in an always positive ratio. Interest here is to identify which proportion of	The overall impact on TT level will have to account also for the ration of RES self-supply for thermal energy via IS 2.2

			the total energy load can be provided by RES.	
Ratio of valorised PV RES	PV production injected into the grid [MWh/year] PV production [MWh/year] **Together with the totally produced PV energy, a ratio can be given on the valorised PV (and so, not curtailed).**	Inverter	To assess the improvements from a reference scenario would not be meaningful, as it would result in an always positive ratio. It will simply account for the energy that is integrated into the grid via a profit for referring to "the injection of PV surplus properly remunerated".	The ratio is strictly at IS 2.1 level and it will result from the demonstration work.
Storage capacity installed	Cumulative V1G BESS storage capacity activated [kWh] Cumulative 1st life BESS storage capacity [kWh] This will give the total cumulative volume of energy that has been stored, thanks to the BESS and EV management via the EMS/LEMS.	Server	A reference case would not be meaningful as the current reference is the not existence of storage means.	The impact of the current IS, will have to be integrated with the results from IS 2.3
Battery degradation rate	Nominal 1st life BESS capacity [Ah] Final 1st life BESS capacity [Ah] Number of cycles of 1st life batteries [n] **This will give an assessment of the 1st life BESS degradation rate, due to the demonstration activity.**	Server	A reference case would not be meaningful for this indicator. Actually it becomes meaningful when compared to other BESS as by IS 2.3	The KPI is not bounded to a specific objective, but serves to the knowledge creation via the comparisons with IS 2.3
Increased system flexibility for energy players/stakeholders	Number of activations per year Average Power flexibility [kW] Average Energy flexibility [kWh] Average activation duration	Server	A reference case would not be meaningful as the current reference is the not existence of flexibility services in the demonstration area.	The system flexibility to be achieved at TT level as to be integrated with the results form IS 2.3. This will give an overall estimation of the impact of the

	Flexibility load ratio can be evinced by the Average Power flexibility divided by the reference Peak Load.			demonstration activity
Reduced energy cost for consumers	Expenses electricity [EUR] Income PV injection [EUR] Income energy services [EUR] **Thanks to this indicators, the reduced energy costs incurred by the revenue stream of the PV injection and through energy services can be accounted for separately and by dividing it by the overall energy expenses, defined the overall cost reduction ratio for the IS.**	Smart Meter	The reference value is here already integrated into the calculation, to the overall energy expenses without PV injection or energy service revenue streams.	For the assessment of the impact on TT level, the indicators from IS 2.2 have to be integrated.
Investment cost	This indicator is less clear yet, as the definition of the cope and perimeter of this KPI is yet not harmonised among the LH cities.			

5.2.2 Monitoring plan for measure 2.2: Smart district heating with innovative storage

The UC is driven by its long-term mission under the Public Delegation of Service (PDS) in providing heating, cooling and possibly other energy services to the end-users under the catchment area of the DHCN (but not only). The geothermal based DHCN is a first of its kind development for the city of Nice and will give important feedback for further, similar type of replications. The integration of an AI-driven supervision platform will provide valuable experimentation for the industry on possible energy savings and further flexibility driven hybrid systems integration.

The demonstration will be conducted within the perimeter of the first DHCN customers, all new real estate developments of the Nice Meridia district. The supervision platform to be implemented will use in a first step, AI algorithms to optimize the production station's thermal and the network's hydraulic balance. The optimization towards energy services and even flexibility offers (thermal and electrical) to end-users will further be explored.

In a second step, as the catchment area growth in terms of connected final users, thermal storage will further support the exploitation performances of the DHCN system. In total, 3 types of storage will be available on site (plan yet to be defined): cold storage via a centralized ice storage, heat storage via an innovative PCM based distributed thermal storage and a BESS at the production site.

Monitoring will be part of the DHCN operation practice. The DHCN operator will centralize all data at the production site. This will ensure all needed data can be queried for the assessment of the above-cited KPIs.

Table 38 Summary-list of KPIs and related parameters for Measure 2.2 Smart district heating with innovative storage

KPI	Parameter(s)	Data source	Baseline	Target
Energy savings	REF heating energy [MWh/year] REF cooling energy [MWh/year] Heating energy provided [MWh/year] Cooling energy provided [MWh/year] **By adding the relative savings among cooling and heating energy, the total thermal saving can be assessed.**	Smart Meter	The baseline is the current heating and cooling market situation: gas boilers for heating and SHW and electric chillers for cooling production respectively.	The contribution of this IS to the overall achievement of the TT level KPI will be of major importance.
Carbon dioxide Emission Reduction	REF heating coeff [tCO2eq/MWh] REF cooling coeff [tCO2eq/MWh] Heating produced coeff [tCO2eq/MWh] Cooling produced coeff [tCO2eq/MWh] **By adding the saving respectively achieved for the heating and cooling energy provided to the customer pool, the total CO2 savings from the DHCN can be assessed.**	Smart Meter	The baseline is as in the previous case.	The contribution to the TT level indicator might be consistent together with the saving achieved by IS 2.1

Peak load reduction	REF heating peak [MW] REF cooling peak [MW] MAX heating peak [MW] MAX cooling peak [MW] REF elec peak prod [MW] MAX elec peak prod [MW] **By diving the measured peak load by its reference heating, cooling and electricity peak load respectively, the % of peak load reduction can be calculated**	Smart Meter	The DHCN system is "new", so the peak load reference will have to be estimated. It is possible to compare the metered peak loads and be assessed against the actual cumulated subscribed peak loads from customers.	The combined effect of all IS of TT#2 will be added to identify the maximal peak load reduction achieved.
Degree of energy self-supply by RES	Heating provided [MWh/year] Cooling provided [MWh/year] Elec consumption aux. heating [MWh/year] Elec consumption aux. cooling [MWh/year] **By dividing these 2 metered indicators, the ratio of RES self-supply can be estimated and via a weighted average, assess the overall impact of the IS 2.2.**	Smart Meter	To assess the improvements from a reference scenario would not be meaningful, as it would result in an always positive ratio. Interest here is to identify which proportion of the total energy load can be provided by RES.	The overall impact on TT level will have to account also for the ration of RES self-supply from IS 2.1
Reduced energy cost for consumers	REF heating expenses	Smart Meter, Energy bills	The reference value here is as for	For the assessment of the impact on TT

	REF cooling expenses Heating expenses (fixed+variable) Heating expenses (fixed+variable) Reduced heating and cooling costs can so be calculated as the cumulated savings from the current energy bill compared to a BAU reference.		the first two indicators.	level, the indicators from IS 2.1 have to be integrated.
Investment cost	This indicator is less clear yet, as the definition of the cope and perimeter of this KPI is yet not harmonised among the LH cities.			

5.2.3 Monitoring plan for measure 2.3: Utilizing 2nd life batteries for smart large-scale storage schemes

The UC will be a combination of BESS charge and discharge cycling procedures, in order to assess their performances in supporting an individual self-consumption endeavour by absorbing PV energy and providing consumption load's peak shifting and peak shaving.

The current UC or IS, has to be isolated from the previous UC or IS, defining temporal slots for their activation and ensure to not overlap with UCs entailed in IS 2.1. For this, an experimentation calendar will be defined, providing under a control environment (BESS capacities to be activated, cycling typology and similar PV production and load environments) an effective mean to provide such comparison.

The BESS is foreseen to be instrumented in case the BESS control won't give access to all needed measurement points, as for the methodology for the characterization of 2nd life of the BESS that yet has to be settled. This will be defined once the 2nd BESS stacks will be delivered and the connection test can be done.

The same applies to the V2G charging pole. It is yet not completely clear what information can be retrieved via the charging pole about the EV integrated BESS. So possible complementary metering equipment or development of dedicated APIs can be assessed once the assets are delivered.

The current IS 2.3, is based on the development of locally hosted control and metering equipment. Therefore, the data streams will be stored locally in UNS/IMREDD and ensure the consistency of a historical database for the post-evaluation of the implemented control strategies.

Table 39 Summary-list of KPIs and related parameters for Measure 2.3 Utilizing 2nd life batteries for smart large scale storage schemes

KPI	Parameter(s)	Data source	Baseline	Target
Storage capacity installed	Cumulative V2G BESS activated capacity [kWh] Cumulative 2nd life BESS activated capacity [kWh] **This will give the total cumulative volume of energy that has been stored, thanks to the BESS and EV management via the EMS.**	Server	A reference case would not be meaningful as the current reference is the not existence of storage means. Instead a cross comparison with other BESS technologies within TT#2 is of interest.	The impact of the current IS, will have to be integrated with the results from IS 2.1
Battery degradation rate	Nominal 2nd life BESS capacity [Ah] Nominal V2G BESS capacity [Ah] Final 2nd life BESS capacity [Ah] Final V2G BESS capacity [Ah] Number of cycles of 2nd life BESS Number of cycles of V2G BESS **This will give an assessment of the respective BESS degradation rate due to the demonstration activity for both 2nd life and V2G.**	Server	A reference case would not be meaningful for this indicator. Actually it becomes meaningful when compared to other BESS as by IS 2.1	The KPI is not bounded to a specific objective, but serves to the knowledge creation via the comparisons with IS 2.1
Increased system flexibility for	**2nd life - Number of activations per year**	Server	A reference case would not be	The system flexibility to be

energy players/stakeholders	**2nd life -Average Power Flexibility [kW]** **2nd life -Average Energy Flexibility [kWh]** **2nd life -Average activation duration** **V2G - Number of activations per year** **V2G -Average Power Flexibility [kW]** **V2G -Average Energy Flexibility [kWh]** **V2G -Average activation duration** **Flexibility load ratio can be evinced by the Average Power flexibility divided by the reference Peak Load for both technologies.**		meaningful as the current reference is the not existence of flexibility services in the demonstration area.	achieved at TT level as to be integrated with the results from IS 2.1. This will give an overall estimation of the impact of the demonstration activity.
Investment cost	This indicator is less clear yet, as the definition of the cope and perimeter of this KPI is yet not harmonised among the LH cities.			

5.2.4 Remarks

The overall monitoring of the achievements of the actions of IS 2.1 will be mainly granted by the centralization of information via EDF S&F, AGREGIO and ENEDIS. These companies will systematically collect the information, store it and post-process it, in order to provide the required data in WP9.

In IS 2.2, the monitoring process will be part of the DHCN operation practice. All data will be centralized by the DHCN operator at the production site. This will ensure all needed data can be queried for the assessment of the selected KPIs.

The Battery Energy Storage System in IS 2.3 will be monitored through the collection of data streams that will be stored locally in UNS/IMREDD and ensure the consistency of a historical database for the post-evaluation of the implemented control strategies. A few parameters regarding data acquisition from the stationary and EV battery storage must be defined.

5.3 Gothenburg

The data provided in the following paragraphs are extracted from deliverable D7.4: Launch of T.T2 activities on Smart energy management and storage for flexibility (Gothenburg) [16] More detailed information about these integrated solutions can be found in this source.

5.3.1 Monitoring plan for measure 2.1 a 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage

Real estate company Akademiska Hus will demonstrate how a DC system can give advantages when local electricity is produced with (PV) and stored in battery systems. The demonstration is in Akademiska Hus new building called "A Working Lab" (AWL), which is an office building of approximately 12 000 m², and an innovations arena. The DC/battery/PV project is incorporated in AWL, and the PV is located on the roof of nearby building SB3 and the roof of AWL.

The market for DC products is small today, and this demonstration will test how the market can deliver the products and how much effort it takes. Furthermore, the energy efficiency for production and consumption of electricity in the AWL building will be measured, and the DC and AC efficiency will be compared.

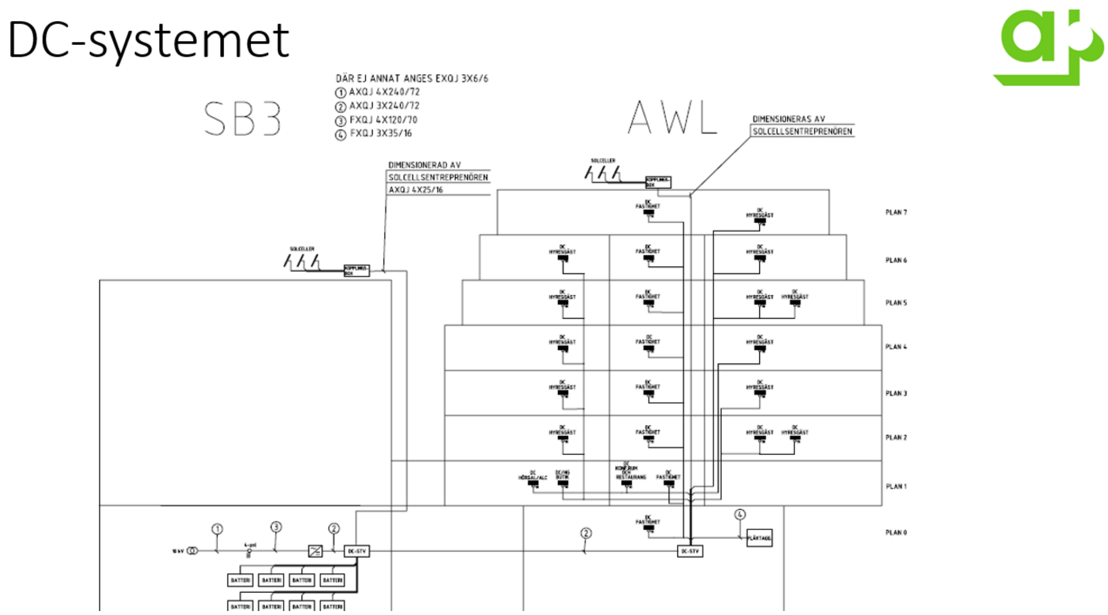


Figure 45 DC/ solar panel and battery system in the AWL building

The measurement system built in AWL building will be used for the evaluation. The data will be stored in the measurement computer, and the calculations will be in reports for IRIS and Akademiska Hus. Data will be stored in Akademiska Hus systems like Wepport, Energiportalen.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.2.

Table 40 Summary-list of KPIs and related parameters for Measure 2.1 a 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage

KPI	Parameter(s)	Data source	Baseline	Target
Peak Load reduction	Charging power to the batteries. [W]	Smart meter	Consumed electricity in the building minus the used PV electricity, which is what should have been bought without the battery and dc systems.	80% peak power reduction
	Charged electricity to the batteries. [Wh]	Smart meter		
	Discharging power from the batteries. [W]	Smart meter		
	Discharged electricity from the batteries. [Wh]	Smart meter		
Storage Capacity Installed	Storage capacity in the battery [kWh]	Smart meter	0 kWh	200 kWh
Degree of energy self-supply by RES	Locally produced electricity kWh/year	Smart meter	0 kWh	10%
	Total consumption of electricity kWh/year	Smart meter		

5.3.2 Monitoring plan for measure 2.2: 200 kWh PCM (Phase Change Material) cooling storage

The expansion of Chalmers Campus Johanneberg area with new buildings will contribute to an increase of power and energy demand in the area. Future energy systems and power loads will be a major part of the energy costs. Reducing power demand is one of the measures to achieve energy-efficient buildings.

The purpose of PCM Cooling Storage is to reduce the peak cooling power demand by storing cooling energy in Phase Change Materials (PCM) in a Thermal Energy Storage (TES). The PCM storage is loaded from Chalmers campus cooling system KB0. It is discharged to AWL KB11 return pipe system.

In this demonstration, the energy efficiency in cooling storage in a PCM material will be measured. Efficiency is measured in storage loses and in investment cost. The market for PCM product is small today. In this project, Akademiska Hus will test how the market can deliver the products and how much effort it takes. The PCM will be evaluated and compare it with a cooling machine. When all data is available, a life cycle cost calculation will be performed.

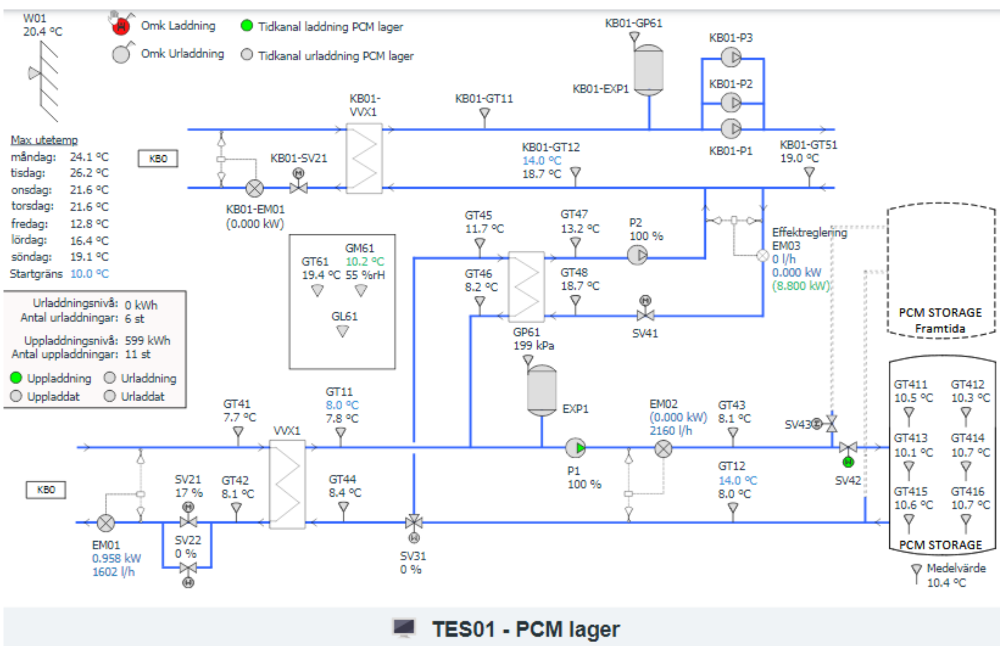


Figure 46 Principle of PCM storage

The measurement system built in the AWL building will be used for the evaluation. The data will be stored in the measurement computer and the calculations will be in reports for IRIS and Akademiska Hus.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.

Table 41 Summary-list of KPIs and related parameters for Measure 2.2 200 kWh PCM (Phase Change Material) cooling storage

KPI	Parameter(s)	Data source	Baseline	Target
Storage Capacity Installed in PCM cooling storage	Output thermal energy from PCM storage	Smart meter	0 kWh	Target for step 1: 200 kWh/50 kW for 4 h Target for step 1+2: 800 kWh/150 kW for 4 h
Peak Load reduction	Output cooling energy power (kW) from PCM	Smart meter	0 kW	Target for step 1: 50 kW Target for step 1+2: 150 kW
	Electricity power used for cooling (kW) calculated from cooling production in chillers	Smart meter		Target for step 1 25 kW (el) Target for step 2 75 kW (el)
Storage energy losses	Input cooling energy [kWh]	Smart meter	Losses from eq. water storage	
	Output cooling energy power from PCM [kWh]	Smart meter		

5.3.3 Monitoring plan for measure 2.3 Low temperature DH 45/30 system for six buildings

This measure considers connecting the buildings in Viva with a low temperature heat transport network.

Since it is such an integral part of the energy system of Viva, it is difficult to find a way of quantifying the result of this individual measure.

The energy system in its entirety will be monitored and evaluated, primarily within the scope of TT#1 and as described in D7.3. However, for this individual demonstrator, it is not possible to construct a baseline for meaningful assessments.

5.3.4 Monitoring plan for measure 2.4 Integration and evaluation of a 200kWh energy storage

This measure explores the re-usefulness of vehicle batteries in stationary applications.

The battery storage in Viva consists of 14 lithium-ion batteries that have previously been used to power buses in public transport in Gothenburg. The batteries, and the storage and the flexibility that they bring, make it possible for a larger portion of the electricity that is generated in Viva to also be used in Viva. This stationary application of the batteries is a perfect example of the type of extended service life that vehicle manufacturers like Volvo are seeking to improve the value and overall sustainability performance of their products. An overview of the batteries' life can be seen in the figure below.

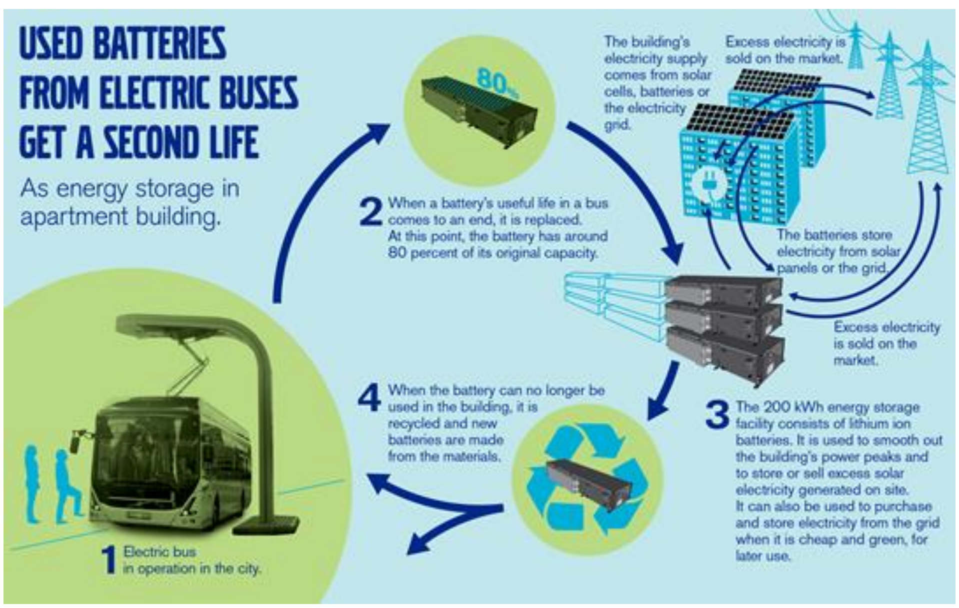


Figure 47 The circularity of the batteries

The monitoring will be carried out by Riksbyggen in close cooperation with the utility company Göteborg Energi who has access to most of the data through their work with the overall energy management system, see measure 1.6.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.

Table 42 Summary-list of KPIs and related parameters for Measure 2.4 Integration and evaluation of a 200kWh energy storage

KPI	Parameter(s)	Data source	Baseline	Target
Peak Load Reduction	Used electricity [Wh]	Smart meters	Consumed electricity in the building minus the used PV electricity, which is what should have been bought without the battery.	25%
	Purchased electricity [Wh]	Smart meter		
	Used PV-generated electricity [Wh]	Smart meter		
Battery Degradation Rate	Energy taken out from the batteries over time [Wh]	Smart meter	Zero degradation.	Degradation rate per energy taken from the battery and degradation rate per year.
	Time in use [years]	N/A		
	Load cycles of the batteries [-]	N/A		
	Storage capacity in the batteries [Wh]	Battery specifications from supplier and/or smart meters.		
Storage Capacity Installed	Storage capacity in the batteries [Wh]	Battery specifications from supplier and/or smart meters.	0 kWh	200 kWh

5.3.5 Remarks

Akademiska Hus demonstrations in TT2, IS2.1 and IS2.2, will up and running on time. The PCM storage installation in IS2.2 is made in steps where a second step, involving more cooling storage, will hopefully be implemented after the evaluation of step 1. The next step for demonstration IS2.1 is to test the system together with other systems in the building and between DC-battery-solar panels. Demonstration IS2.2 will also be tested together with the other systems in the building and between PCM components. When the testing of these systems is done the operation and evaluation will start.

6 Monitoring plans of TT3 Smart e-Mobility

6.1 Utrecht

The data provided in the following paragraphs are extracted from deliverable D5.5: Launch of T.T.3 activities on Smart e-mobility (Utrecht) [17]. More detailed information about these measures can be found in this source.

6.1.1 Monitoring plan for measure 3.1: V2G e-cars

The Mobility as a Service (MaaS) "We Drive Solar" car-sharing system will be demonstrated in the LH demo district by means of 14 solar-powered e-cars delivered by Renault. The subscription models currently offered in amongst others the Lombok area will be applied for the rollout of the system in Kanaleneiland-Zuid. This roll-out is demand-driven, implying that the introduction will follow a phased approach with more cars being added once the demand is established for the first ones. The first car will be placed at the local innovation hub Krachtstation. Together with local partners, citizen engagement activities will be organised to investigate demand for car-sharing services.

Main component	Technical specification
V2G e-cars	• Renault Zoe by We Drive Solar MaaS • Range up to 395 km • 22 kW fast AC charging, later in project V2G bidirectional charging once available

Also, Bo-Ex will procure 4 e-vans to replace its existing vans for maintenance and service use. V2G e-vans are not expected on the market in the project.

Main component	Technical specification
e-vans	• Renault Kangoo Z.E. Maxi • Range up to 200 km • 44 kW motor

LomboXnet is monitoring the driven km by all e-cars as part of their monitoring system, as well as the number of shared e-cars in the district. For calculation of the emission reductions, the same conversion factors will be used as those used in the DoA. Project partner Civity has a data connection to the car sharing system that will enable it to transfer driven km data for KPI evaluation. This will be implemented in the year 2020.

Table 43 Summary-list of KPIs and related parameters for Measure 3.1 V2G e-cars

KPI	Parameter(s)	Data source	Baseline	GA- Target
NOx emission reduction	Number of kilometres driven by the car-sharing fleet	LomboXnet monitoring system	same amount of km/year driven by comparable fossil fuel cars	1 ton in 5 years
	NOx emission factors for EVs	DoA		
	NOx emission factors for comparable fossil fuel cars	DoA		
Fine particulate matter emission (FPM)	Number of kilometres driven by the car-sharing fleet	LomboXnet monitoring system	same amount of km/year driven by comparable fossil fuel cars	0,02 ton in 5 years
	FPM emission factors for EVs	DoA		
	FPM emission factors for comparable fossil fuel cars	DoA		
Carbon monoxide emission reduction	Number of kilometres driven by the car-sharing fleet	LomboXnet monitoring system	same amount of km/year driven by comparable fossil fuel cars	3 ton in 5 years
	CO emission factors for EVs	DoA		
	CO emission factors for comparable fossil fuel cars	DoA		
Carbon dioxide Emission Reduction	Number of kilometres driven by the car-sharing fleet	LomboXnet monitoring system	same amount of km/year driven by comparable fossil fuel cars	308 ton in 5 years
	CO_2 emission factors for EVs	DoA		
	CO_2 emission factors for comparable fossil fuel cars	DoA		
	Number of vehicles available for sharing	LomboXnet monitoring system	Number of shared cars at start of project	18 cars

Access to vehicle sharing solutions for city travel	Number of inhabitants of target area	Municipality		
Yearly km driven in e-car sharing system	Number of kilometres driven by the car-sharing fleet	LomboXnet monitoring system	Amount of km by shared cars at present	270,000 km per year

6.1.2 Monitoring plan for measure 3.2: V2G e-buses

IRIS partner QBuzz is relocating its bus depot from the Europalaan in Utrecht to Westraven, a district just south of the IRIS district in Kanaleneiland-Zuid, and at the Remiseweg, across the Amsterdam-Rijn channel from Westraven. Smart charging of the buses will be tested, but V2G e-buses and chargers are not available. QBuzz will investigate the options for V2G charging at its new bus-depot with the objective to demonstrate and optimize smart charging. At this moment, 13 e-buses are in operation by QBuzz and by summer 2020, this number is expected to have grown to 68. Actual implementation of 68 e-buses on city level is now planned for 2020 and on regional level, as the province of Utrecht is working on emission free transport by 2028, the upscaling to 143 e-buses is well underway.

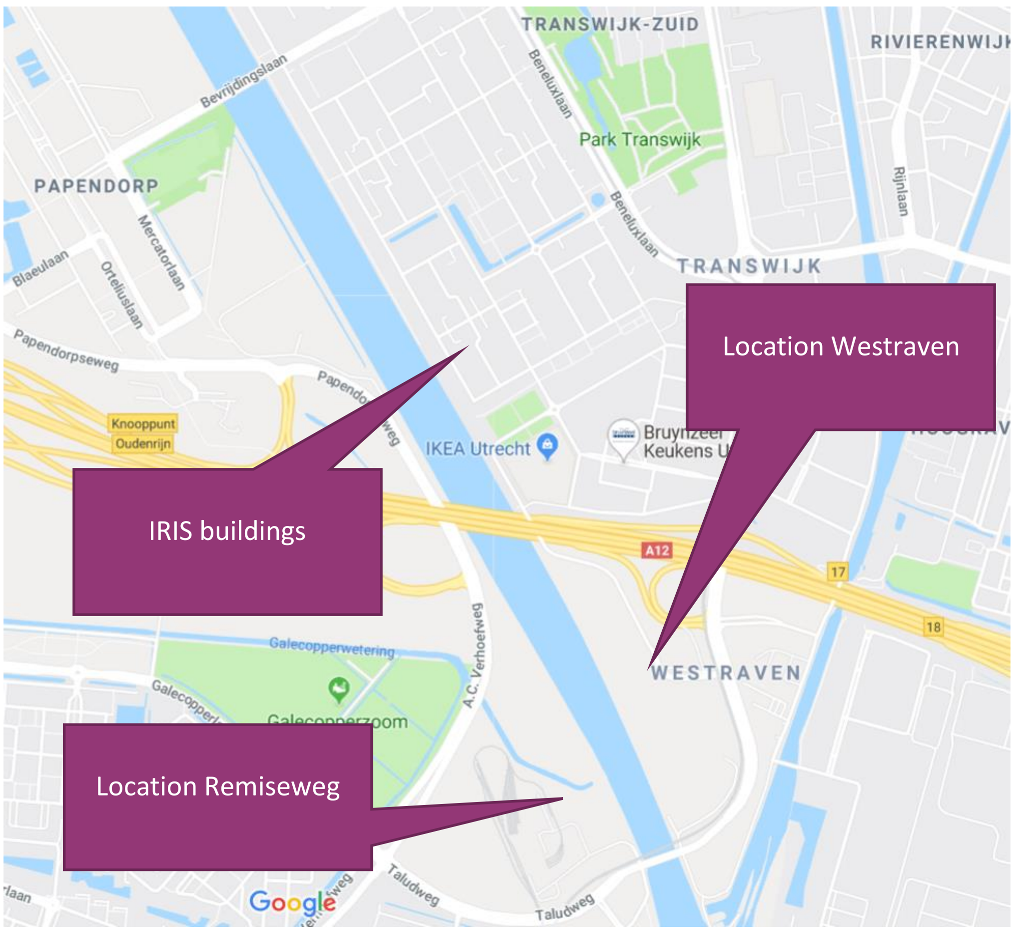


Figure 48 New e-bus charging locations of QBuzz

Main component	Technical specification
Qbuzz: electric busses: batteries and charging	• Bus length: 12 meters or 18 meters • Bus width: 2.55 meters • Battery capacity: 250kW, 362 kWh depending on type • Fast charging power: 450 kW • Continuous recharging 10 to 100 kW, OCPP 1.6 (Open Charge Point Protocol)

The buses feature detailed monitoring and data storage equipment based on the ViriCiti platform, which monitors in the buses and in the chargers many parameters including voltage, currents, state of charge, energy charged, accelerator usage and other parameters. QBuzz has appointed a Data Scientist to analyse the data being generated and started a research cooperation project with University Utrecht, LomboXnet and USI to research the business case of V2G-buses and chargers.

Table 44 Summary-list of KPIs and related parameters for Measure 3.2 V2G e-buses

KPI	Parameter(s)	Data source	Baseline	GA- Target
NOx emission reduction	Number of kilometres driven by E-buses	ViriCity monitoring system	same amount of km/year driven by comparable fossil fuel buses	22 ton in 5 years
	NOx emission factors for E-buses	DoA		
	NOx emission factors for comparable fossil fuel buses	DoA		
Fine particulate matter emission	Number of kilometres driven by E-buses	ViriCity monitoring system	same amount of km/year driven by comparable fossil fuel buses	0,26 ton in 5 years
	FPM emission factors for E-buses	DoA		
	FPM emission factors for comparable fossil fuel buses	DoA		
Carbon monoxide emission reduction	Number of kilometres driven by E-buses	ViriCity monitoring system	same amount of km/year driven by comparable fossil fuel buses	1,6 ton in 5 years
	CO emission factors for E-buses	DoA		
	CO emission factors for comparable fossil fuel buses	DoA		
Carbon dioxide Emission Reduction	Number of kilometres driven by E-buses	ViriCity monitoring system	same amount of km/year driven by comparable fossil fuel buses	4785 ton in 5 years
	CO_2 emission factors for E-buses	DoA		
	CO_2 emission factors for comparable fossil fuel buses	DoA		

6.1.3 Remarks

In general, activities are progressing according to plan, except that low demand for the V2G shared e-cars is starting to pose a risk that intended numbers will not be reached. There are some deviations: the demand for shared e-cars is lower than expected which may result in a lower number of shared e-cars in the district, and there are no V2G smart charging technologies for e-buses on the market yet. the overall ambitions of TT#3 of demonstrating smart e-mobility are not affected.

Important lessons learned include:

- The demand for shared vehicles in social housing segment is lower than in other segments of society and is until now not easy to activate.
- E-buses are developing strongly on city level.
- Smart e-mobility systems and V2G charging are quickly developing on city level (and buses and V2G) and IRIS is a main driver of these developments.

The team is considering new and extra actions to be taken to increase the interest in shared e-cars in the district, together with local stakeholders and in collaboration with the citizen engagement activities. At the same time the underlying reasons will be further analysed. The new research on e-buses and the potential for smart charging and V2G operation will be started. Production of V2G shared cars will take off in 2020; shortly after that the first cars are expected to be tested in IRIS.

6.2 Nice

The data provided in the following paragraphs is extracted from deliverable D6.5: Launch of T.T.3 activities on Smart e-mobility (Nice). More detailed information about these integrated solutions can be found in this source.

6.2.1 Monitoring plan for measure 3.1 Smart Solar - V2G - EV charging

This measure addresses the deployment of a smart charging infrastructure (hard- and soft-ware). Smart charging deals charging system where electric vehicles, charging stations and charging operators share data connections. It aims to monitor, manage, and restrict the use of charging devices to optimize energy consumption. By monitoring a large pool of charging stations equipped with fast charging points, belonging to both public and private networks, it is expected to provide more flexibility to the public electricity grid not only by implementing power-shaving and shifting (V1G) but also other energy services as i.e. primary or tertiary reserves (V2G). The smart integration of such strategies should lead to the optimization of the total energy consumption, and possibly generate a new income stream for EVCI operators and owners.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below.

Table 45 Summary-list of KPIs and related parameters for Measure 3.1 Smart Solar - V2G - EV charging

KPI	Parameter(s)	Baseline	Target (as described in DoW or declared)
Carbon dioxide Emission Reduction	REF electricity CO2 CHP plant [tCO2eq/MWh] REF electricity CO2 [tCO2eq/MWh] Flexibility volume [MWh] **This provides Electricity CO2 savings from flexibility provision via the "replacement method" so, expressed as the electricity CO2 saving between producing the same service volume with a gas CHP plant as compared to low/zero-carbon solution as EV charging management.**	The baseline is the retro calculation of the volume of carbon emission that would have been produced by Gas fired CHP plants to provide the same power and volume of flexibility services as under IS 3.1	This indicator will further contribute to the assessment of IS 2.1.
Peak load reduction	MAX elec peak [MW] REF elec peak [MW]	The reference electricity peak load shall be most likely estimated. Moreover, the	This indicator will further contribute to

	By dividing the measured peak load by its reference electricity peak load, the % of peak load reduction can be calculated	question is pending on how to deal with an uneven charging poles distribution in the demonstration area. An "average peak load" value might apply.	the assessment of IS 2.1.
Storage capacity installed	Cumulative V1G/V2G BESS capacity activated [kWh] **This will give the total cumulative volume of energy that has been stored, thanks to the smart charging.**	A reference case would not be meaningful as there's actually no smart charging operation to refer to.	This indicator will further contribute to the assessment of IS 2.1.
Increased system flexibility for energy players/stake holders	**Number of activations per year** **Average Power flexibility [kW]** **Average Energy flexibility [kWh]** **Average activation duration** **Flexibility load ratio can be evinced by the Average Power flexibility divided by the reference Peak Load.**	A reference case would not be meaningful. Therefore, the indicator should simply disclaim capacity, volume, frequency and duration of provided services. For the latter the reference value for "Peak load reduction" applies	This indicator will further contribute to the assessment of IS 2.1.
Reduced energy cost for custumers	REF Expenses electricity [EUR] Electricity bill [EUR] Income energy services [EUR] **Thanks to this indicators, the reduced energy costs incurred by the reduced energy expenses via peak load shifting and shaving will be accounted for. Moreover, the potential revenue stream from flexibility services can be accounted for.**	The reference value is the previous year annual energy expenses for the EVCI operation for involved stakeholders.	This indicator will further contribute to the assessment of IS 2.1.
Number of e-charging stations deployed in the area	**Number of charging poles which have been connected to the smart charging platform.**	N/A	
Investment cost	This indicator is less clear yet, as the definition of the cope and perimeter of this KPI is yet not harmonised among the LH cities.		

6.2.2 Monitoring plan for measure 3.2 Innovative Mobility Services for the Citizens

This Measure addresses the optimization of the operation of a shared EV fleet by coupling the booking and forecasting of the use of EVs to a smart charging management of the EVCI. The benefits are a higher utilization rate of shared EVs, thus an increased turnover of vehicles, a consequent reduction of the ratio between the number of required charging stations and the number of EVs. It is expected that such an enhanced carsharing exploitation system should favour the implementation of smart charging services in a more reliable and/or efficient manner.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below.

Table 46 Summary-list of KPIs and related parameters for measure 3.2 Innovative Mobility Services for the Citizens

KPI	Parameter(s)	Baseline	Target (as described in DoW or declared)
Carbon dioxide Emission Reduction	Emission factors of a fuel car (average) $KgCO^2eq$/year/vehicle $KgNO^2eq$/year/vehicle KgPM2.5/year/vehicle KgPM10/year/vehicle	The baseline is the retro calculation of the quantity of air pollutants that would have been produced by fossil fuel vehicles to provide the same car rides than the shared EV fleet.	This indicator will further contribute to the assessment of IS 3.2.
Mobility efficiency	Number of subscribers to the carsharing service Number of users of the service Number of booking per user of the service	Number of booking per subscriber to the service	This indicator will further contribute to the assessment of IS 3.2.
Mobility efficiency	Number of carsharing subscribers Number booking/EV/day mileage/EV/day in km	Use ratio of shared EVs before the operation and total mileage per day	This indicator will further contribute to the assessment of IS 3.2.
Fleet availability	Number of vehicles of the fleet available at any time for booking	Number of vehicles available before the operation	This indicator will further contribute to the assessment of IS 3.2.

Remarks

The overall monitoring of the achievements of the actions in measure 1 will be mainly granted by the centralization of information by NCA via EDF and VULOG management platforms and its post processing. For the overall volumes and peak energy consumption and injection metering on the electric grid, ENEDIS could provide the aggregation of the information stored in their data centers. For a fine grain aggregation

level, the authorization from the users of shared vehicles shall be granted to use of the personal data related to their bookings and trips. To assess all detailed information "behind the meter", only NCA should be involved to grant access to ENEDIS for the same reasons as mentioned previously.

The monitoring of the execution of the actions of measure 2 will mainly rely on the information collected by the CIP from the supervision platforms of IZIVIA ("Prise de Nice" public EVCI operation), of EDF (NCA private EVCI operation + smart charging platform) and VULOG (carsharing management). All data from the carsharing operation, including any statistics related to vehicles and booking, will be provided by the carsharing management platform. For a fine grain aggregation level preventing anonymization, the authorization from the users of shared vehicles shall be granted to use the personal data related to their bookings and trips.

6.3 Gothenburg

The data provided in the following paragraphs are extracted from deliverable D7.5: Launch of T.T.3 activities on Smart e-mobility (Gothenburg) [18]. More detailed information about these integrated solutions can be found in this source.

For both the “Easy to be” EC2B for tenants in the apartment building Brf Viva and for the employees on Campus Johanneberg the ICT-solution used in the project is a necessary prerequisite for being able to demonstrate a Mobility as a Service(MaaS) service, but it has a subordinate role. The EC2B service integrates several different mobility solutions within one app. To start with, the following are included: e-cars, e-bikes (normal bikes as well as cargo bikes), light e-vehicles and public transport. Further on, taxi, rental cars and municipal bike sharing might be added. The APIs (Application Programming Interfaces) of all these services are integrated into the EC2B app, which becomes their user interface, while still clearly marketing their brand names.

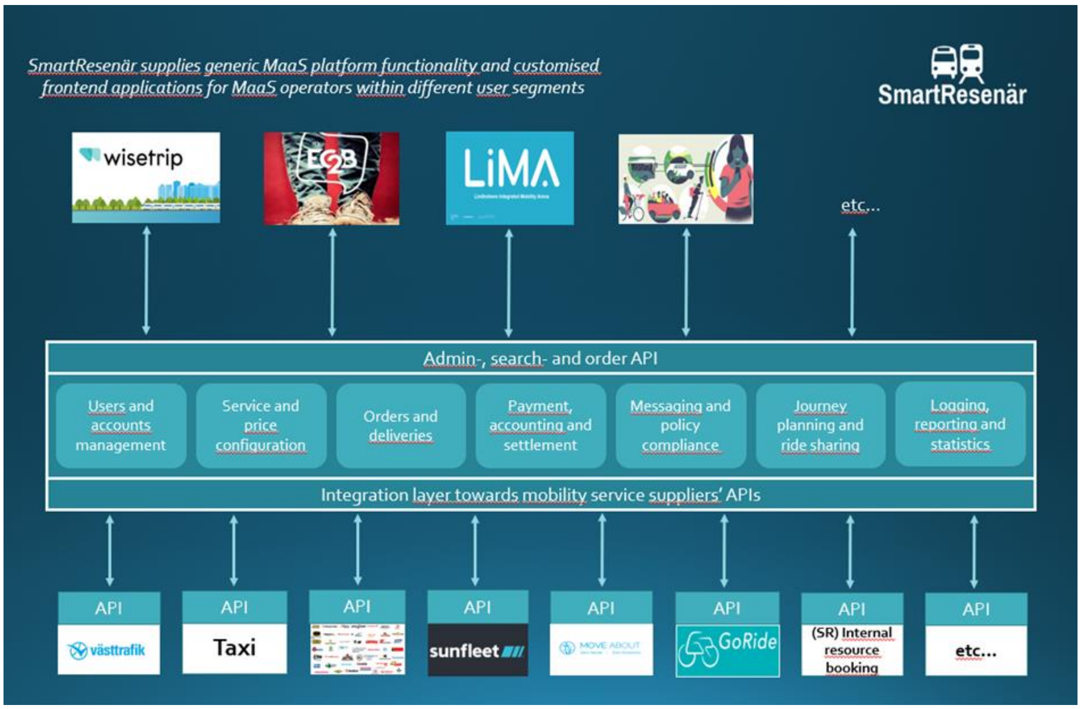


Figure 49 SmartResenär generic MaaS ICT platform used in the project

6.3.1 Monitoring plan for measure 3.1 EC2B for tenants in Brf Viva

The Mobility as a Service (MaaS) concept “Easy to be” (EC2B) offers customers an attractive alternative to owning their own car, allowing easy access to a variety of transport modes (e-cars, e-bikes, public transport etc) in connection to where customers live or work. In demonstrator #1 EC2B is implemented for tenants in the 132 apartments in Brf Viva in Gothenburg, where no private car parking is available.

The city of Gothenburg works to create favourable conditions for property developers who work with innovative housing concepts that reduce the demand for private car ownership. There is no regular parking included but in exchange, the property developer is to implement other measures that reduce the need for private car ownership. Residents will have exclusive access to 4 electric cars (to start with

Renault Zoe, later on one or two of these might be exchanged for somewhat bigger e-car models), 2 light e-vehicles, 4 electric cargo bikes and 5 electric bikes, as well as charging infrastructure for all types of e-vehicles (55 recharging polls for e-bikes, 6 for e-cars and 2 for light e-vehicles).

Figure 50 E-cars being charged in car port at Brf Viva

Figure 51 Some of the shared electric bikes in Brf Viva, including both ordinary e-bikes and cargo bikes. Helmets can also be borrowed

Trivector is responsible for providing data for this measure.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.

Table 47 Summary-list of KPIs and related parameters for Measure 3.1 EC2B for tenants in Brf Viva

KPI	Parameter(s)	Data source	Baseline	Target
Carbon dioxide Emission Reduction	Km driven by tenants	Travel survey	Calculated based on travel survey data from equivalent area and register data on CO_2 -emissions from Swedish vehicles	1040 tonnes reduction in 5 years
	Km driven in e-car sharing system	Data from car sharing provider(s)		
	Average CO_2 -emissions from vehicles used	Data from car sharing provider		
Ease of use for end users of the solution	Ease of use for end users of the solution	Questionnaire	No MaaS solution available to users	
Improved access to vehicle sharing solutions	Access to vehicle sharing solutions	Manual counting of number of vehicles available	Relating to previous avaiability of shared vehicles in the demonstration area	4 electric cars2 light e-vehicles, 4 electric cargo bikes and 5 electric bikes,
Reduction in car ownership among tenants	Car ownership among tenants	Registerdata	Average number of cars/household in area Guldheden = 0,39, statistics from SCB	
Reduction in driven km by tenants	Km driven by tenants	Travel survey	Calculated based on travel survey data from equivalent area	1360500 km/year care mile reduction among tenants and employees in the district
Yearly km driven in e-car sharing systems	Yearly km driven in e-car sharing systems	Data from car sharing provider(s)	0	

6.3.2 Monitoring plan for measure 3.2 EC2B for employees on Campus Johanneberg

In the version of the EC2B service demonstrated at the Johanneberg campus area, it was originally assumed that it would be offered to all end-users in the campus area, both students and employees (15 000 people). However, after thorough discussions with the local partner consortium for T7.5, it was obvious that partners saw clear advantages with demonstrating a version of the EC2B service specifically targeting the needs of the employees in the campus area, instead of launching a more general service open to both students and employees. Hence, employees in the Johanneberg campus area (e.g. tenants to Akademiska Hus and Chalmers fastigheter, the two main property owners in the campus area) will now get access to a light version of EC2B, which includes booking and payment of e-vehicles (e-cars and e-bikes) at several locations around the district, but which does not include specific measures in connection to each building. A variety of transport suppliers already active in the district will provide transportation services (e-car sharing, bike sharing, e-scooters and public transport). Furthermore, a function will be developed within the EC2B app which allows employees to send receipts of their transport expenses (car rental fee, public transport tickets etc.) directly from the app to their employer's economy department in order to reduce administrative procedures.

Figure 52 Potential mobility hubs at Campus Johanneberg.

Data for the measure will be provide by Trivector.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.

Table 48 Summary-list of KPIs and related parameters for Measure 3.2 EC2B for employees on Campus Johanneberg

KPI	Parameter(s)	Data source	Baseline	Target
Carbon dioxide Emission Reduction	Km driven by employees	Travel survey	Calculated based on travel survey data from equivalent area and register data on CO_2 -emissions from Swedish vehicles	1040 tonnes reduction in 5 years
	Km driven in e-car sharing system	Data from car sharing provider(s)		
	Average CO_2 -emissions from vehicles used	Data from car sharing provider		
Ease of use for end users of the solution	Ease of use for end users of the solution	Questionnaire	No MaaS solution available to users	
Improved access to vehicle sharing solutions	Access to vehicle sharing solutions	Manual counting of number of vehicles available	Relating to previous avaiability of shared vehicles in the demonstration area	
Reduction in driven km by tenants and employees in the district	Km driven by employees	Travel survey	Calculated based on existing travel survey data from participating organisations	1360500 km/year care mile reduction among tenants and employees in the district
Yearly km driven in e-car sharing systems	Yearly km driven in e-car sharing systems	Data from car sharing provider(s)	Relating to previous availability of shared vehicles in the demonstration area	

6.3.3 Remarks

In TT3 the EC2B service is up live and a lot of what Trivector and other partners discussed as possibilities and hypotheses has been turned into a functioning service and implemented in real life. Although there is still some way to go before reaching the defined goals, all partners involved are proud to see the EC2B service live, enabling the residents in Brf Viva to make sustainable transport choices tailored to their everyday needs.

As of November 2019, the first round of monitoring of travel behaviour among the residents in Brf Viva (IS3.1) has been finished, and Trivector is about to start analysing this data. This will provide interesting information to further understand how MaaS combined with accommodation effects travel behavior and enable further fine-tuning of the service. The implementation of EC2B in demonstrator is now achieved, and activities that remain to be implemented in demonstrator 1 include carrying out further campaigns to spur use of the service, as well as continued monitoring of the usage.

During the coming year focus will be on developing EC2B for Campus Johanneberg, i.e. for IS3.2. Constructive discussions are going on with the main property owners and employers in the campus area on how to develop the service to cater for the needs of employees in the area. Partners have a clear shared vision of the future mobility on campus and will be able to draw upon the experiences from demonstrator 1 in the work to realize this vision. This work will go into a more intense phase during late 2019 and the spring of 2020, with demonstrator 2 hopefully to be implemented from May 2020.

7 Monitoring plans TT4 City Innovation Platform (CIP)

7.1 Utrecht

The data provided in the following paragraphs are extracted from D5.6: Launch of T.T.4 activities on City Innovation Platform and information services (Utrecht) [19]. More detailed information about these measures can be found in this source.

7.1.1 Monitoring plan for measure 4.1: Monitoring E-Mobility with LoRa network

Deploying and operating EV charging bays is a substantial investment, which requires the most optimal and efficient use for a feasible business case. In the current situation, it is not possible to provide EV-car users and charging pole operators with information about proper or illegal usage of the parking bay. The aim for this use case within the IRIS-project is to create insight in the (in-efficient) usage of parking bays and charging infrastructure.

A sensor will be placed in the parking bay to measure usage. By combining the data from the parking sensor with the data from the charging pole, an information service emerges, monitoring the proper use of the charging bay. The municipality of Utrecht and the Charge Point Operator wish to better understand the problem of inefficient use of the parking bay. This service allows identifying and quantifying inefficient use of the parking bays when the charging bay is occupied, but there is no connection with the EV charging infrastructure. The aim is to investigate if the city can put public chargers into place without making a specific traffic rule for each charging bay by monitoring false usage. This potential safes investment in time and money for taking 2.500 traffic rules and still have efficient utilisation of the chargers.

Parking Sensors:

The LoRaWAN in-ground parking sensor is equipped with triple detection technology - magnetic, ultrasound and infrared detection – in order to increase the accuracy. The sensor is equipped with a replaceable battery (note, other suppliers require replacing the entire sensor, including electronics).

Speed of detection: The sensor performs measurements with a frequency of every 0,5 seconds. The parking sensor, therefore, detects a quick vehicle rotation, namely a car leaving (car1) and another car (car2) entering the parking bay within 5 seconds. This is important to ensure car 2 is not charged for parking duration of car 1.

Figure 53 LoRa Parking Sensor

<u>*Charging poles*</u>

The charging poles used are the public chargers put into place by consortium partner WeDriveSolar. The specification requirements are specified by the PoR of the municipal concession for public chargers. For data processing the OCPI standard is implemented.

Figure 54 WeDriveSolar public charger in Utrecht

Data information services

Using the City Innovation Platform (CIP) the data from the sensors and the connection status is combined. To integrate the sensor data into CIP a specific API is developed by IRIS project partner Civity. To integrate connection data into the CIP the standard protocol OCPI is used. This allows the CIP to obtain data not only from the charging poles used in the IRIS project but also from all available public chargers in The Netherlands, enabling many other services.

Within this project data analysis will be done using Excel or similar software. When other services are developed, a dashboard might be a useful add-on.

KPIs

No specific KPIs are defined for T5.6. The KPIs for the charging infrastructure are reported in deliverable D5.5 (TT#3 Smart e-mobility) [17]. In the next paragraph evaluation point for monitoring the results of the pilot are defined.

Monitoring plan

Figure 55 provides an overview of the data that will be generated and disclosed on the CIP. The sensors measure whether a vehicle occupies the parking space. This status is transmitted to the CIP. Based on the data form the charge point (Last Mile Solutions), the system then verifies whether there is actually a car connected to the charge point at that moment. Together, these data streams result in the following statuses:

1. Charging location unoccupied: No vehicle, no connection;
2. Charging location incorrect use: Vehicle in place, no connection;
3. Charging location correct use: Vehicle in place and a connection.

When connecting or disconnecting a vehicle, all three statuses are scrolled through. In order to keep the data clean, some adjustments are made to the display in the reports:

- When a vehicle arrives, the status will always be set to 2, because it takes some time to connect the vehicle. Status 2 is reported when no vehicle is connected within five minutes. When a vehicle is connected status changes to 3.
- The same applies when an electric vehicle leaves the charging location. Status 2 is reported if the charging location has not changed to status 1 within five minutes.
- Each charging pole has two sockets and two associated charging poles with sensors. A user can connect his vehicle to socket A, but be parked on sensor B. In the report, the socket and parking bay do not have to match, but instead, the number of occupied parking bays and sockets in use are measured.

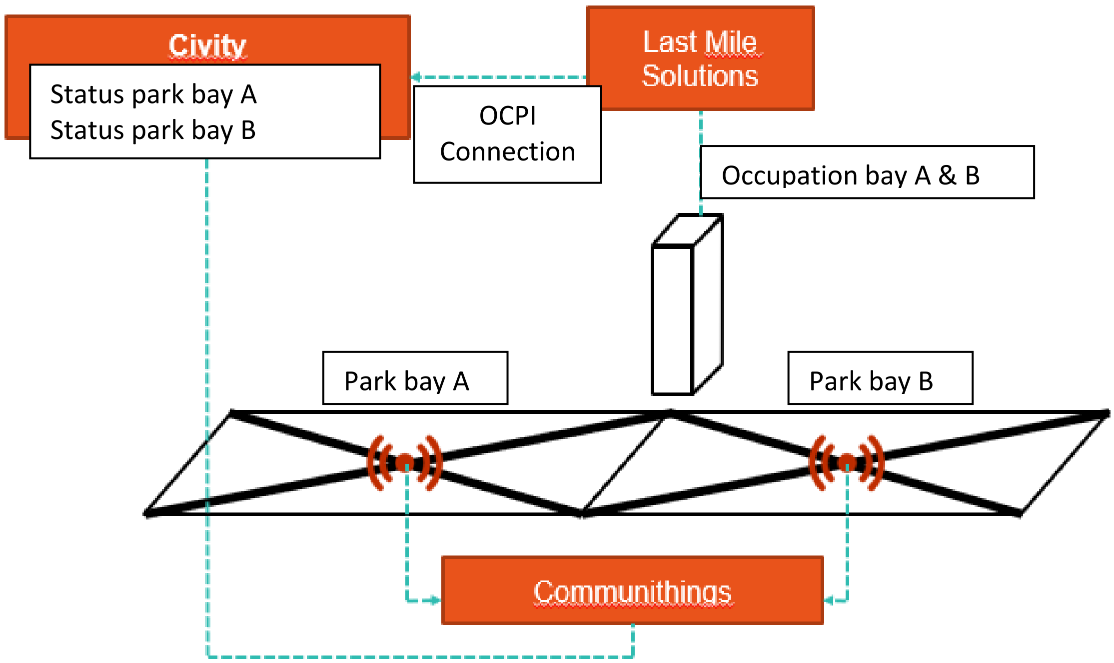


Figure 55 Overview of the data streams that will be generated

Civity will build a dashboard, which will show the "live" status at the different parking bays. In addition to the live monitor, Civity will produce weekly short management reports with the usage statistics of the loading locations. This is includes:

- Number of loading transactions at the loading locations.
- Number of times and percentage of the total number of loading locations times status 2.
- Number of times and percentage of the total number of loading locations times status 3.
- Number and duration of status 2 per loading location.
- Number and duration of status 3 per charging location.

For evaluation of the pilot the following results are expected.

- Expected false use of charging bays with traffic rule = 20%
- Aimed false use of charging bays with sensor and no traffic rule = 25%
- Aimed false use of charging bays with sensors and with traffic rule and additional law enforcement = 5%

Monitoring starts in January 2020 and data will be collected for at least 2 years. After 3 months generated data will be thoroughly analysed and decision will be made on potential development of a data-service.

7.1.2 Monitoring plan for measure 4.2: Smart Street Lighting with multi-sensoring

The GA stated the objective to introduce Smart Street Lighting in Kanaleneiland-Zuid, which encompasses equipping lamp posts with smart multi-sensors. Data collected through these sensors should be used to enhance data driven district policies aimed at reducing/minimizing problems faced by the citizens in public space.

Lamp post as a Modular Hub

Figure 56 Top left and right: Lamp post as modular hub, bottom left:Smart pedestrian crossing

To develop new and innovative sensor and connectivity services on lamp posts it is necessary to rethink the lamp post as a Modular Connectivity and Sensor Hub. The hub is a completely modular structure and can accommodate various functions. Parking machine, e-charging point, public market electricity supply, event connection electricity supply, axle load measurement, smoothness measurement, neighbourhood AEDs, street lighting fixture, camera for surveillance, camera for environment, all kinds of sensors, radar, 5G antenna and equipment. The hub has an electricity connection and fiber optic connection. The hub has been carefully designed and fits the street scene.

To establish this objective a “smart pedestrian crossing” will be realised in Kanaleneiland Zuid including the following design elements:

- A smart pedestrian crossing with luminous white strips with LED lighting. Sensors that detect the proximity of traffic and pedestrian control the light.
- Multiple sensors attached to a Smart Pole on one side of the crossing. The smart pole is a light column in which various functions can be accommodated, such as cameras, measurement sensors for noise levels and air pollution, dynamic lighting, but also traffic detection. The sensors can distinguish between traffic type and speed.

- Collection and assessment of data via the Luminext management system. It must be further determined which communication platform best fits the desired applications. (Lora / 2G, 4G / Powerline or a combination).
- Power supply through the municipal public lighting grid, combined with a solar panel that can feed back into the municipal public lighting grid, recharge a battery and/or is connected to the apartments' smart energy grid (all depending on location and feasibility).

The data collected with the sensor attached to the smart pole will be transferred and disclosed on the CIP. The main purpose of this stage is to learn what it means to implement sensors, connectivity and smart lighting in public space. The municipality needs these lessons to be able to implement third party (commercial) services in the second stage.

KPIs

No KPI's are defined for this data service. The KPI's for the smart street lighting are reported in deliverable 5.3 (TT#1 Smart renewables and near zero energy district).

Evaluation points are:

- What is the demand for information services from the municipality?
- How is the collected data used (public services, policy development, commercial services)?
- What are effects on traffic safety?

Monitoring plan

The measure will generate the following data:

- Traffic sensor data: Sensors that detect the proximity of pedestrian and traffic to control the light). The sensors can distinguish between traffic type and speed.
- Multiple sensor data: cameras, measurement sensors for noise levels and air pollution, dynamic lighting, but also traffic detection.
- Power metering data: through the municipal public lighting grid, combined with a solar panel that can feed back into the municipal public lighting grid, recharge a battery and/or is connected to the apartments' smart energy grid (all depending on location and feasibility).

The data collected will be transferred and disclosed on the CIP. The main purpose of this stage is to learn what it means to implement sensors, connectivity and smart lighting in public space. The municipality needs these lessons to be able to implement third party (commercial) services in the second stage.

Collection and assessment of data will be done via the Luminext management system. It must be further determined which communication platform best fits the desired applications. (Lora / 2G, 4G / Powerline or a combination).

Planning of activities

The placing of the smart lighting and the smart crossing is due for summer 2020.

Table 49 Timing of activities of measure 4.2 – Smart Street Lighting with multi-sensoring

Phase	Activity	Planning
1 Design	Co-creation session	July2019
2 Engineering	Functional specification	Nov-Dec 2019

3 Contracting	Contracting Eneco, contractor for ground word	Jan 2020
4 Realization	Placing smart lighting	Summer 2020
5 Testing	Field test, data connection test	2020-2021
6 Completion	Gathering lessons learned for tender 2021	2021-2022

7.1.3 Monitoring plan for measure 4.3: 3D Utrecht City Innovation Model

The municipality of Utrecht wants to stimulate the use of 3D home and district modelling as a way to increase citizen engagement in urban planning. Experience shows that participation leads to better projects, better considerations and decision-making and more support for finally selected solutions. Among others the municipality wants to enhance citizen engagement in urban planning by offering data services to citizens visualizing the impact of different scenarios for a specific area by making use of data stored in a 3D model brought together in a catalogue through the City Innovation Platform (CIP).

In the first 2 years of the project explored the potential use of 3D home and district modelling as a way to increase citizen engagement. Two different projects are developed within this measure:

1. App "Mijn Woonwijk"
2. Livinglab 'Omgevingsvisie'

App "Mijn Woonwijk"

In the first project developed within measure is a Minimal Viable Product (MVP) *"Mijn Woonwijk"*[3] was developed and tested among a limited number of users. The objective this App is to increasing involvement of citizens in the changes and new projects in their neighbourhood (see Figure 57). The goal is to learn how citizen engagement can be approved by using this digital application.

[3] Detailled report can be downloaded from the IRIS-Utrecht website

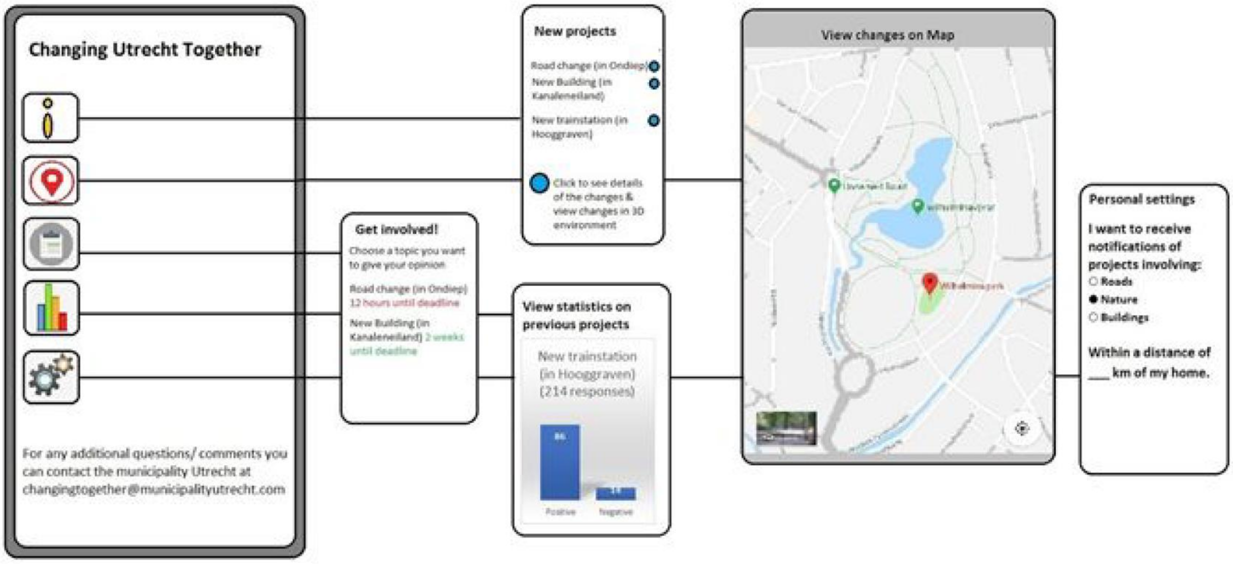


Figure 57 Overview of the MVP "Mijn Woonwijk" developed to test potential for use of 3D data

<u>Living lab 'Omgevingsvisie'</u>

The second project is the development a '3D City Information Model application'. In a first draft IRIS project partner Civity developed a 3D model (see Figure 58) for the Kanaleneiland district in Utrecht. This model is a data-based 3D representation of the district and provides insight into the energy performance in Kanaleneiland. The application includes information from various system and application domains. This was a first attempt of 3D visualization that potentially can support integrated city planning and promote the involvement of citizens.

Figure 58 Screenshot of the 3D city information model application

In a second stage within this project this 3D model will be used within the livinglab “Omgevingswet”; a participative development of urban vision of the city district Kanaleneiland (district Zuid-West). Driven by a new national planning regulation law called “Omgevingswet’, the municipality is now taking a second step into 3D modelling as a planning tool. The city district ‘Zuid-West’, that also contains the neighbourhood Kanaleneiland-Zuid, is selected to be a pilot area for the new urban planning law called ‘Omgevingswet’. The planning law requires an integrated plan and vision from the municipality that gives the citizens frameworks to live, do business and innovate. At the push of a button, a citizen must understand what the municipality is aiming for in a part of the city, how the citizen can contribute to this and why that is important. Transparency is key.

To reach this goal the city aims at developing a 3D city model or digital twin filled with different data sources. In the Living Lab a first draft of this digital twin will be developed. Because it’s a fist version and a pilot one specific theme is chosen as a pilot to work on. This theme is energy or sustainable development. Within the Living Lab a application is developed that will support the development of the new planning vision. What is the question, which data is part of that, and how do we apply the solution within the vision?

Technology and data available via the Spotinfo Environment Server. The data will be stored in the CIP and displayed in the 3D city model (Spotinfo Environment Server).

KPIs

No KPIs are defined for this measure.

Monitoring plan:

Mijn Woonwijk app: The app was tested among a very limited group of users, and interviews among these users revealed that they were positive about the MVP.

Living Lab ‘Omgevingsvisie’: The monitoring plan is to be determined in the Project Start-up Session. We foresee a qualitative evaluation of the use of the 3D-city model for participation purposes by preforming questionaries’ with participants and in depth interviews with the project managers of the Omgevingsvisie.

Planning of activities

Mijn Woonwijk app:

- The project is brought to a closure. No further activities will be done.

Living Lab “Omgevingsvisie”:

- January 2020: defining roll of the 3D model within the participation process.
- February 2020: development of the model. Data collection and declosure of data in the 3D model.
- March 2020: 3 participation sessions with neighbourhood citizens in Kanaleneiland supported by the 3D city model
- April 2020: further development of the Omgevingsvisie supported by de 3D city model data services.
- Summer 2020: qualitative evaluation

7.1.4 Monitoring plan for measure 4.4: Monitoring Grid Flexibility

The developed data service is a DSO Grid Flexibility Service aimed at trading needed local grid capacity by the DSO Stedin. The pilot aims to gain experience with the actual realization of a business case for energy services on assets (battery storage, PV panels, electric vehicles etc.) and how to use these assets within an energy ecosystem as created within IRIS (see TT#2). An underlying goal is to give Stedin and other parties better insight into the potential of flex services for reducing effect on peak loads in the grid and in the future avoiding heavy grid investment.

The flexibility service is developed and tested within the energy system that is installed in the IRIS project in Kanaleneiland Zuid. The district energy system will connect energy consumers, energy producers and energy storage providers, including the following components:

- PV panels on the roofs of the apartment buildings
- Solar V2G charged e-cars
- Stationary battery storage
- Hybrid heat pumps

Specification on the hardware is found in Deliverables 5.3, 5.4 and 5.5.

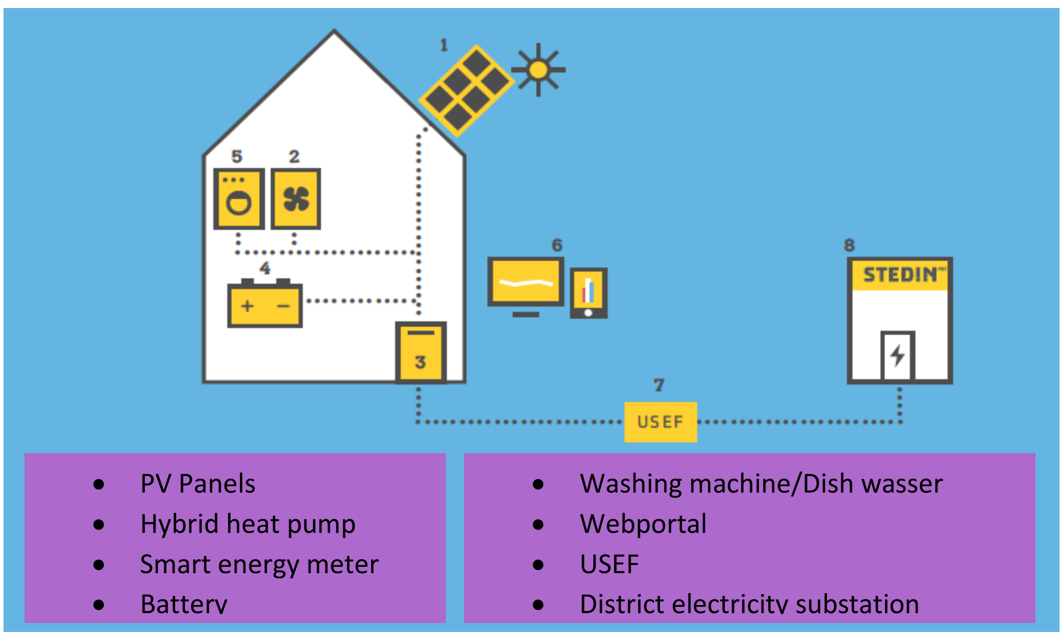


Figure 59 Element of the smart energy system in Kanaleneiland Zuid

The DSO Stedin designed a flex chain for congestion management based on the principles of USEF communication protocols and the GOPACS congestion flex trade market. This chain is the standard for Stedin and with that it is the basis for the pilot within IRIS for the communication protocols for the flex trade. This flex chain, with the adjustments necessary for IRIS and the realization of the data links, will be used for this pilot.

KPIs

No KPI's are defined for this measure. The report on the KPI for the hardware and services are found in Deliverables describing the launch of Transition Track 1, 2 and 3 (D5.3 [11], D5.4 [14] and D5.5 [17]. Points for evaluation are:

- What is the added commercial value of the flex energy services?
- Is the service level of the integrated flex market sufficient?
- Is the marketplace transparent and accessible for different parties?
- Is the USEF communication protocol working sufficiently?

Monitoring plan

In accordance with this proposal, a monitoring plan (where is what recorded and measured and how that data is validated and recorded) an analysis plan (who performs which analyses according to which model / models) is drawn up.

The effect on flex's business case is determined by adding in those cases where Stedin would have called for the flex; there are times when flex is requested by Stedin and the flex offer fits within acceptable costs, adding the costs for Stedin to the realized revenues of the flex. Flexible trading for aggregators in other markets.

Based on the flex offered, in those cases that Stedin would have actually called it, it will be settled with the registered (virtual) tax. This determines the peak reduction.

Planning of activities

Table 50 Planning of activities for Utrecht Measure 4.1: Monitoring grid flexibility

Phase	Activity	Planning
1 Design	Data and market architecture	2019
2 Engineering	Data connections	Q1 2020
4 Operation	Making flex request and offers	2020 – 2023
6 Monitoring	Monitoring and reporting financial effects	2020-2023

7.1.5 Monitoring plan for measure 4.5: Fighting Energy Poverty

Housing Corporation Bo-Ex has the ambition to contribute to improving the financial position of its tenants. A large proportion of its tenants have a relatively low income and, after deducting all fixed costs such as rent and energy, less than 100 euros per month to spend freely. The objective is to develop a data service for tenants of housing corporation Bo-Ex, which gives them control over and/or better understanding of their energy bills, resulting in reduced energy bills and increased disposable income of tenants.

In Q1 2020 Eneco TOON is to be installed in 48 dwellings. TOON is a dashboard giving tenants real-time insight into energy usage and costs. This already provides a big step into control of energy consumption and thus reducing energy poverty. Eneco has an extra data service developed that gives insight into energy spillage/leakage in the household. It tells TOON owners were energy inefficiencies and loss is happening. Based on energy usage profiles, it shows standby losses, inefficient household equipment etc. The app

doesn't give suggestions or advise what measures can be taken and what savings can be made. This is an additional data service that could be developed within IRIS project.

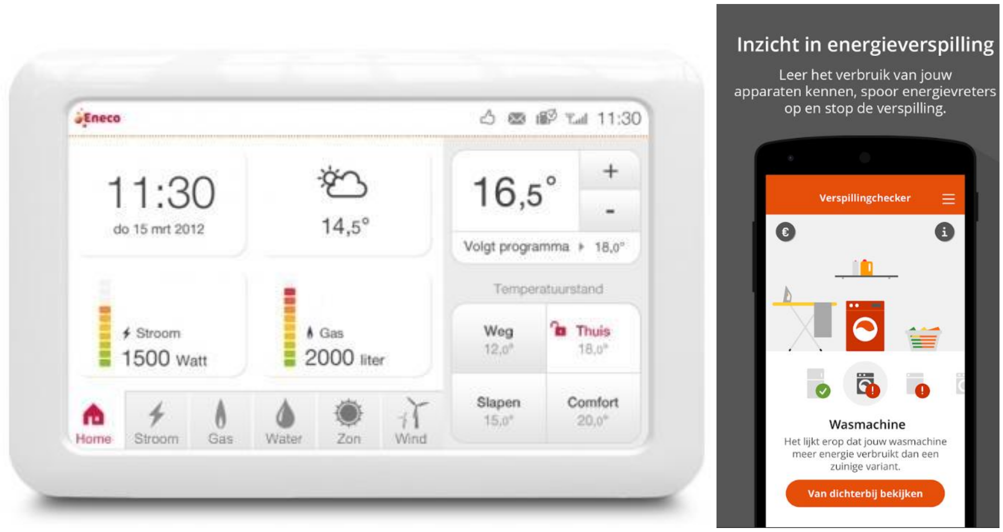


Figure 60 Left, HEMS Eneco Toon, Right, impression of the app that gives insight into energy inefficiencies

<u>*Monitoring plan*</u>

The monitoring will be done with the data obtained with the HEMS TOON installed in the dwellings.

Table 51 Summary-list of KPIs and related parameters for measure 4.5: Fighting Energy Poverty

KPI	Parameter(s)	Data source	Baseline	GA- Target
Reduced energy cost for costumers	Thermal and Electric energy consumption of the demonstration site [kWh/ m²year]	TOON	Current energy consumption	-/- 20%
	Thermal energy and electric reference demand or consumption [kWh/ m²year]	From baseline		
	Current energy price	?		

7.1.6 Remarks

The measures taken in TT4 (City Innovation Platform) for Utrecht are predominantly not easy to cover by the more generic KPIs. For this reason, these measures don't lead to much input for the KPI tool. Nevertheless, the data generated by the measures could provide interesting insights for the partners in the other Lighthouse- and follower cities within the IRIS project and in smart city projects beyond the IRIS umbrella.

Conclusions 4.1: Monitoring E-Mobility with LoRa network

So far, the pilot is developing successfully. Cooperation between involved IRIS project partners Municipality of Utrecht, LomboXnet and Civity is established, leading to task and budget assignment and

planning. Also, procurement of equipment (parking sensors) and cooperation with Communithings is established. After the sensors are put into place and monitoring starts further conclusions can be drawn.

Conclusions measure 4.2: Smart Street Lighting with multi-sensoring

The measure Smart Street Lighting has started off as a solitaire pilot within the IRIS project. The specifications have been made in co-creation with the neighbourhood and the resulting smart pedestrian crossing will be implemented in summer 2020. After installation monitoring and data management can start. The city hopes to derive lessons from this first stage pilot to the city-wide tender for smart street lighting. To make this connection possible a project manager for the pilot (stage 1) and the tender (stage 2) will be assigned.

Conclusions on measure 4.3: 3D Utrecht City Innovation Model.

The first steps developing a 3D City Model have been made. The new planning regulation 'Omgevingswet" and the development of a new Urban Planning Vision for the district offer a perfect opportunity to bring the development to a higher plan and use the model of digital twin in a real live demonstation for a participative development of the Urban Planning Vision of Kanaleneiland. A project team is assembled and the project kick off is early 2020.

Conclusions for measure 4.4: Monitoring Grid Flexibility

For the implementation of Grid Flexibility Services, the assets need to be installed. The energy storage battery will be installed Q1 2020 meaning services will start summer 2020. Possible progress so far has been implementing the necessary data connections.

7.2 Nice

7.2.1 Monitoring plan for measure 4.1 Sensors data collection in air quality

AtmoSud aims to push data (PM10, PM2.5, NO2 and O3) from AZUR forecast air quality platform, daily to CIP. The data will afterward be used to create citizen engagement demonstrators. To provide high spatial and temporal resolution information, AZUR platform needs an update of the monitoring network with micro sensors over the demonstration area and to use real-time traffic data.

Measure#1 will enable to take advantage of collecting data in order to generate citizens' engagement. On the one hand benefits are expected for the air quality evaluation (upgrade AZUR accuracy output, additional local traffic and air quality data, integration of sensors data within a data model). On the other hand, this measure will support citizen engagement. The data collected will be converted into pedagogical tools to raise awareness, enhance behavioral change, improve the quality of urban life etc.

AZUR platform is a part of the forecast air quality system supported by AtmoSud. Modelling team checks everyday output of the system and its compliance with quality objectives. The hourly output from AZUR will be included in the operational system checklist.

Table 52 Summary-list of KPIs and related parameters for measure 4.1 Sensors data collection in air quality

KPI	Unit	Details
Number of connected urban objects	Number	The urban screens in public transports and on the road for awareness campaign and the pedagogical panel provided to the business district will count as urban objects connected with data.
Usage of open data	Likert scale (no unit)	Every data collected by AtmoSud are open and available freely on our base https://www.datasud.fr/ . The data collected for the IRIS project will follow this line required by the French government. Our data are the only references, certified by the Environment Ministry for the Provence-Alpes-Côte d'Azur region. Because of the nature of our work the demonstrations for #TT4 are all based on open data solutions. Currently the accuracy of daily AZUR is close to 100%. A 75% accuracy for hourly AZUR is expected.
Quality of open data	Likert scale (no unit)	
Open data based solutions	Likert scale (no unit)	
Share of RES in ICT power supply	Likert scale (no unit)	The requirements specification for the pedagogical panel and the micro sensors demands the providers to call on RES as much as possible.
Usage of open source software	Likert scale (no unit)	Every development for the AZUR device relies on open source software.

7.2.2 Monitoring plan for measure 4.2 BIM/CIM data display

The Nice Côte d'Azur Metropolis wants to demonstrate the capacity of the multi-scale BIM from the perspective of the City Information Platform (CIP) deployed in the IRIS project and the ability to integrate real-time "hot" data at the urban and scale Buildings. The demonstrator allows you to navigate the urban model that surrounds the new IMREDD building. This urban model covers the territory of NCA between the airport and Carros and allows to visualize the real-time data of the urban sensors as well as the IMREDD building and its energy production and storage equipment

The expected impact may be different according to the target groups (Users of the building, private compagnies, public entities, and citizens) but the main goal is to improve the various stakeholders' global understanding of the urban future of Nice Meridia district in terms of development of physical accommodations and of main activities performed by this area.

Table 53 Summary-list of KPIs and related parameters for measure 4.2 BIM/CIM data display

KPI	Parameter(s)	Baseline	Target (as described in DoW or declared)
Quality of CIP	Number of sensors connected to the CIP	0.There is no sensor connected to the CIP	Number of sensors is more than 50.
Quality of datasets	Number of measurements added each day into the CIP	0.There is no measurements into the CIP	Number of measurements added each day into the CIP are more than 10 000.
Usage of the CIP	Number of consumers using datasets from the CIP	0.There is no consumers	Number of consumers using the CIP are more than 5.
Usage of the dashboard	Number of people visiting the BIM/CIM dashboard at the SCIC	0.The dashboard doesn't exist	Number of annual visits are more than 5.

7.2.3 Monitoring plan for measure 4.3 Services for mobility

This measure is related to the TT#3 demonstration activity in Nice which is focusing on building and optimally coupling systems operating both EVCIs and electric carsharing fleets over a city, aiming at implementing a "Smart Charging" management and testing various related use cases. Smart Charging requires to access real-time and historical data of various profiles to dynamically control and monitor both EVCI and EV management platforms aiming at a better forecasting of the turnover of the shared EVs and an optimal charging plan of EVs to provide both 1|a better service to EV end users by 2| flexibility services to reduce local grid imbalances on the public electricity grid.

All KPIs related to the deployment of the Smart Charging application and of the related services are specified in section 6.2 describing the TT#3 KPIs.

The following table describes the KPIs specific to the Measure#3 corresponding to the support by the CIP of the TT#3 demonstration activities.

Table 54 Summary-list of KPIs and related parameters for measure 4.2 Services for mobility

KPI	Parameter	Baseline	Target
Quality of open Data	Number of datasets compliant with industry or governmental agencies standard data models [integer]	Existing industry standard data models for energy and FIWARE foundation data (device, transportation).	100% of datasets in CIM compliant with existing standards if any.
	Total number of datasets [integer]		
Usability of open data	Ratings of the easiness of use of datasets on the Likert scale [integer, Likert]	N/A – Smart Charging is a new application.	The ambition is a rating of 4 computed from the average ratings from users.
Open data-based solutions	Number of datasets accessed from CIP producer/consumer APIs [integer]	N/A – Smart Charging is a new application.	70% of datasets accessed from the CIP.
	Total number of datasets [integer]		

7.2.4 Monitoring plan for measure 4.4 Services for grid flexibility

This measure will be implemented through measure 2.1 whose specifications are developed in deliverable 6.4. The local energy management system will be implemented on the two buildings: PALAZZO MERIDIA and IMREDD. This system, which is connected to local VRES (variable renewable energy sources), decentralized battery storage and public/private EV charging infrastructure, aims to test different scenarios in order to provide flexibility services to the power grid. Data from the system will be collected and then will be used by the CIP. It should be noted that, all the data will not be uploaded to the CIP because this is very time-consuming and would not add value to the project. Indeed, queries will be made on the two web services provided by the BMS and the EMS only for the data needed to calculate the KPIs. Then, the aggregation and data modelling (data model FIWARE) will be done before pushing these data on the CIP.

KPIs deal with services provided by the battery and energy production devices. For PALAZZO MERIDIA and IMREDD buildings, battery storage system is planned to increase the natural self-consumption of the building (common parts of the building for PALAZZO MERIDIA). Therefore, the monitoring plan is mainly based on the installation of electric power meters located in well-defined places. In addition, the actual

efficiency of the batteries (auxiliary consumption, non-ideal inverter and non-ideal discharge/charge behaviour) should be measured, but also the KPIs for the whole building should be evaluated. Different scenarios will then be tested on these buildings. For example:

- use of the first life battery
- use of the second life battery
- use of the V2G technology

As a result, the KPIs will evolve during the course of the project in order to evaluate with precision these scenarios.

The KPIs related to this measure have been defined in TT1.

7.2.5 Remarks

The monitoring of TT4 measures will be based on data collected through City Innovation Platform.

7.3 Gothenburg

The data provided in the following paragraphs are extracted from deliverable D7.6: Launch of T.T.4 activities on City Innovation Platform and information services (Gothenburg) [19]. More detailed information about these measures can be found in this source.

7.3.1 Monitoring plan for measure 4.1 CIM- City Information Model

Gothenburg wishes to establish a CIM (City Information Model) and use digitalization (and primarily geospatial data) as a driving force. BIM is the existing well-established approach that most construction companies use to model, build and visualize buildings, bridges and streets. CIM can be explained as an extension of BIM (Building Information Model) to encompass an entire city.

A pilot of CIM will be demonstrated with the objective to take the first steps to build our CIM. In the pilot it is intended to take advantage of BIM and the BIM data already delivered to the city, and create a tool to collect, validate, and save the data. The next step, in establishing the CIM pilot, will be to link other types of geospatial data to the collected BIM data. This data should be accessible to people with the correct access rights, and some of it should be provided openly. The data should be possible to visualize in a visualization tool an also be possible to use in design tools used by design teams

The ambition is to demonstrate the City Information Model pilot for the areas around three reference projects, within infrastructure, that provide or will provide BIM data in the pilot. Johanneberg was the original area where the pilot was to be demonstrated, but there will not be any data from infrastructure BIM here, so our main focus is the areas around reference projects, see map in Figure 61. It has proven harder than expected to get projects to share BIM data, which means that one of the reference projects might have to be replaced.

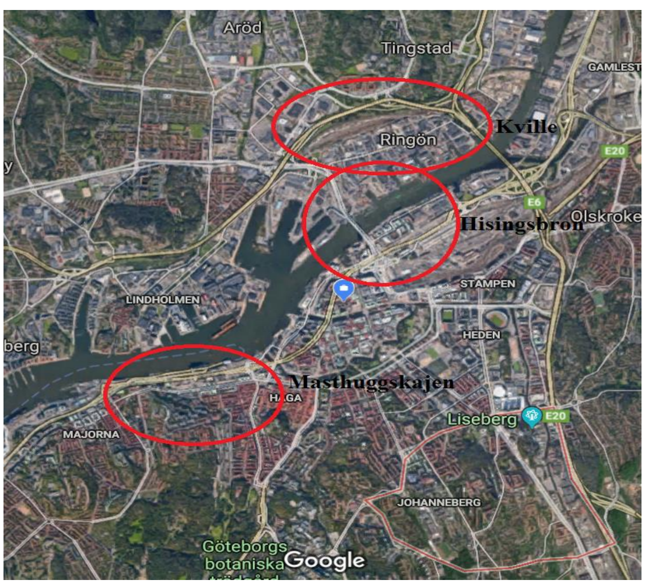


Figure 61 Map over areas for CIM pilot demonstration

The City of Gothenburg is responsible for providing data for this measure. The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.

Table 55 Summary-list of KPIs and related parameters for Measure 4.1 CIM- City Information Model

KPI	Parameter(s)	Data source	Baseline	Target (as described in DoA or declared)
Quality of open Data	Number of datasets that are DCAT compliant in CIM pilot [integer]	Manual check by Gothenburg City	0. There is no CIM Pilot and there are no Datasets in the CIM pilot.	100% of DataSets in CIM pilot are DCAT compliant.
	Total number of datasets in CIM pilot [integer]	Manual check by Gothenburg City		
Open data-based solutions	Number of applications using the API in the CIM pilot [integer]	Manual check, how many applications exist after Innovation Challenge by Gothenburg City.	0. There is no CIM Pilot API and therefore there are no applications using it.	Number of applications using the API are more than 5.
Usage of open source software	Number of full purchased solutions from one single company used [integer]	Manual check by Gothenburg City and Tyréns	0. There is no CIM Pilot and therefor there are no solutions built with or without open source software.	No full purchased solution from one single company is used in the CIM pilot.

7.3.2 Monitoring plan for measure 4.2 Energy Cloud

The purpose of the Energy Cloud demonstrator is to showcase the value of easy access to structured energy data to promote and support the reduction of energy consumption in buildings – initially at Chalmers Campus and in the Gothenburg City and eventually in Sweden, Europe and the rest of the world. The objective includes demonstrating how efficient building management, development and replication of innovative energy services can be accelerated by the application of standardized data semantics across the real estate industry. Energy Cloud will collect energy data from buildings in Gothenburg, including micro-production, EV-charging, building control systems, smart meters and tenants and the data will be categorized according to a unified semantic, RealEstateCore (see https://www.realestatecore.io and https://doc.realestatecore.io/3.1/full.html), that enables easy sharing of data between stakeholders in the building sector and the smart city as well as fast replication of data-driven energy efficiency services.

The primary demonstration area for the Energy Cloud demonstrator will be the Chalmers University Johanneberg campus, see Figure 62. This includes buildings such as HSB Living Lab, with advanced digitalization and comprehensive sensor and energy data acquisition systems, older office and student housing buildings on the Chalmers campus with more standard and generic low-end data acquisition solutions as well as some new and ongoing housing development projects in downtown Gothenburg representing the present standard set up for modern commercial building projects including on-site electricity micro-production, EV charging solutions etc.

Figure 62 A map depiction of the Chalmers Campus Johanneberg. The location of AWL, one of the buildings in the Energy Cloud demonstrator also part of the transition track #2 demonstrator is marked in red

Data for the measure will provided by Metry.

The KPIs that have been selected to assess the success and suitability of this measure are summarized in the table below and related parameters are described in detail in Annex A13.

Table 56 Summary-list of KPIs and related parameters for Measure 4.2 Energy Cloud

KPI Selection	Parameter(s)	Data source	Baseline	Target
Quality of open Data	Number of datasets that are REC (RealEstateCore) compliant in Energy Cloud demonstrator		There is no Energy Cloud demonstrator and there are no Datasets in the Energy Cloud pilot	100% of DataSets in Energy Cloud demonstrator are REC compliant.
	Total number of datasets in Energy Cloud			
Open data-based solutions	Number of applications using the REC compliant datasets in the Energy Cloud demonstrator		There is no Energy Cloud demonstrator and therefore there are no applications using it.	Number of applications using the REC compliant datasets in the Energy Cloud demonstrator are more than 3.

7.3.3 Remarks

The first phase of the CIM project has identified that there are several benefits of requesting and collecting BIM as a city, but the work in terms of collecting BIM data in the city and in other municipalities in Sweden is immature and it is harder than expected to get hold of BIM data from the City of Gothenburg. Uncertainties also remain about how to handle different level of secrecy of the information in the BIM data. One challenge faced is to decide what data to save and what data to discard. To save all data can be challenging for the personnel that needs to manage it.

The CIM pilot is closely related to the City Innovation Platform, and the pilot is designed in such a way that it is dependent on the components of the City Innovation Platform. Thus, a test version of the City Innovation Platform needs to be built to start implementing the CIM pilot. Close cooperation with the work done in WP 4 have been necessary and will continuously be required. The City of Gothenburg has no obligations to implement the CIP and might decide not to. This will affect the way ahead for the CIM pilot components and how they can be used and implemented in a broader perspective.

The CIM pilot is said to be ready for demonstration by the end of 2019. In 2020, an innovation challenge is planned, if the uncertainties regarding what data can be shared are solved. The plan is that the CIM pilot will be evaluated after this Innovation Challenge. Two new KPIs have been added to the evaluation during February 2020. A description of these will be included later, in an updated version D9.5.

The Energy Cloud demonstrator project has gone through a re-boot process due to withdrawal from the initial project partner Chalmers University of Technology. The project is now back on track with a new balanced and motivated stakeholder consortium and has clearly defined objectives in line with the overall IRIS objectives as well as the original objectives for the Energy Cloud demonstrator. In fact, due to the introduction of the real estate company Akademiska Hus into the stakeholder consortium, the focus of the demonstrator has become even more relevant for IRIS from a replication point of view. The project also has an updated project plan, including an updated timeline that indicates a 12-month delay. It´s, however, expected that the project demonstrator still will be implemented and evaluated within the time boundaries of the IRIS-project overall time plan.

Next step of the Energy Cloud project includes completion of a detailed specification of the demonstrator. This process will be concluded during Q4 2019 and trigger the start of the implementation phase as outlined in sub-task 7.6.2.4. The demonstrator implementation is expected to be completed at the end of Q2 2020 thus allow for a 12-month evaluation phase and 6-month sub-sequent replication phase within the overall time boundaries of the IRIS-project.

8 Monitoring plans of TT5 Citizen engagement and co-creation

8.1 Utrecht

The data provided in the following paragraphs are extracted from deliverable D5.7: Launch of T.T.5 activities on Citizen engagement and motivating feedback (Utrecht) [20]. More detailed information about these demonstrators can be found in this source.

8.1.1 Monitoring plan for measure 5.1: Community building by Change agents

In a low-income multicultural district like Kanaleneiland-Zuid, a very significant portion of the population has not finished primary education and has very low written language skills, in any language. As a consequence, people get their information through word of mouth, rather than through written information whether on paper or digital. There are of course also residents who do have better language skills and have no problems consuming written information. Some of them have grown into an informal community or apartment block leader role: they inform their neighbours of current events when they meet in the stairway and when a resident is looking for information, these neighbours are consulted first, before or even instead of professional channels such as the municipality, social workers or the housing corporation. The same citizens regularly visit meetings and events in the neighbourhood for social reasons and to keep track of what is happening in the community. This measure therefore means to inform these community and apartment block leaders of the measures of the IRIS project and their purpose. By informing these community leaders, they can act as change agents for the rest of the community.

A first step in each demonstration district is to identify *change agents*. As part of the first citizen engagement activities for the design of smart street lighting in June 2018 a first mapping exercise was performed by interviewing local housing corporation Bo-Ex, the municipal district office, district cops and other local enforcement professionals and accompanying them on their rounds through the district. The contacts they have provided have been visited individually and via this snowball method almost all the key formal and informal influencers in the district were involved in the preparation of the citizen engagement process. The existing local news agencies, including local Internet and regional TV network ‘U in de Wijk’ (English: ‘You in the district’) and the local volunteer district newspaper developed a keen interest in the project and will be our main partners in the citizen journalism implementation. Next steps:

- The recently formed group of change agents will regularly be consulted and be extended for next citizen engagement activities and regularly consulted e.g. when formulating the communication messages for citizens, follow-up of progress on the integrated solutions that they provided their input for (so far this is the smart street lighting, more integrated solutions will follow later in 2018).
- Where applicable, change agents active in the existing volunteer district new networks will be involved as Citizen Journalists: ‘U in de Wijk’ and the district newspaper have expressed their keen interest.

Throughout the duration of the entire project the network of change agents will be maintained, informed regularly by visiting community events and Bo-Ex meetings with tenants. Figure 63 shows the programme for the scheduled activities for this measure.

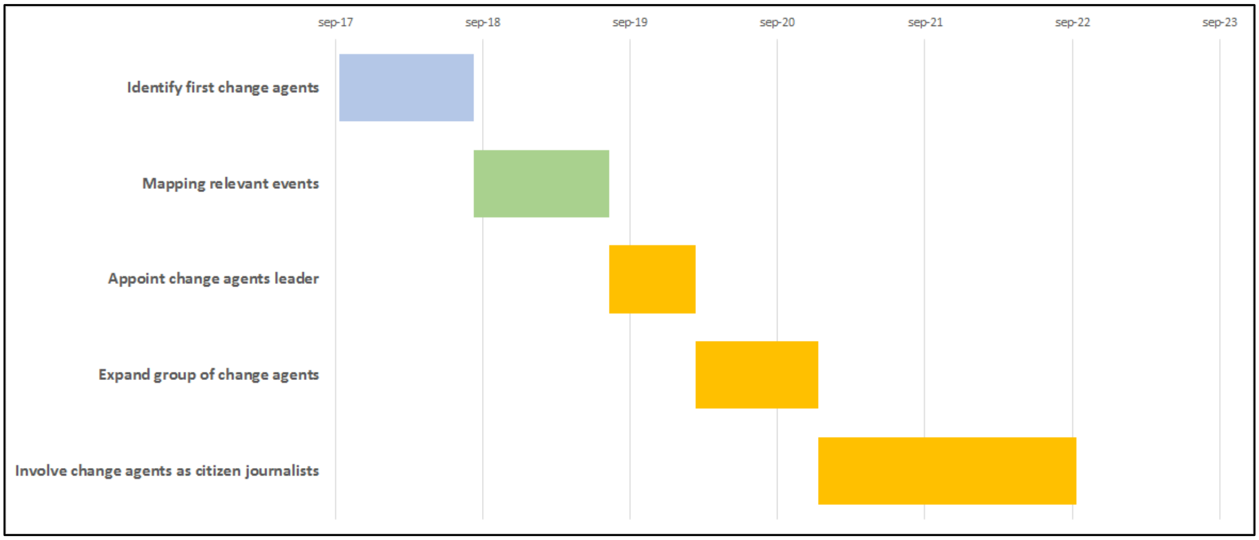


Figure 63 Timing of activities measure 1 - Community building by change agents

Monitoring of this Measure consists of collecting data regarding the amount of change agents, the motivation of the change agents to fulfil this role, amount of people reached by the change agents and the general. With this data, we know why people chose to change agent and the impact of these agents.

Table 57 Summary-list of KPIs and related parameters for Measure 5.1: Community building by Change agents

KPI	Parameter(s)	Data source	Baseline	GA- Target
Increased environmental awareness	Increased environmental awareness	Survey	NA	4 on the scale of 1-5 (Likert Scale)
People reached	Number of citizens reached	Survey	Anticipated advantage before implement-tation of the measure	4 on the scale of 1-5 (Likert Scale)
	Total number of citizens considered as the total target group of the project	Survey		
Local community involvement in planning/ implementation phase	Local community involvement in the planning/ implementation phase	Survey	NA	4 on the scale of 1-5 (Likert Scale)

8.1.2 Monitoring plan for measure 5.2: Campaign District School Involvement

Three schools in the demonstration district will be involved in the IRIS project. To involve children and parents through the primary schools Kaleidoscoop, Da Costaschool and Schatkamer children and their parents will be involved. Professional school MBO Utrecht will be involved by providing training and possibly jobs to youngsters living in the district, while installing and maintaining the integrated smart solutions in the demo district. The premise is that by targeting children and local students their families, living in the district, might familiarize themselves and develop an emotional relationship with the energy solutions their sons and daughters are realizing in their own neighbourhood.

Figure 64 shows the programme for the scheduled activities for this measure.

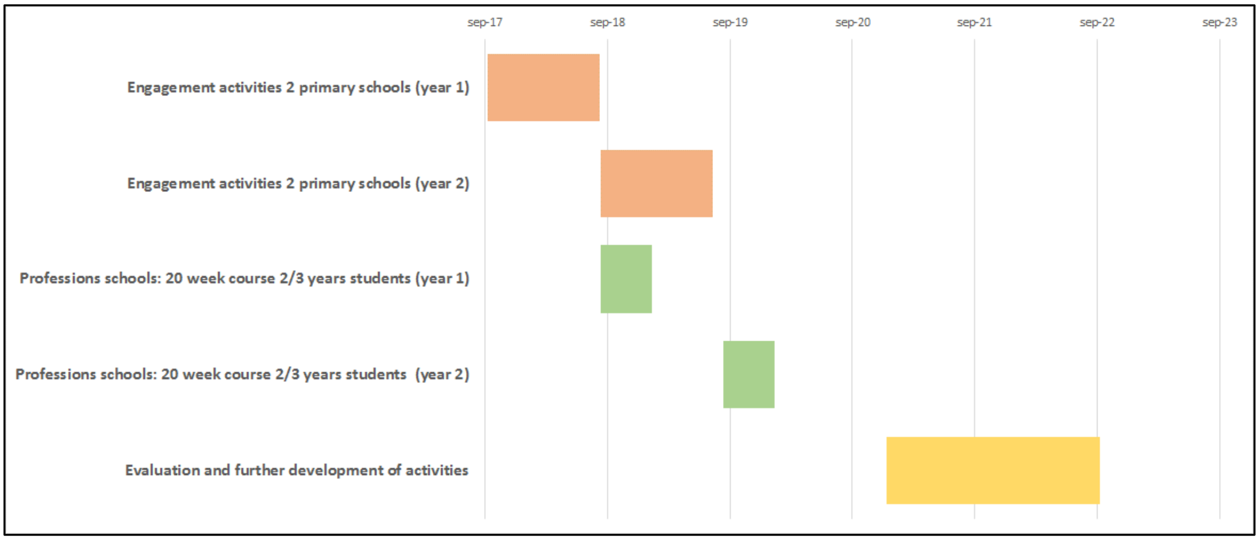


Figure 64. Timing of activities measure 2 - Campaign District School Involvement

Monitoring of the Measure consists of the amount of activities and children on as well the Primary as well the High schools involved in this project. Besides, the impact of the awareness of the tenants of Bo-Ex is measured with inquiries.

Table 58 Summary-list of KPIs and related parameters for Measure 5.2: Campaign District School Involvement

KPI	Parameter(s)	Data source	Baseline	GA- Target
People reached	Number of citizens reached	Survey	NA	80%
	Total number of citizens considered as the total target group of the project	Survey		

8.1.3 Monitoring plan for measure 5.3: Evaluation and co-creation

This Measure consists of two sub-measures:

1. Create a local innovation hub
2. Citizen co-creation to develop a personal interface of HEMS and/or apps

Regarding the first mentioned sub-measure: a multi-functional hub for co-creation, user-driven innovation, dissemination and communication in the demo district, will be established in the local innovation hub. This hub provides room to facilitate conversation between local stakeholders, including residents, but will also be used as a meeting place for actual solution design and implementation, allowing for better results and creating faster and more targeted improvements. The hub will e.g. be used to organise the co-creation sessions/workshops for the integrated solutions listed on level 3 and 4 of the engagement ladder.

Regarding the second mentioned sub-measure: the HEMS Toon gives tenants insight and feedback on their energy consumption and savings. The potential value of the Toon is quite high, but there's also a risk of prejudice. If the tenants don't adopt the HEMS Toon, the energy consciousness will be not increased and the HEMS Toon will not be a sustainable solution.

The activities related to the Measure Local innovation hub consist of finding the best location for mentioned activities. This location is 'Het Krachtstation' (English: 'The Powerstation') in the district of Kanaleneiland-Zuid. This former school building is located in the district near the bus station and near the office of Bo-Ex. In this building, several companies and start-ups coming from this district has been established in the past years. Besides, this building has enough facilities to welcome people and organize meetings and workshops. To become a local innovation hub, not only a good location is required, but also a high attractiveness and low threshold for people to visit this building is necessary.

The activities related to the HEMS Toon consists of develop a process and/or product which helps the tenants to use the HEMS Toon.

Figure 65 shows the programme for the scheduled activities for this measure.

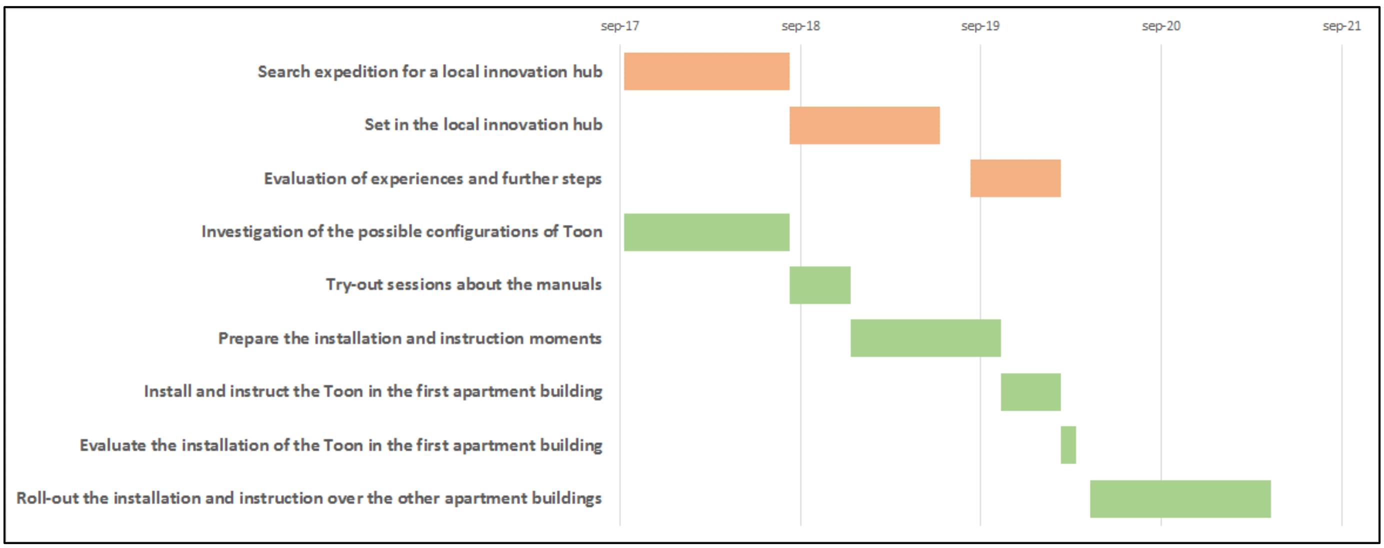


Figure 65. Timing of activities measure 3 –Evaluation and co-creation

Monitoring of the Measure consists of the acknowledgement of this location as an innovation hub among people from the district.

Table 59 Summary-list of KPIs and related parameters for Measure 5.3: Evaluation and co-creation

KPI	Parameter(s)	Data source	Baseline	GA- Target
Ease of use for end-users of the solution	Ease of use for end users of the solution	Survey	NA	4 on the scale of 1-5 (Likert Scale)
Advantages for end-users	Advantages for end-users	Survey	Anticipated advantage before implement-tation of the measure	4 on the scale of 1-5 (Likert Scale)
Local community involvement in planning/ implementation phase	Local community involvement in the planning/ implementation phase	Survey	NA	3 on the scale of 1-5 (Likert Scale)

8.1.4 Monitoring plan for measure 5.4: Campaign Smart Street Lighting

A campaign for smart street lighting is closely linked to the development of a data-service for smart street lighting and is incorporated in these activities. This activity is the first IRIS Citizen Engagement activity and the first engagement part was held June 2018.

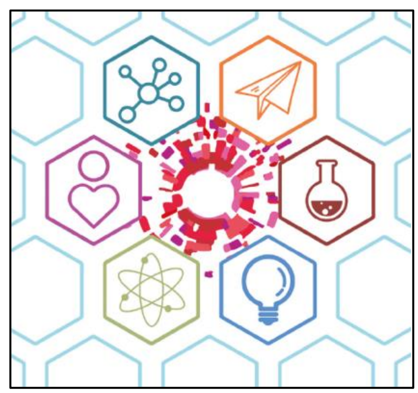


Figure 66 Design thinking scheme

The outcomes of the first part of this have been reported exhaustively and shared with the other lighthouse cities. In this report we summarize these outcomes and the next steps.

Within this campaign we've followed the principles of design thinking. This principle defines two main steps: first finding the right problem and after this finding the right solution.

In June 2018 these steps have been executed together with people from the district of Kanaleneiland-Zuid, people from the (data and lighting) industry and other involved people.

To obtain the right solution, three workshops have been held:

- Workshop 1 to gather information and needs from the people from the district (inhabitants, entrepreneurs and professionals);
- Workshop 2 to create new concepts of solutions, based on the outcomes of workshop 1;

- Workshop 3 to match the outcomes from workshop 2 with the involved people.

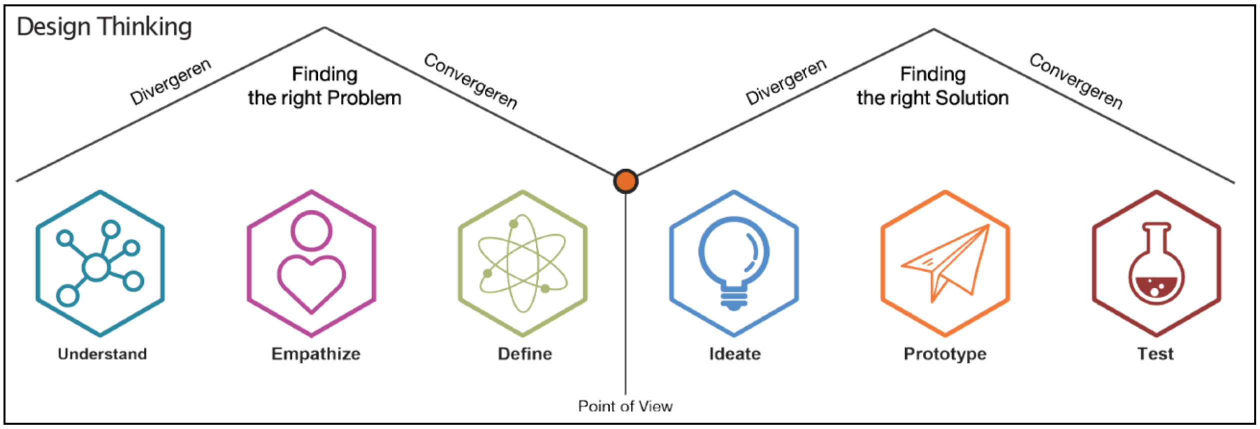


Figure 67 Design thinking model

Figure 68 shows the programme for the scheduled activities for this measure.

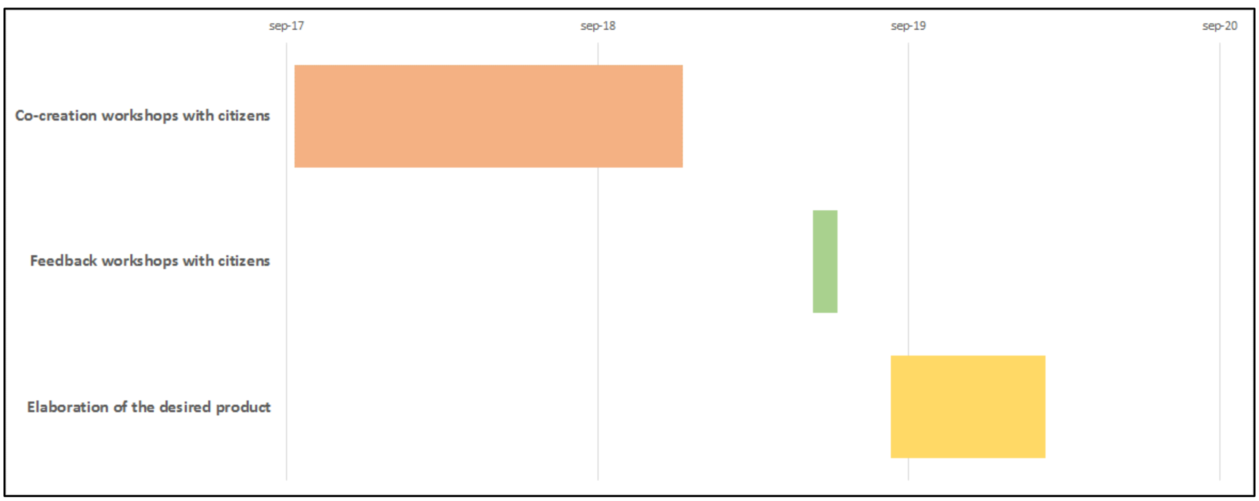


Figure 68 Timing of activities measure 4 –Campaign Smart Street Lighting

Monitoring of this Measure focuses on the degree of participation among people from the district and the lessons learned from these workshops for other engagement initiatives.

Table 60 Summary-list of KPIs and related parameters for Measure 5.2: Campaign District School Involvement

KPI	Parameter(s)	Data source	Baseline	GA- Target
Local community involvement in development process	Local community involvement in development process	Survey	NA	4 on the scale of 1-5 (Likert Scale)

8.1.5 Monitoring plan for measure 5.5: Virtual reality platform

According the DoA, this activity focus on a virtual reality platform, extending existing Oculus Rift® VR experiences for apartment buildings to other new buildings so households can experience their future 'new' home, including infotainment and interactive training about the new smart energy and mobility services they may expect.

Figure 69 VR experience
Source: https://www.pebblestudios.co.uk/2017/03/29/our-guide-on-how-to-create-immersive-vr-experiences/

In an earlier stage, experiments with 3D visualization have taken place to experience the renewed house of tenants after a refurbishment. This visualization worked well, since almost all apartments are building up the same and by using pictures (old/new) people could image which new parts/products were installed. On the other side, we've experienced that a certain amount of tenants can't 'read' visualizations: they don't understand a visualization and the linked pictures and descriptions to the visualization.

But, evaluating this tool and discussing the real objective for the Measure (create support for the plans for the refurbishment), we've decided to change plans. Still creating a certain way of reality of the main objective, but the tool will not be virtual reality, but we broaden our scope and try to find the best solution within Extended Reality (of which Virtual Reality is part of).

With XR we identify the mix between analogue and digital, with room for VR, AR, and other mix options. Its increasingly being used as a collective name for innovative applications.

> *'Extended reality (XR) is a term referring to all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables. It includes representative forms such as augmented reality (AR), mixed reality (MR) and virtual reality (VR) and the areas interpolated among them.'* Source: https://en.wikipedia.org

The challenge is to find the best way(s) to involve tenants in their current and new house by making use of Extended reality. The approach to find this way(s) is similar to the M#3 Smart street lighting Measure. With this approach, we first gather information from the tenants: what information do they need to obtain a better view on their new home? And which parts of the apartment building and environment are desirable to focus on? And what helps tenants to understand the plan of refurbishment?

Based on the discussions we've had about this Measure, we've chosen for another tool than the Oculus Rift® (or equal VR product). The Oculus Rift do give tenants insight in their existing and new situation. But has also some disadvantages: the glass is heavy to wear the glass can only be used by one person at the time, the glass brings hygienic problems and it cost a lot of effort (time and cost) to create a realistic virtual reality.

The tool we've chosen for to develop brings the following principles together:

- District wide insights;
- Insights in costs and benefits of the energy transition (including refurbishment works) for the tenants / citizens;
- Interaction elements, which can be conducted by more than one person at a time;
- An experience for young and old and independent of languages.

The tool consists of an interactive table with camera and projection screen. This table contains a scale model of the district of Kanaleneiland-Zuid with the twelve apartment buildings of Bo-Ex. People can play with this model: they can add miniature PV-panels on the roofs, put insulation around the apartment buildings, bring in energy storage and so on. Every activity of the person who plays with this model, directly results in insight in energy costs and benefits and environmental consequences. With this model, we develop an easy, accessible experience which can be played by different people at different places.

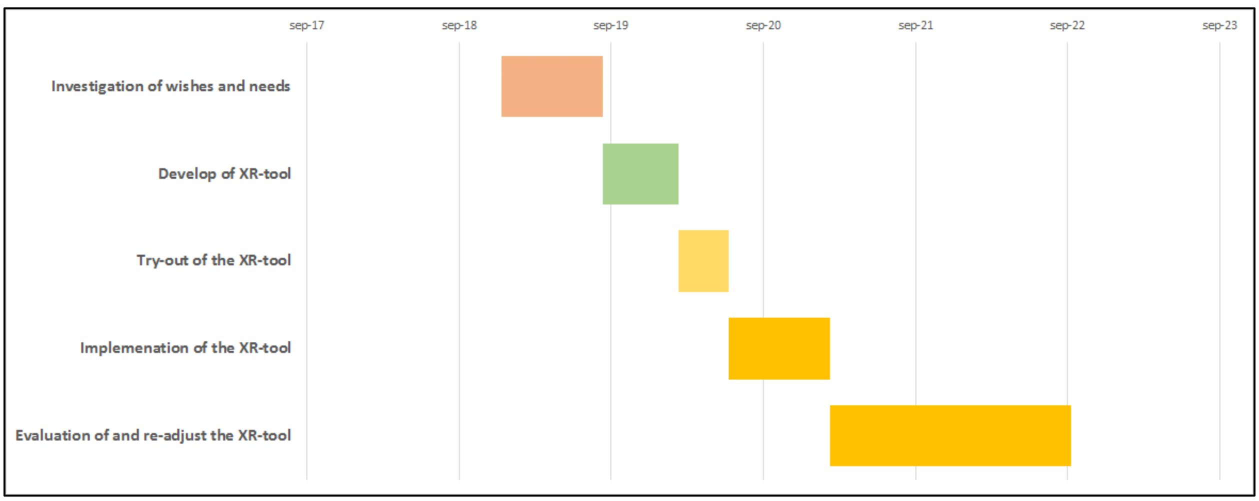


Figure 70. Timing of activities measure 5 - Virtual reality platform

Monitoring of this Measure focuses on the participation and degree of understandability among tenants regarding the planned refurbishment works.

Table 61 Summary-list of KPIs and related parameters for Measure 5.5: Virtual reality platform

KPI	Parameter(s)	Data source	Baseline	GA- Target
Ease of use for end-users of the solution	Ease of use for end users of the solution	Survey	NA	4 on the scale of 1-5 (Likert Scale)

8.1.6 Remarks

For Measure 5.1: Community building by Change agents, a chage of plans was required due to a lack of change agents in the district. In November 2019 a pilot with a professional change agent during the implementation of Eneco Toon. If this succeeds, we can appoint this agent for more IRIS related activities and build a team of people who can act as agents.

Regarding this Measure 5.2: Campaign District School Involvement , the activities taken out on the primary schools were quite successful, for the activities with the profession students of the MBO-Utrecht there's space for improvement. Because of the (potential) successes we succeed with this initiative in the coming years.

Measure 5.3: Evaluation and co-creation an important change of tactics has been conducted in the last few months of the second year of the IRIS project. It will prove whether a personal door-to-door contact increases the engagement and whether working with a professional social consultant as a familiar and continuously recurring face leads to more trust. And eventually to more commitment and consent with the planned transition activities, especially the refurbishment activities.

A successful route of citizen engagement was developed in Measure 5.4: Campaign Smart Street Lighting. The only point of attention is to follow-up quickly with purchasing the product before people are uninterested in the outcomes and their part of it.

It took some time to discuss what the best solution is regarding Measure 5.5: Virtual reality platform. The original idea has too many drawbacks. The current idea is supported by everyone within the IRIS team. We hope that these enthusiastic reactions will result in the same reactions from the people who will be asked to play this XR experience.

8.2 Nice

8.2.1 Monitoring plan for measure 5.1 Public awareness campaign on air quality

This measure consists of promoting air quality and mobility benefits linked with the new tramway line achievement and the public transport network reorganization. The goal is to convert a one-off action, take the tramway or the bus, into a regular habit. The engagement mode for this demonstrator consists of a reinsurance campaign which relies on positivity and environmental impact. It will inform citizens that if they take public transport this act fosters the air quality. By being conscious of the benefits on the environment, citizens may change their habits.

Informative awareness messages and visuals will be broadcast on media such as urban screens (on the street, in tramway/bus stations, etc.) and digital mass media such as the website of the partners, or local applications. Moreover, the communication can be strengthened by an inbound strategy. Citizens should have the opportunity to learn more about this topic by finding the reference information on the website of AtmoSud. The content will be delivered thanks locally collected data. Several options are considered: air quality condition, carbon emissions gain, mobility alternative suggestions, eco-friendly practices, etc. These user-oriented messages will require to collect and share multi-sources traffic and activity data on the City Innovation Platform. This challenge will be handled thanks to a partnership between AtmoSud, NCA and IMREDD.

Table 62 Summary-list of KPIs and related parameters for Measure 5.1 Public awareness campaign on air quality

KPI number	Unit	Details	Object of assessment
People reached	Number	• Number of people reached in public transports (tramway, bus) • Number of students/high schools pupils participating in the project • Number of persons interviewed during polls	Urban awareness campaign Commuting to work Student training
Increased environmental awareness	Likert scale (no unit)	• Questionnaires/Interview/Polls • Emissions and air quality indicators variation • Travelled kilometers on car sharing devices in the Business district (before/after awareness campaign) • Number of users of car sharing devices in the Business district (before/after awareness campaign)	Urban awareness campaign Commuting to work Student training

8.2.2 Monitoring plan for measure 5.2 Public awareness campaign on energy

This measure targets the optimization of the awareness of energy consumption. The area chosen for the implementation of the actions is composed of collective social buildings managed by several social lessor (i.e. Côte d'Azur habitat, Erilia, Logement, etc.). Most of the inhabitants are from foreign origin. Some families have been present in their flat for several years. They feel at home. It is an area where residents can combine several problems: low level of education, poor fluency in the French language both orally and in writing, low income, unemployment, addictive behaviour, trafficking of all kinds, etc. In this context, IRIS partners chosen to work with different audiences and to adapt the tools and messages according to the target audience (i.e. children and college students, teenagers, and adults). The focus is on children who are more receptive than their parents to the messages we want to get across. Studies show that they are good vectors for their entourage and that they spread the good word in their families.

Table 63 Summary-list of KPIs and related parameters for Measure 5.2 Public awareness campaign on energy

KPI	Unit	Detail	Object of assessment
Increased awareness of energy usage	Likert scale (no unit)	Survey Training/ Awareness sessions at school & college	Axis 1: USAGE AWARENESS - COMPREHENSION AID Primary school pupils Students Smart Flat
Increased Consciousness of citizens	Likert scale (no unit)	Visit and specific survey completed by teenagers	Axis 2: AWARENESS OF INDIVIDUAL ACTS / COLLECTIVE FEEDBACK I LIKE MY SUB STATION
Increased Environmental awareness	Likert scale (no unit)	Training/ Awareness sessions at school & college	Axis 1: USAGE AWARENESS - COMPREHENSION AID Primary school pupils Students
People reached	Number	Number of participants in the sessions	Axis 1: USAGE AWARENESS - COMPREHENSION AID Primary school pupils Students Smart Flat

8.2.3 Monitoring plan for measure 5.3 Citizens individual engagement - IOT invoices

This measure aims to provide tenants with a global source of information on their energy consumption related to the housing they occupy by grouping their different consumption from different sources into one application. In addition to the general approaches of Measure #2, this axis makes it possible to individualize the storytelling and to encourage people to adopt virtuous behaviours. Given the technical

specificities of the district of Les Moulins, the families living in this district have a fragmented approach of their environmental and energy impact related to their housing. Their energy bill is made up of four different sources (Heating, Hot water, Cold water, and Electricity) on which tenants have more or less the opportunity to act, if any.

Monitoring of this Measure consists of collecting data regarding the amount of people reached, the motivation to change behaviours, and the improving their understanding of their energy environment. With these data, we know why people chose to change behaviour and the impact of these program.

Table 64 Summary-list of KPIs and related parameters for Measure 5.3 Citizens individual engagement - IOT invoices

KPI	Unit	Detail	Object of assessment
People reached	Number	Number of connections to the new web services	Axis 3: AWARENESS OF INDIVIDUAL ACTS / INDIVIDUAL RETURNS
User engagement	Number	Number of inhabitants agree with the data collector	Axis 3: AWARENESS OF INDIVIDUAL ACTS / INDIVIDUAL RETURNS

8.2.4 Remarks

The monitoring of TT5 measures will be based on surveys.

8.3 Gothenburg

The data provided in the following paragraphs are extracted from deliverable D7.7: Launch of T.T.5 activities on Citizen engagement (Gothenburg). More detailed information about these measures can be found in this source.

8.3.1 Monitoring plan for measure 5.1-5.4 Min Stad as a tool for citizen engagement

Within IRIS, the possibilities for developing Min Stad (My City) into an active dialogue tool will be explored. The goal is to spread information more efficiently in a new channel, to reach new user groups and to explore how far the dialogue between the municipality and citizens can be developed within the current legislative framework. A first step may be to, with the help of citizens, find a good form for how data is presented and to link new forms of information into the current dialogue process. In a further development, the tool Min Stad can be developed to present more complex information while allowing the citizen to not only write comments but also modify the proposal presented by the city and / or create their own suggestions in the form of models, sketches or the like.

Figure 71. Min Stad (My City) introduction page http://minstad.goteborg.se/minstad/index.do?lang=en

The demonstrator scope the five activities 2a) Citizenship engagement model (ME-model), 2b) Smart City Hub, 2c) Continuous Dialogue, 2d) Inclusive Life Challenge, and 2e) Interview Survey.

The expected impact of the demonstrator Min Stad (My City) as a dialogue tool for citizen engagement is to find ways for citizen engagement through a new channel, to reach new user groups and to explore how far the dialogue between the municipality and citizens can be developed within the current legislative framework.

Data for the measure will provided by Gothenburg City-City Planning Office by continues check the number of user's trough yearly statistics for users of Min Stad.

Table 65 Summary-list of KPIs and related parameters for Measure 5.1-5.4 Min Stad

KPI	Parameter(s)	Baseline	Target (as described in DoW or declared)
Local community involvement in the planning phase	Number of participants	N/A	N/A
User engagement	Number of participants	N/A	N/A

8.3.1 Monitoring plans for measure 5.5 Minecraft as a tool for citizen engagement

The demonstrator Minecraft as a dialogue tool for citizen engagement is to study the possibility to increase the ability for children to have influence of the development of their local environment through Minecraft. Minecraft can be included as a tool to contribute to children's and young people's engagement in urban planning. Is it a useful tool to take part of children's and young people's perspectives, the children's perspective, young people's local knowledge and at the same time give them new knowledge about the city's planning work?

The demonstrator includes the two activities 1a) Minecraft in the planning process in Bergsjön and 1b) Minecraft summer camp in Gothenburg City Triennal, 2021.

Figure 72. A part of the area Bergsjön in Minecraft

The study will involve different age groups of children and young people. The activity for Minecraft in the planning process in Bergsjön will be carried out through 6 workshops at the Bergsjö School in the spring and autumn and in collaboration with the organization for the planning work and Bergsjön 2021. The city building office specialist in dialogue with children and young people participates. An architecture educator /pedagogue leads the work.

The activity Minecraft summer camp in Gothenburg City Triennal, 2021 is a summer camp for children, arranged in collaboration with the Gothenburg City Triennial 2021 and its contributing partners.

The test is performed within the planning dialogue process and the Child Impact Assessment (BKA). Gothenburg City Building Office has a strong need to test tools and methods for child dialogue in the planning process to which the project will respond.

The expected impact of the demonstrator is to increase the knowledge about how to use Minecraft as a dialogue tool in relation to the citizens in planning processes and urban development. The ambition is to identify opportunities and success factors.

Data for the measure will provided by Gothenburg City-City Planning Office. Data will be collected through Survey and / or interviews with participants after workshops in activity Minecraft in the planning process and after the Minecraft summer camp in Gothenburg City Triennal.

Table 66 Summary-list of KPIs and related parameters for Measure 5.5 Minecraft as a tool for citizen engagement

KPI Selection	Parameter(s)	Data source	Baseline	Target
Local community involvement in the planning phase	Number of participants		N/A	Number of participants in the spatial planning contest, more than hundred.

8.3.28 Monitoring plan for measure 5.6 VR/3D BIM

This demonstration entails demonstration of a BIM (Building Information Modelling) based 3D Augmented Reality/Virtual Reality (AR/VR) Environment that will virtually immerse users into the inner workings and properties of a building, providing deeper understanding and involvement in the building's processes. This demonstrator is implemented in the AWL (A Working Lab) building, where the innovative environment and extensive sensor network will provide relevant inputs to the demonstrator.

The solution will be implemented as a client-server solution consisting of a cloud server responsible for hosting and serving data, including both BIM and sensor data, and serving the data to both AR and VR clients. The cloud server communicates with the sensor network(s) of the building(s) and processes the sensor data for further streaming to the AR and VR clients.

The cloud server will be accessible via an online web-based user portal, which will allow users to both browse existing data (BIM models) and upload new BIM models.

The expected impact: Thanks to the intuitive and simple user interface, a number of new stakeholders that have previously not been involved or asked will be able to engage themselves in these matters. All this, in turn, will enable a greater understanding of and a momentum towards how buildings should be designed and operated for increased sustainability, accessibility and comfort.

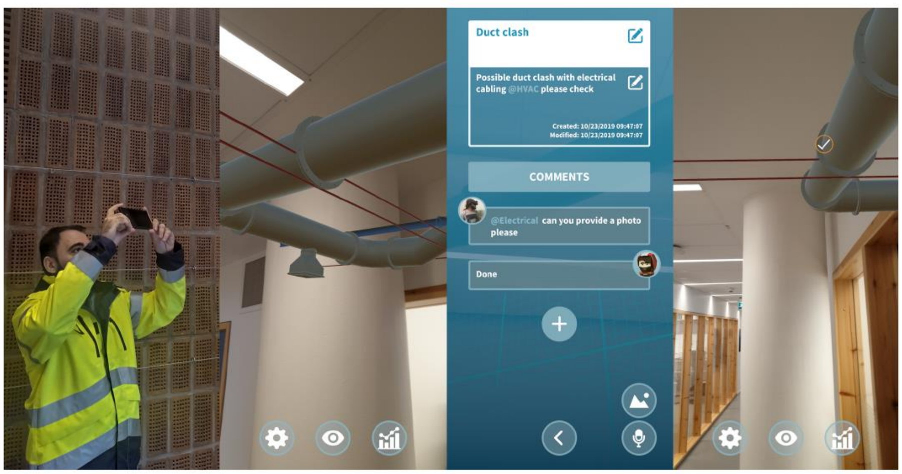


Figure 73. *Example use of the annotation feature*

Data for the measure will provided by Johanneberg Sicience Park in cooperation with RE Space AB. Part of the data will be collected by automatic such as, the number of registered users, the number of sessions initiated, the number of API calls made to sensor data. Data as, the ease of use, the increased environmental awareness and the perceived usefulness of the demonstrator will be collected by user surveys.

Table 67: Summary-list of KPIs and related parameters for Measure 5.6 VR/3D BIM

KPI	Parameter(s)	Baseline	Target (as described in DoW or declared)

Increased environmental awareness	The extent to which the project has used opportunities for increasing environmental awareness and educating about sustainability and the environment. (Likert scale)	N/A	Not defined
Ease of use for end users of the solution	The extent to which the solution is perceived as difficult to understand and use for potential end-users. End-users are conceptualised as those individuals who will be using/working with the solution. Some solutions or innovations are perceived as relatively difficult to understand and use while others are clear and easy to the adopters. It is presumed that a smart city solution that is easy to use and understand will be more likely adopted than a difficult solution. (Likert scale)	N/A	Not defined

8.3.38 Monitoring plan for measure 5.7 Personal Energy Threshold

The objective was to demonstrate a PET, together with tenants in the HSB Living Lab for possible replication in the HSB building stock. The tenants have not earlier been able to choose what kind of energy source they want and when to use it, and there is also poor feedback on their own energy consumption. The property owners' knowledge of the individuals' energy consumption is not visual enough, and the PET have been demonstrated and monitored within a research study for possible replication and upscaling.

Within the PET project an app was developed to monitor energy usage and give feedback to users regarding their energy consumption. The ERO application was designed with a smart home system in mind that could balance the energy demand and supply. The app has a function called Personal Energy Threshold (PET), a momentary power level showing when there is a plenitude or a shortage of energy in relation to the household's energy consumption.

Figure 74 *The ERO app and different interfaces. (Connecting the solar production system was not possible within the frame works of this project.)*

The expected impact was to develop a deeper understanding of the tenants' energy consumption at individual level, and let each individual choose what type of energy source to be used and when. Through the developed application ERO the aim was to nudge individuals to choose "green" energy such as energy from the installed PVs (façade and roof).

Data for the measure will provided by HSB Living Lab.

Table 68 Summary-list of KPIs and related parameters for Measure 5.7 Personal Energy Threshold

KPI	Parameter(s)	Baseline	Target (as describe DoW or declared)
Increased environmental awareness	The extent to which the project has used opportunities for increasing environmental awareness and educating about sustainability and the environment. (Likert scale)	N/A	Not defined

8.3.4 Remarks

The demonstrator "Min Stan" has been through a re-boot process due to a lack of resources at City Planning Office in 2019. The project is however now back on track with planned activities with objectives in line with the overall IRIS objectives as well as the original objectives for the demonstrator. The project

also has an updated project plan including an updated timeline that indicates a 6-month delay of this report. It´s however expected that the project demonstrator still will be implemented and evaluated within the time boundaries of the IRIS-project overall time plan.

The Minecraft demonstrator has been through a re-boot process due to a lack of resources at City Planning Office in 2019. There was a previous plan to carry out the entire activity in the detailed planning work for Önneredsskolan. This is no longer relevant as the school is no longer interested as of the time lag that occurred during the resource loss on SBK. The project is however now back on track with a project directive, steering and project group, and planned activities with objectives in line with the overall IRIS objectives. New proposal for current planning work to link activity 'Citizens' Dialogue through Minecraft ' is a detailed plan in Bergsjön, for housing between Space and Komettorget about 700 housing units. April 6-8, the first Minecraft workshops were held at the Bergsjö School. Workshops will be conducted on three additional occasions in the spring of 2020.

To investigate other possibilities with Minecraft in a more open and creative phase of the planning process a new activity has been developed within the Minecraft demonstrator: Minecraft in the Gothenburg City Triennal 2021. The planning of this activity is being done during this spring 2020.

The demonstration entails demonstration of a BIM (Building Information Modelling) based 3D Augmented Reality/Virtual Reality (AR/VR) application will be developed according to the requirements of the project. The focus remains on UX (including immersion, responsiveness, user-friendliness) taking into consideration the distinct characteristics of smartphones/tablets and VR headsets. The aim is to create a cross-platform application that can be ported to any of the state-of-the-art headsets (Oculus, Valve etc.) and is available for iOS and Android devices.

In the demonstration of Personal energy Thresholder, it was unfortunately not possible to control district heating. In total, seven participants took part in the study from the beginning to the end. None of the participants used ERO extensively.

9 Monitoring timelines

The timelines in this chapter are produced to obtain a clear overview of when measurement data is expected to be obtained for all measures per city. These timelines clearly show which project needs extra attention in order to make sure that project agreements are met or need to be adjusted.

The green areas in the timelines in this represent when measurement data is expected to be obtained for each measure. The red line indicates the deadline after which it is not possible to acquire at least 2 years of monitoring data within the IRIS project period. The numbers in the first column represent the measure numbers as described in the measure tracker [10], which are listed in Annex A2.

9.1 Utrecht

Table 69 Timeline representing the expected measurement period for each measure in Utrecht

Year	18	19	19	19	19	20	20	20		20	21	21	21	21	22	22	22
Quarter	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
1.1																	
1.2																	
1.3																	
1.4																	
1.5																	
1.6																	
1.7																	
2.1																	
2.2																	
2.3																	
3.1																	
3.2																	
4.1																	
4.2																	
4.3																	
4.4																	
4.5																	
5.1																	
5.2																	
5.3																	
5.4																	
5.5																	

9.2 Nice

Table 70 Timeline representing the expected measurement period for each measure in Nice

		2019		2020												2021												2022											2023					
		11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	9	10	11	12	1	2	3	4	5	6
1.1																																												
1.2	Phase 1																																											
	Phase 2																																											
	Phase 3																																											
1.3	Solution 1+2 on B13																																											
	Solution 1 on B14																																											
	Solution 1+3 on B14																																											
1.4																																												
2.1																																												
2.2																																												
2.3																																												
3.1																																												
3.2																																												
4.1																																												
4.2																																												
4.3																																												
4.4																																												
5.1																																												
5.2																																												
5.3																																												

9.3 Gothenburg

Table 71 Timeline showing the expected measurement period for each measure in Gothenburg

Year	18	19	19	19	19	20	20	20		20	21	21	21	21	22	22	22
Quarter	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
1.1																	
1.2																	
1.3																	
1.4																	
1.5																	
1.6																	
1.7																	
2.1																	
2.2																	
2.3																	
2.4																	
3.2																	
3.2																	
4.1																	
4.2																	

10 Output to other work packages

The output of this deliverable to the other work packages is represented in the table below.

Table 72 Output of D9.5 to other work packages

WP	Deliverable	Use of D9.5 output
WP4, City innovation platform	D4.6 (M30) Integration of CIP in LH Cities	The monitoring equipment in each LH city that is required to collect real-time, high-resolution data will be accessed through the CIP. The relevant data will become available to KPIs tool through the platform. Moreover, the static data that are required for calculating the KPIs will be stored in the platform.
WP9 Monitoring and evaluation	D9.6: (M38) Intermediate report after one year of measurement	The actual performance data collection and reporting will be carried out. The KPI tool will be used to calculate and visualize the KPIs in each LH city.
	D9.7: (M60) Report on evaluation and impact analysis for integrated solutions	The actual performance data collection and reporting will be carried out. The KPI tool will be used to calculate and visualize the KPIs in each LH city.
	D9.9 Second update of Data management plan	Output, the information for all data variables provide the basis for the data input of the data management plan.
WP8 Replication activities	D8.4 – D8.12: Replication plans of follower cities, European level replication guidelines	Output used for monitoring and evaluation of IRIS replicable solutions.

11 Conclusions and recommendations

11.1 Challenges in setting up the monitoring framework

Several challenges were met during the process of defining the KPIs for the project and setting up a framework to collect the monitoring data. Examples of such challenges are;

- Making all technical partners responsible for the implementation of the measures understand the value of a large unified monitoring plan, in order to facilitate and enhance the collaboration into setting up such a plan.
- Finding KPIs that are relevant to measure the impact of the actions in the project
- Finding KPIs that are measurable in the integrated solutions
- Dealing with delays in the installation of equipment
- Making sure that data is accessible
- Connecting data sources to a CIP which is also under construction
- Dealing with delays in demonstrations
- The requirement of having at least 2 years of monitoring data

The most important lessons learned from the KPI revision process are:

- When it comes to setting up a physical monitoring plan, certain KPIs turn out not to be measurable. This can be due to:
  - Misunderstanding of what the KPI exactly means at the start of the project.
  - Discovering physical limits in time / space. For example, when certain measures are taken simultaneously at the same place, it is impossible to analyse their separate effects.
- From a monitoring perspective, it is very important to stay flexible during the project in order to be able to adjust the monitoring goals when necessary.
- Even though KPIs seem to be well-defined and used by others, still misunderstandings or mistakes can arise, which have to be solved for each case.
- It is of great importance to keep a comprehensive overview of how KPIs are interpreted or modified on Measure level, in order to maintain the possibility for aggregation and comparison of KPIs.
- The definition of KPIs, together with setting up a proper monitoring plan, can become a complicated and therefore, sluggish procedure. It is very important to be well prepared and keep project partners who are responsible for the demonstrators engaged during this process.
- When revising which KPIs are being monitored, make sure that goals mentioned in the grant agreement are still met.

11.2 Summary of the conclusions from each lighthouse city

The project consists of several demonstation project which are divided by 5 transition tracks (TTs): TT1; Smart renewables and closed-loop energy positive districts, TT2 (Smart Energy Management and Storage for Grid Flexibility), TT3 (Smart e-Mobility Sector), TT4 (City Innovation Platform (CIP) Use Cases), TT5 (Citizen engagement and co-creation).

11.2.1 Utrecht

All measures of TT1 (Smart renewables and closed-loop energy positive districts) represent a comprehensive monitoring program which has a firm basis in the use of the HEMS Toon, which is an online meter which presents data on a frequent level. This enhances automation of the data input for calculation of the KPIs.

Most of the demonstrations within TT1 are implemented simultaneously in the same buildings. It is therefore impossible to measure the effect of separate measures on the same KPI. For this reason, a large part of the KPIs that have to do with the refurbishment of buildings in TT1 are aggregated to TT level. A comprehensive monitoring plan is presented for each KPI and the related measurements.

For TT2 (Smart Energy Management and Storage for Grid Flexibility) a large part of the monitoring infrastructure is already placed or about to be installed very soon. Next step is to connect the monitoring to the CIP, to collect the data into the KPI tool. The monitoring plan for the KPI Peak load reduction is currently being finalised and will be incorporated in the updated version of D9.5

In TT3 (Smart e-Mobility Sector) in general, activities are progressing according to plan, except that low demand for the V2G shared e-cars is starting to pose a risk that intended numbers will not be reached. There are some deviations: the demand for shared e-cars is lower than expected which may result in a lower number of shared e-cars in the district, and there are no V2G smart charging technologies for e-buses on the market yet. The overall ambitions of TT3 of demonstrating smart e-mobility are not affected.

The measures taken in TT4 (City Innovation Platform) for Utrecht are predominantly not easy to cover by the more generic KPIs. For this reason, these measures don’t lead to much input for the KPI tool. Nevertheless, the data generated by the measures will provide interesting insights for the partners in the other Lighthouse- and follower cities within the IRIS project and in smart city projects beyond the IRIS umbrella.

11.2.2 Nice

In TT1 (Smart renewables and closed-loop energy positive districts) the monitoring phase of measure 1 (Positive Energy Building) will start on May 2020 in order to fulfil the two years data measurement period. Data analysis will be performed for the 2 buildings on a regular basis (every 3-months), and data will be processed and stored to the KPI tool. Monitoring for measure 2 (Near zero energy retrofit) has already been started. The REPERE service (Measure 3) follows the monitoring phase of the Measure 2 as it uses data produced from solutions 1 to 3. The Dashboard (Measure 4, Symbiotic waste heat network) will be implemented in the IRIS demonstration area by mid-2022, due to the delay in the contraction. For this reason, the dashboard will be initially implemented in another area. Both areas share common features,

so the results from the external area will be used in conjunction with the results from the IRIS demonstration area.

For TT2 (Smart Energy Management and Storage for Grid Flexibility), the overall monitoring of the achievements of the actions of IS 2.1 (Flexible electricity grid networks) will be mainly granted by the centralization of information via EDF S&F, AGREGIO and ENEDIS. These companies will systematically collect the information, store it and post-process it, in order to provide the required data in WP9.

In IS 2.2 (Smart district heating with innovative storage), the monitoring process will be part of the DHCN operation practice. All data will be centralized by the DHCN operator at the production site. This will ensure all needed data can be queried for the assessment of the selected KPIs.

The Battery Energy Storage System in IS 2.3 (Utilizing 2nd life batteries for large-scale storage) will be monitored through the collection of data streams that will be stored locally in UNS/IMREDD and ensure the consistency of a historical database for the post-evaluation of the implemented control strategies. A few parameters regarding data acquisition from the stationary and EV battery storage must be defined.

For TT3, in measure 3.1 (Smart Solar - V2G - EV charging) the overall monitoring of the achievements of the actions will be mainly granted by the centralization of information by NCA via EDF and VULOG management platforms and its post-processing for nourishing WP9 tasks. For the overall volumes and peak energy consumption and injection metering on the electric grid, ENEDIS could provide the aggregation of the information stored in their data centres. For a fine grain aggregation level, the authorization from the users of shared vehicles shall be granted to use the personal data related to their bookings and trips. To assess all detailed information “behind the meter”, only NCA should be involved to grant access to ENEDIS for the same reasons as mentioned previously.

In measure 3.2 (Innovative Mobility Services for the Citizens) the monitoring of the execution of the actions will mainly rely on the information collected by the CIP from the supervision platforms of IZIVIA (“Prise de Nice” public EVCI operation), of EDF (NCA private EVCI operation + smart charging platform) and VULOG (carsharing management). It will be based on the post-processing of this information for nourishing WP9 tasks. All data from the carsharing operation, including any statistics related to vehicles and booking, will be provided by the carsharing management platform. For a fine grain aggregation level preventing anonymization, the authorization from the users of shared vehicles shall be granted to use the personal data related to their bookings and trips.

The monitoring of TT4 measures will be based on data collected through City Innovation Platform.

The monitoring of TT5 measures will be based on surveys.

11.2.3 Gothenburg

In Gothenburg, most demonstrations are installed and now running according to plan. However, for IS1.3 (Cooling from geo energy without chillers), IS1.5 (Seasonal energy trading with adjacent office block) and TT5 (Citizen engagement and co-creation) problems have occurred. In the case of IS1.3 and IS1.5, the involved partners are working hard to solve the problems. The deliverable on transition track 5 has not yet been finalized and therefore the description of work in this TT will be included in a later, updated version, of D9.5. In this updated version, some new KPIs connected to TT4 (City Innovation Platform (CIP)

Use Cases) will also be included. These KPIs have already been identified, and the involved partners are working on an update of D7.6 to include them.

11.3 Aggregation of KPIs

After updating the KPI lists, a revision of the selected KPIs which are possible candidates for aggregation was undertaken. This revision also incorporates the feedback of the partners responsible for the specific solutions and the TT leaders. Aggregation up to IRIS level will be done for the KPIs ‘Energy savings’ and ‘CO_2 emission reduction’. With the monitoring data from this report, the next step in aggregation can be taken by preparing the KPI tool to aggregate all relevant variables.

11.4 Recommendations

The next deliverable in WP9 is D9.6: Intermediate report after one year of measurement, it will present the first intermediate results of the monitoring framework. To reach this target, several steps are required:

- Assist partners of the integrated solutions in collecting the monitoring data into the KPI tool and/or the CIP
- Now real monitoring data will be made available, the KPI tool has to be tested with this data in order to adapt and improve the tool in real live.
- Consultation with the demonstration partners and the TT leaders to agree on how KPIs are presented in terms of graphics, detail etc.
- Where the calculation of more technical KPIs is predominantly quite straightforward. KPIs based on surveys still require attention.
    - The design of surveys to measure the KPIs
    - Agree on timeframe and schedule of surveys
    - Agree on the interpretation of surveys and how to collect data to the KPI tool

12 References

All public IRIS deliverables are accessible through: https://irissmartcities.eu/public-deliverables

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A1. Form for interpretation of KPIs

INSTRUCTIONS:

- Open the file of the *transition track*. This file describes which KPIs belong to which *integrated solution* in this transition track.
- Open the KPI-card file and read the description of this KPI.
- For the interpretation, take the *integrated solution* as reference.
- To interpret the KPI, fill out this table. Note: It is not necessary to answer the question in the given order. Feel free to jump around in the table. Use the table as a means to help in the interpretation of the KPI.

Step	Question	Answer
1.	Which *integrated solution* is focussed on?	
2.	Which KPI is focussed on?	
3.	Does the description of the KPI fit to the *integrated solution*?	❍ Yes, go to step 5 ❍ No, go to step 4
4.	Adjust the description of the KPI	
5.	At what timescale do we want to know this KPI?	❍ Per second ❍ Per hour ❍ Per day ❍ Per week ❍ Per month ❍ Per year ❍ Otherwise, …………
6.	At what spatial scale do we want to know this KPI?	❍ Per individual

		❍ Per group of individuals ❍ Per dwelling(s) ❍ Per apartment building(s) ❍ Per district ❍ Otherwise, …………
7.	Describe the delineation in space and time of this KPI	
8.	Is the KPI formula correct?	❍ Yes, go to step 10 ❍ No, go to step 9
9.	Adjust the KPI formula	
10.	Remarks about the KPI formula	
11.	What is the baseline of this KPI? Tip: Baseline is described in deliverable D5.1 for all integrated solutions	
12.	Which type of measurement is needed to determine the KPI?	❍ Data or measurements of an existing meter ❍ Data or measurements of a new meter ❍ Data from databases ❍ Survey ❍ Otherwise, ………
13.	Describe the type of measurements needed for the KPI	

14.	Where is measured for this KPI? Tip: use the monitoring schedule and name the meter and whose meter it is	
15.	When is measured for this KPI?	
16.	Who can provide the data?	
17.	Are there restrictions to unlock the data?	
18.	In what format is the data available?	
19.	Is it easy to link to the City Innovation Platform?	
20.	Who is responsible for KPI?	
21.	Who calculates the KPI?	
22.	Do a trial calculation of the KPI based on the project plan. Save your calculation! Explanation: Assume that 100% of the project plan is implemented and calculate the KPI based on that implementation. Is the result of the calculation a useful outcome? Is it realistic?	Describe in words what the outcome of the KPI says:
23.	Remarks	

A2. Measure numbering

The numbering of the measures is based on the IRIS measure tracker, which can be found online [21]

A2.1 Utrecht Demonstration measure tracker

Transition Track 1: Retrofit activities apartment buildings	
Measure 1	District wide PV
Measure 2	LT district heating
Measure 3	HEMS TOON
Measure 4	NZEB refurbishment
Measure 5	Smart (hybrid) e-heating systems
Measure 6	AC/DC home switchboxes
Measure 7	Smart DC Street Lighting
Transition Track 2: Placement Solar V2G charging points	
Measure 1	Solar V2G charging points for e-cars/e-vans (demand driven)
Measure 2	Solar V2G charging point for e-buses
Measure 3	Stationary storage in apartment buildings

Measure 4	EMSs- Smart Energy Management System
Transition Track 3	
Measure 1	V2G e-cars (demand driven)
Measure 2	V2G e-buses
Measure 3	V2G maintenance vans
Transition Track 4	
Measure 1	Monitoring E-Mobility with LoRa network
Measure 2	Smart Street Lighting with multi-sensoring
Measure 3	3D Utrecht City Innovation Model
Measure 4	Monitoring Grid Flexibility
Measure 5	Fighting Energy Poverty
Transition Track 5	
Measure 1	Community building by change agents
Measure 2	Campaign District School Involvement
Measure 3	Campaign Smart Street Lighting

Measure 4	Co-creation in Local Innovation Hub
Measure 5	VR New Home and District Experience

A2.2 Gothenburg Demonstration measure tracker

Transition Track / Measure Number	Measure title
Transition Track 1	
Demonstration 1	At least 200 kWh electricity storage in 2nd life batteries powered by 140 kW PV
Demonstration 2	Heating from geo energy with heat pumps (2-300 m deep boreholes)
Demonstration 3	Cooling from geo energy without chillers
Demonstration 4	Local energy storages consisting of water buffer tanks, structural storage and long-term storage in boreholes
Demonstration 5	Seasonal energy trading (cooling in summer season) with adjacent office block
Demonstration 6	Advanced Energy Management System to achieve peak shaving and minimal environmental impact
Demonstration 7	Building Integrated Photovoltaics (BIPV) in façade
Transition Track 2	
Demonstration 1	350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage
Demonstration 2	PCM cooling storage

Demonstration 3	Low temperature DH 45/30 system for six buildings
Demonstration 4	Integration and evaluation of a 200kWh energy storage
Transition Track 3	
Demonstration 1	EC2B, version for accomodation (Riksbyggen's BRF Viva)
Demonstration 2	EC2B, version for workplaces (Johanneberg campus area)
Transition Track 4	
Demonstration 1	CIM- City Information Model
Demonstration 2	Energy Cloud
Transition Track 5	
Measure 1	ME model
Measure 2	SCH - smart city hub
Measure 3	CD - continuous dialogue
Measure 4	ILC - inclusive life challenge
Measure 5	Minecraft competition
Measure 6	VR/3DBIM - building information modeling

Measure 7	PET - Personal Energy Treshold?

A2.3 Nice Demonstration measure tracker

Transition Track / Measure Number	Measure title
Measure 1: IS 1.1 (Positive Energy Building)	*Collective self-consumption at building scale (Palazzo Meridia)*
	Collective self-consumption at building scale (UNS-IMREDD)
Measure 2: IS 1.2 (Near zero energy retrofit)	Optimization of heating load curve
Measure 3: IS 1.2 (Near zero energy retrofit)	Commissioning process from the design of the operation
Measure 4: IS 1.3 (Symbiotic waste heat network)	Dashboard providing real-time energy balance

Transition Track 2	
Measure 1: IS 2.1 Flexible electricity grid networks	LEM - Local Energy Management system
Measure 2: IS 2.2 Smart district heating with innovative storage	DHC Smart District Heating and Cooling optimization algorithm
Measure 3: IS 2.3 Utilizing 2nd life batteries for large-scale storage	Stationary storage deployment in buildings and local electric flexibility management
Transition Track 3	
Measure 1: IS 3.1 Smart solar V2G EV charging	Deployment of a smart charging infrastructure (hardware and software).
Measure 2: IS 3.2 Innovative mobility services for the citizen	Free floating EV car sharing system

Transition Track 4	
Measure 1: IS 4.1 Services for urban monitoring	Sensors data collection in mobility through 5G IOT network
Measure 2: IS 4.2 Services for city management and planning	BIM/CIM data display
Measure 3: IS 4.3 Services for mobility	Charging infrastructure data for optimal EV-based free-floating car sharing
Measure 4: IS 4.4 Services for grid flexibility	Data interoperability with energy cloud
Transition Track 5	
Measure 1: IS 5.1 Co-creating the energy transition)	Public awareness campaign
Measure 2: IS 5.2 Participatory city modelling	Participation of citizens to city life
Measure 3: IS 5.4 Apps and I/F for energy efficient behavior	Citizens collective engagement
Measure 4: IS 5.4 Apps and I/F for energy efficient behavior	Citizen individual engagement

A3. KPI Numbering

The list of KPIs is updated in the IRIS measure tracker [21]. Below is the updated list as for February 2020.

KPI #	KPI name	KPI #	KPI name
1	Accessibility of open data	24	NOx emission
2	Access to vehicle sharing solutions for city travel	25	Number of connected urban objects
3	Advantages for end-users	26	Number of e-charging stations deployed in the area
4	Battery Degradation Rate	27	Number of efficient vehicles deployed in the area
5	Carbon dioxide Emission Reduction	28	Number of Free-Floating subscribers
6	Carbon monoxide emission reduction	29	Open data-based solutions
7	CO2 reduction cost efficiency	30	Participatory governance
8	Data loss prevention	31	Peak load reduction
9	Data safety	32	People reached
10	Degree of energy self-supply by RES	33	Platform downtime
11	Developer engagement	34	Reduced energy cost for costumers
12	Ease of use for end users of the solution	35	Reduced energy curtailment of RES and DER
13	Energy savings	37	Reduction in annual final energy consumption by street lighting
14	Expiration date of open data	38	Reduction in car ownership among tenants
15	Fine particulate matter emission	39	Reduction in driven km by tenants and employees in the district
16	Improved access to vehicle sharing solutions	41	Share of RES in ICT power supply
17	Increased awareness of energy usage	42	Storage capacity installed
18	Increased consciousness of citizenship	43	Trialability
19	Increased environmental awareness	44	Usage of open source software
20	Increase in Local Renewable Energy production	45	User engagement
21	Increased system flexibility for energy players/stakeholders	46	Yearly km driven in e-car sharing systems
22	Local community involvement in the implementation phase	47	Quality of open data
23	Local community involvement in the planning phase	51	Storage energy losses

A4. Overview of all data sources

A4.1Utrecht

Table 73 Overview of all data sources for the measurement of KPIs for Utrecht

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
1.1	Annual electricity generated by PV panels	kWh/y	TOON	Eneco
1.1	Annual Electricity consumption	kWh/y	TOON	Eneco
1.1	Electrical energy consumption by RES	kWh/y	TOON	Eneco
1.1	CO_2 coefficient for electricity in the Netherlands	Tonne / kWh	..	BoEx
1.1	Amount of PV installed after project	kWp	Project results	BoEx
1.2	Thermal energy consumption of the demonstration site	kWh/ m^{2}year	TOON	Eneco
1.2	Thermal energy reference demand or consumption [kWh/ m^{2}year]		From baseline	BoEx
1.2	Area of demonstration site	m^2	From building data	BoEx
1.2	Emission factor for fuel combustion	Tonne CO_2/ kWh	?	Eneco
1.2	Current energy price	Euro / kWh	..	Eneco
1.2	Annual costs of project	Euro / year	..	BoEx
1.3	Increased awareness of energy usage	Likert scale 1-5	Survey	BoEx
1.4	Thermal energy consumption of the demonstration site	kWh/y	TOON	Eneco
1.4	Thermal energy reference demand or consumption	kWh/ y	From baseline	BoEx
1.4	Area of demonstration site [	m^2	From building data	BoEx
1.4	Thermal energy consumption of the demonstration site	kWh/y	TOON	Eneco
1.4	Thermal energy reference demand or consumption	kWh/y	From baseline	BoEx
1.4	Emission factor for fuel combustion	Tonne CO_2/ kWh	Eneco	Eneco

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
1.4	Energy savings	kWh/y	KPI	BoEx
1.4	Current energy price	Euro/kWh	..	Eneco
1.4	CO_2 emission reduction	Tonne CO_2/y	KPI	BoEx
1.4	Annual costs of project	Euro/y	?	BoEx
1.5	Thermal energy consumption of the demonstration site	kWh/y	TOON	Eneco
1.5	Thermal energy reference demand or consumption	kWh/ y	From baseline	BoEx
1.5	Area of demonstration site [	m^2	From building data	BoEx
1.5	Thermal energy consumption of the demonstration site	kWh/y	TOON	Eneco
1.5	Thermal energy reference demand or consumption	kWh/y	From baseline	BoEx
1.5	Emission factor for fuel combustion	Tonne CO_2/ kWh	Eneco	Eneco
1.5	Energy savings	Euro	KPI	BoEx
1.5	Current energy price	Euro/kWh	..	Eneco
1.5	CO_2 emission reduction	Tonne CO_2/y	KPI	BoEx
1.5	Annual costs of project	Euro/y	?	BoEx
1.6	Annual Electricity consumption before solution	Euro/y	Information from tenant?	BoEx
1.6	Annual Electricity consumption after solution	Euro/y	TOON?	Eneco
1.6	Energy savings	kWh/y	KPI	BoEx
1.6	CO2 coefficient for electricity in the Netherlands	Tonne CO_2/kWh	BEST table	BoEx
1.7	Annual Electricity consumption of streetlighting	kWh/y	Luminext Luminizer telemanagement	UT
1.7	Electricity consumption for streetlighting before measure.	kWh/y	?	UT
1.7	CO_2 coefficient for electricity in the Netherlands	Tonne CO_2/kWh	BEST table	UT
2.1 – 2.4	Peak load reduction		Monitoring equipment Stedin	Stedin
3.1	Number of kilometres driven by the car-sharing fleet	m	LomboXnet monitoring system	LomboXnet

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
3.1	NOx emission factors for EVs	Tonne NOx/km	DoA	LomboXnet
3.1	NOx emission factors for comparable fossil fuel cars	Tonne NOx/km	DoA	LomboXnet
3.1	FPM emission factors for EVs	Tonne FPM/km	DoA	LomboXnet
3.1	FPM emission factors for comparable fossil fuel cars	Tonne FPM/km	DoA	LomboXnet
3.1	CO emission factors for EVs	Tonne CO/km	DoA	LomboXnet
3.1	CO emission factors for comparable fossil fuel cars	Tonne CO/km	DoA	LomboXnet
3.1	CO_2 emission factors for EVs	Tonne CO_2/km	DoA	LomboXnet
3.1	CO_2 emission factors for comparable fossil fuel cars	Tonne CO_2/km	DoA	LomboXnet
3.1	Number of vehicles available for sharing	#	LomboXnet monitoring system	LomboXnet
3.1	Number of inhabitants of target area	#	Municipality	LomboXnet
3.2	Number of kilometres driven by E-buses	Km	ViriCity monitoring system	LomboXnet
3.2	NOx emission factors for E-buses	Tonne NOx/km	DoA	LomboXnet
3.2	NOx emission factors for comparable fossil fuel buses	Tonne NOx/km	DoA	LomboXnet
3.2	FPM emission factors for E-buses	Tonne FPM/km	DoA	LomboXnet
3.2	FPM emission factors for comparable fossil fuel buses	Tonne FPM/km	DoA	LomboXnet
3.2	CO emission factors for E-buses	Tonne CO/km	DoA	LomboXnet
3.2	CO emission factors for comparable fossil fuel buses	Tonne CO/km	DoA	LomboXnet
3.2	CO_2 emission factors for E-buses	Tonne CO_2/km	DoA	LomboXnet
3.2	CO_2 emission factors for comparable fossil fuel buses	Tonne CO_2/km	DoA	LomboXnet
4.5	Thermal and Electric energy consumption of the demonstration site	kWh	TOON	Enenco

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
4.5	Thermal energy and electric reference demand or consumption	kWh/ m^2year	From baseline	Bo-Ex
4.5	Current energy price	Euro / kWh	Survey	Eneco
5.1	Increased environmental awareness	Likert scale	Survey	Municipality of Utrecht
5.1	Number of citizens reached	Integer	Survey	Municipality of Utrecht
5.1	Total number of citizens considered as the total target group of the project	Integer	Survey	Municipality of Utrecht
5.1	Local community involvement in the planning/ implementation phase	Integer	Survey	Municipality of Utrecht
5.2	Number of citizens reached	Integer	Survey	Municipality of Utrecht
5.2	Total number of citizens considered as the total target group of the project	Integer	Survey	Municipality of Utrecht
5.3	Ease of use for end users of the solution	Likert scale	Survey	Municipality of Utrecht
5.3	Advantages for end-users	Likert scale	Survey	Municipality of Utrecht
5.3	Local community involvement in the planning/ implementation phase	Likert scale	Survey	Municipality of Utrecht
5.4	Local community involvement in the planning/ implementation phase	Integer	Survey	Municipality of Utrecht
5.5	Ease of use for end users of the solution	Likert scale	Survey	Municipality of Utrecht

A4.2 Nice

Table 74 Overview of all data sources for the measurement of KPIs for NIce

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
1.1	Locally produced electrical energy (electricity generated by the PV panels)	kWh	Digital smart electricity meter	IMREDD
1.1	Electrical energy consumption (electricity demand only for building common areas)	kWh	Digital smart electricity meter	IMREDD
1.1	Electrical energy consumption (total building electricity demand)	kWh	Digital smart electricity meter	IMREDD
1.1	Electrical energy consumption (electricity imported from the grid)	kWh	Digital smart electricity meter	IMREDD
1.1	Electrical energy consumption (electricity exported to the grid)	kWh	Digital smart electricity meter	IMREDD
1.1	Electrical energy consumption (electricity provided by the battery to the building)	kWh	Digital smart electricity meter	IMREDD
1.1	Electrical energy consumption (electricity demand of auxiliary equipments of storage room - ventilation, micro controllers from EMS)	kWh	Digital smart electricity meter	IMREDD
1.1	Electrical energy consumption (electricity demand of auxiliary equipments of storage room - ventilation, micro controllers from BMS etc)	kWh	Digital smart electricity meter	IMREDD
1.1	Thermal energy consumption (total building **heat** demand)	kWh	Digital smart thermal meter	IMREDD
1.1	Thermal energy consumption (total building **cool** demand)	kWh	Digital smart thermal meter	IMREDD
1.1	Locally produced electrical energy (electricity generated by the PV panels)	kWh	Digital smart electricity meter	NEXITY
1.1	Electrical energy consumption (electricity demand only for building common areas)	kWh	Digital smart electricity meter	NEXITY
1.1	Electrical energy consumption (total building electricity demand)	kWh	Digital smart electricity meter	NEXITY
1.1	Electrical energy consumption (electricity imported from the grid)	kWh	Digital smart electricity meter	NEXITY
1.1	Electrical energy consumption (electricity exported to the grid)	kWh	Digital smart electricity meter	NEXITY

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
1.1	Electrical energy consumption (electricity provided by the battery to the building)	kWh	Digital smart electricity meter	NEXITY
1.1	Electrical energy consumption (electricity demand of auxiliary equipments of storage room - ventilation, micro controllers from EMS and BMS etc)	kWh	Digital smart electricity meter	NEXITY
1.1	Thermal energy consumption (total building heat and cool demand)	kWh	Digital smart thermal meter	NEXITY
1.2	Energy Savings	kWh	Existing smart meter	CAH
1.2	C02 Reduction Cost Efficiency	MWH, €	Smart Meter, Energy Bill	CAH
1.2	Carbon Dioxide Emission Reduction	kWh	Existing smart meter	CAH
1.2	Return on Investment	MWH, €	Smart Meter, Energy Bill	CAH
1.3	Thermal energy consumption (building heat demand per distribution system)	kWh	Digital smart thermal meter	COFELY
1.3	Indoor Air Temperature	°C	Air temperature sensor	COFELY
1.3	Outdoor Air Temperature	°C	Air temperature sensor	Meteo France
1.3	Solar Radiation	W/m²	Air temperature sensor	CAMS radiation Service (COPERNICUS)
2.1	Volume of PV Energy produced	MWh	Inverter	UNS/IMREDD, NEXITY/NEXITY PM
2.1	Volume of energy injected into the grid	MWh	Smart Meter	UNS/IMREDD, NEXITY; others
2.1	Total activated flexibility volume	MWh	Server	UNS/IMREDD, NEXITY;MNCA
2.1	Maximal electricity peak	MW	Smart Meter	UNS/IMREDD, NEXITY/NEXITY PM; IDEX;MNCA
2.1	Annual energy consumption	MWh	Smart Meter	UNS/IMREDD, NEXITY/NEXITY PM; IDEX;MNCA
2.1	PV injected into grid with retribution	kWh	Smart Meter	UNS/IMREDD, NEXITY/NEXITY PM; IDEX;MNCA

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
2.1	Storage capacity mobilized by the demonstration	kWh	Server	UNS/IMREDD, NEXITY/NEXITY PM
2.1	Storage capacity mobilized by the demonstration	kWh	Server	IMREDD; MNCA
2.1	Number of flexibility activations	n	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
2.1	Average capacity of flexibility activations	kW	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
2.1	Average volume of the capacity provided during activation	kWh	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
2.1	Average duration of activation	hours	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
2.1	Electricity bill	Euro	Energy bill	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
2.1	Income generated by PV resell	Euro	Energy bill	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
2.1	Income generated by flexibility activations	Euro	Energy bill	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
2.2	DHCN supply-heat	MWh	Smart Meter	IDEX;MNCA
2.2	DHCN supply-cold	MWh	Smart Meter	IDEX;MNCA
2.2	Maximal electricity peak	MW	Smart Meter	UNS/IMREDD, NEXITY/NEXITY PM; IDEX;MNCA
2.2	Maximal heating peak	MW	Smart Meter	IDEX;MNCA
2.2	Maximal cooling peak	MW	Smart Meter	IDEX;MNCA
2.2	Annual energy consumption	MWh	Smart Meter	UNS/IMREDD, NEXITY/NEXITY PM; IDEX;MNCA
2.2	Battery capacity as by constructor	Ah	Server	UNS/IMREDD
2.2	Heating Bill	Euro	Energy bill	UNS/IMREDD, NEXITY/NEXITY PM; DALKIA
2.2	Number of flexibility activations	Number	Server	UNS/IMREDD
2.3	Storage capacity mobilized by the demonstration	kWh	Server	IMREDD

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
2.3	Battery capacity as by constructor	Ah	Server	UNS/IMREDD, NEXITY/NEXITY PM
2.3	Battery capacity as by test	Ah	Server	UNS/IMREDD, NEXITY/NEXITY PM
2.3	Charge/discharge cycles for the BESS	Number	Server	UNS/IMREDD, NEXITY/NEXITY PM
2.3	Battery capacity as by constructor	Ah	Server	UNS/IMREDD
2.3	Battery capacity as by test	Ah	Server	UNS/IMREDD
2.3	Number of flexibility activations	Number	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
2.3	Average capacity of flexibility activations	kW	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
2.3	Average volume of the capacity provided during activation	kWh	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
2.3	Average duration of activation	hours	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
3.1	Total activated flexibility volume	kWh or MWh	Server	MNCA or EDF
3.1	Maximal electricity peak	kW or MW	Server	EDF or MNCA or ENEDIS
3.1	Cumulative V1G/V2G BESS capacity activated	kWh or MWh	Server	MNCA or EDF
3.1	Number of yearly flexibility activations	Number	Server	EDF
3.1	Average Power flexibility	kW or MW	Server	EDF
3.1	Average Energy flexibility	kWh or MWh	Server	EDF
3.1	Average activation duration	hours	Server	EDF
3.1	Expenses electricity	EUR	Energy bill	MNCA
3.1	Income energy services	EUR	N/A	EDF or MNCA
3.1	Supervised fast charging poles	Number	Server	EDF or MNCA
3.2	Access to vehicle sharing solutions for city travel	Number	AIMA (VULOG platform)	MNCA
3.2	Number of efficient vehicles deployed in the area	Number	AIMA (VULOG platform)	MNCA
3.2	Number of free floating subscribers	Number	AIMA (VULOG platform)	MNCA
4.2	Number of sensors connected to the CIP	Number	CIP	MNCA
4.2	Number of measurements added each day into the CIP	Number	CIP	MNCA

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
4.2	Number of consumers using datasets from the CIP	Number	CIP	MNCA
4.2	Number of people visiting the BIM/CIM dashboard at the SCIC	Number	CIP	MNCA
4.3	Number of datasets compliant with industry or governmental agencies standard data models	Number	CIP	MNCA
4.3	Total number of datasets	Number	CIP	MNCA
4.3	Ratings of the easiness of use of datasets on the Likert scale	Number (Likert scale)	Survey	MNCA
4.3	Number of datasets accessed from CIP producer/consumer APIs	Number	CIP	MNCA
4.3	Total number of datasets	Number	CIP	MNCA
4.4	PV production	MWh/year	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Energy injected into the grid	MWh/year	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	MAX elec peak	MW	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Elec consumption	MWh/year	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	PV production injected into the grid	MWh/year	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Cumulative V1G BESS storage capacity activated	kWh	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Cumulative 1st life BESS storage capacity	kWh	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Level of charge of the electric battery relative to its capacity	Number	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	SoC		Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Nominal 1st life BESS capacity	Ah	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
4.4	Final 1st life BESS capacity	Ah	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Number of cycles of 1st life batteries	Number	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Number of activations per year	Number	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Average Power flexibility	kW	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Average Energy flexibility	kWh	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
4.4	Average activation duration	sec	Server	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
5.2	Increase awareness of energy usage	Number (Likert scale)	Survey	Cofely
5.2	Increased environmental awareness	Number (Likert scale)	Survey	Cofely
5.2	Increased consciousness of citizens	Number (Likert scale)	Survey	Cofely
5.3	People reached	Number	Survey	Cofely
5.3	User engagement	Number	Survey	Cofely

A4.3 Gothenburg

Table 75 Overview of all data sources for the measurement of KPIs for Gothenburg

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
1.1	Hourly load curve from the apartments	Wh	Smart meters	Riksbyggen
1.1	Hourly electricity production from PVs	Wh	Smart meters	Riksbyggen
1.1	Hourly electricity delivered from the grid	Wh	Smart meter	Riksbyggen/Göteborg Energi
1.1	Hourly carbon intensity of the grid electricity	g CO2-e/Wh	N/A	Göteborg Energi
1.1	Monthly electricity production from PVs	Wh	Smart meter	Riksbyggen
1.1	Monthly electricity delivered from the grid	Wh	Smart meter	Riksbyggen

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
1.2	Monthly produced thermal energy in Viva	Wh	Smart meter	Riksbyggen
1.2	Monthly used thermal energy	Wh	Smart meters	Riksbyggen
1.2	Hourly thermal load curve from the apartments	Wh	Smart meters	Riksbyggen
1.2	Hourly thermal energy production in Viva	Wh	Smart meters	Riksbyggen
1.2	Hourly thermal energy delivered from the grid	Wh	Smart meter	Riksbyggen
1.2	Hourly carbon intensity of the DH grid	g CO_2 -e/Wh	N/A	Göteborg Energi
1.2	Yearly carbon dioxide Emission Reduction	tonnes/year	Calculation	Riksbyggen
1.2	Investment cost	€	Calculation	Riksbyggen
1.2	Service life	Years	N/A	Riksbyggen
1.2	Running costs	€/year	Calculation	Riksbyggen
1.3	Current levels of cooling used in CTP	Wh	Smart meter	CTP
1.3	Supplied amount of cooling by Viva	Wh	Smart meters	Riksbyggen
1.3	Associated energy usage	Wh	Smart meters	Riksbyggen
1.3	Hourly carbon intensity of the electricity grid	g CO_2 -e/Wh	N/A	Göteborg Energi
1.3	Yearly carbon dioxide Emission Reduction	tonnes CO_2 /year	Calculation	Riksbyggen
1.3	Investment cost	€	Calculation	Riksbyggen
1.3	Service life	Years	N/A	Riksbyggen
1.3	Running costs	€/Years	calculation	Riksbyggen
1.4	Volume of accumulator tanks	m3	N/A	Riksbyggen
1.4	Temperature interval of accumulator tanks	K	N/A	Riksbyggen
1.4	Conditioned floor area of Viva	m2	N/A	Riksbyggen
1.4	Storage capacity in the structure	Wh	N/A	Riksbyggen
1.4	Space heating demand	Wh	Smart meters	Riksbyggen
1.4	Hot tap water demand	Wh	Smart meters	Riksbyggen
1.4	Heat produced by heat pumps	Wh	Smart meter	Riksbyggen
1.4	Purchased DH	Wh	Smart meter	Riksbyggen
1.4	Hourly carbon intensity of the DH grid	g CO_2 -e/Wh	N/A	Göteborg Energi
1.4	Yearly carbon dioxide Emission Reduction	tonnes/year	Calculation	Riksbyggen
1.4	Investment cost	€	Calculation	Riksbyggen
1.4	Service life	Years	N/A	Riksbyggen
1.4	Running costs	€/year	Calculation	Riksbyggen

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
1.5	Purchased power to CTP	W	N/A	CTP
1.5	Purchased power to Viva	W	Smart meter	Riksbyggen
1.5	Annual peak power in CTP	W	N/A	CTP
1.5	Annual peak power in Viva	W	Smart Meter	Riksbyggen
1.5	First annual peak power in Viva	W	Smart meter	Riksbyggen
1.5	Monthly costs in CTP	€	Calculation	CTP
1.5	Monthly costs in Viva	€	Calculation	Riksbyggen
1.5	Hourly purchased electricity curves in CTP	Wh	Smart meter	CTP
1.5	Hourly purchased electricity curves in Viva	Wh	Smart meter	Riksbyggen
1.5	Hourly purchased heating curves in Viva	Wh	Smart meter	Riksbyggen
1.5	Monthly energy use during the first service year in Brf Viva before the seasonal energy trading is deployed.	Wh	Smart meter	Riksbyggen
1.5	Hourly carbon intensity of the DH grid	g CO_2 -e/Wh	N/A	Göteborg Energi
1.5	Hourly carbon intensity of the electricity grid	g CO_2 -e/Wh	N/A	Göteborg Energi
1.5	Yearly carbon dioxide Emission Reduction	tonnes/year	Calculation	Riksbyggen
1.5	Investment cost	€	Calculation	Riksbyggen
1.5	Service life	Years	N/A	Riksbyggen
1.5	Monthly purchased electricity in CTP	Wh	N/A	CTP
1.5	Monthly purchased electricity in Viva	Wh	Smart meter	Riksbyggen
1.5	Monthly purchased heating in Viva	Wh	Smart meter	Riksbyggen
1.6	Thermal energy demand	Wh	Smart meter	Riksbyggen
1.6	Purchased thermal energy	Wh	Smart meter	Riksbyggen
1.6	Electricity demand	Wh	Smart meter	Riksbyggen
1.6	Purchased electricity	Wh	Smart meter	Riksbyggen
1.6	Mean CoP in the heat pumps	N/A	Smart meters	Riksbyggen
1.6	Cost rates of purchased thermal energy	€/Wh	N/A	Göteborg Energi

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
1.6	Cost rates of purchased electricity	€/Wh	N/A	Göteborg Energi
1.6	Produced electricity in PVs	Wh	Smart meter	Riksbyggen
1.6	Hourly carbon intensity of the DH grid	g CO_2 -e/Wh	N/A	Göteborg Energi
1.6	Hourly carbon intensity of the electricity grid	g CO_2 -e/Wh	N/A	Göteborg Energi
1.6	Peak purchased thermal energy	W	Smart meters	Riksbyggen
1.6	Peak purchased electricity	W	Smart meters	Riksbyggen
1.6	Installed capacity of flexibility providers: Heat pumps, battery storage, accumulator tanks	W, Wh	N/A	Riksbyggen
1.7	Electricity production by BIPV in HSBLL	kWh	Smart Meter	HSB
1.7	Electricity usage in HSBLL	kWh	Smart Meter	HSB
2.1	Charging power to the batteries	kW	Smart meter	Akademiska Hus
2.1	Charged electricity to the batteries	kW, kWh	Smart meter	Akademiska Hus
2.1	Discharging power from the batteries	kW, kWh	Smart meter	Akademiska Hus
2.1	Discharged electricity from the batteries	kW, kWh	Smart meter	Akademiska Hus
2.1	Locally produced electricity	kW, kWh	Smart meter	Akademiska Hus
2.1	Total consumption of electricity	kW, kWh	Smart meter	Akademiska Hus
2.1	Storage capacity in the battery	kW, kWh	Smart meter	Akademiska Hus
2.2	Input cooling energy	kW, kWh	Smart meter	Akademiska Hus
2.2	Output cooling energy	kW, kWh	Smart meter	Akademiska Hus
2.2	Output cooling energy power from PCM	kW, kWh	Smart meter	Akademiska Hus
2.2	Electricity power used for cooling [kW] calculated from cooling production in chillers	kW, kWh	Smart meter	
2.4	Storage capacity in the batteries	Wh	Battery specifications from supplier and/or smart meters.	Riksbyggen
2.4	Used electricity	Wh	Smart meters	Riksbyggen
2.4	Purchased electricity	Wh	Smart meter	Riksbyggen
2.4	Used PV-generated electricity	Wh	Smart meter	Riksbyggen

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
2.4	Energy taken out from the batteries over time	Wh	Smart meter	Riksbyggen
2.4	Time in use	Years	N/A	Riksbyggen
2.4	Load cycles of the batteries	N/A	N/A	Riksbyggen
3.1	Km driven by tenants	Km	Travel survey	Trivector
3.1	Km driven in e-car sharing system	Km	Data from car sharing provider(s)	Trivector
3.1	Average CO_2 -emissions from vehicles used in the demonstration	CO_2 /km	Data from car sharing provider	Trivector
3.1	Ease of use for end users of the solution	Likert scale	Questionnaire	Trivector
3.1	Car ownership among tenants	Cars per apartment	Official statistics on registered cars	Trivector
3.2	Km driven by employees	Km	Travel survey	Trivector
3.2	Km driven in e-car sharing system	Km	Data from car sharing provider(s)	Trivector
3.2	Average CO_2 -emissions from vehicles used in the demonstration	CO_2 /km	Data from car sharing provider	Trivector
3.2	Ease of use for end users of the solution	Likert scale	Questionnaire	Trivector
3.2	Access to vehicle sharing solutions	Shared vehicles per number of employees in the area	Manual counting of number of vehicles available	Trivector
4.1	Number of datasets that are DCAT compliant in CIM pilot	Integer	N/A	Gothenburg City
4.1	Total number of datasets in CIM pilot	Integer	N/A	Gothenburg City
4.1	Number of applications using the API in the CIM pilot	Integer	N/A	Gothenburg City
4.1	Number of full purchased solutions from one single company used	Integer	N/A	Gothenburg City
4.2	Number of datasets that are REC (RealEstateCore) compliant in Energy Cloud demonstrator			
	Total number of datasets in Energy Cloud [integer]			
	Number of applications using the REC compliant datasets in			

TT.M	Variable name	Unit of measurement	Collection method (meter)	Responsible partner
	the Energy Cloud demonstrator [integer]			

A5. Document template: Monitoring

KPIs

Include here a table of selected KPIs, baseline (quantitative value) and target (quantitative value).

Lowest possible monitoring level, e.g. measure/building. If measures are combined/aggregated, this will be presented in Chapter 6.

In this sub-chapter, the table will summarize the contents (KPIs/parameters) of tables in Annex 1.

The more detailed description of each parameter (usually several parameters), will be presented in Annex

Table 76. Summary-list of KPIs and related parameters for Measure X / Building Y (one table per building/installation/measure) [example of KPI (Thermal) Energy savings]

KPI	Parameter(s)	Baseline	Target (as described in DoW or declared)
Energy savings (thermal)	Thermal energy consumption of the demonstration-site [kWh/year]	Baseline: Thermal energy reference demand or consumption (simulated or monitored) of demonstration-site [kWh/year]. Conditioned floor area [m^2]	Can be expressed as a % in savings, or kWh per year, etc.
	Conditioned floor area [m2]		

Monitoring plan

Describe how the monitoring should take place.

Timeline of activities; start of monitoring period, end of monitoring period.

A schematic diagram of the setup (if necessary).

Data collection approach: How the data will be collected for each measure; responsibilities, who (partner/subcontractor) is in charge of the data collection, it provides definitions on the (requirements for the) monitoring infrastructure, format of collected data, automation (?), frequency of data collection (also in Table 76).

A description of how the baseline is established for each measurement.

A6. Document template: Aggregation

Expected impact

In this sub-chapter you can summarize the aggregated expected impact of the measures/solutions for the transition track level, e.g. by using the targets from the Grant agreement and input from chapter 5.3.1 in this document.

Actions:

1. WP9 will cross check that performance data and selected indicators cover GA targets and clarify which indicators are common for the LH cities (and which are not), WP9 will send feedback to LHC coordinators TT leaders on recommended input to this chapter. For UTR and GOT, this is expected to be ready by mid-August.

Aggregation of KPIs for each LH city

Each LH city has its own set of KPIs that can be related to the IRIS KPI house; the top level of the house containing the IRIS level KPIs (IL) is however the same for all cities. On solution level (STT1-5), the KPIs may vary between the cities since different solutions are implemented in each city and the cities have different objectives, but in many cases the same KPIs can be found in all cities, thus allowing comparison between the Transition Tracks of the cities. For some Transition Tracks the evaluation of integrated solutions cannot be separated and the KPIs are hence calculated at Transition Track level (TT1-5). The KPIs for each transition track and possibilities to aggregate them are presented in D9.2.

Indicate position of KPIs to solutions/measures or transition track as related to the IRIS KPI-house in the table below.

Actions:

1. Partners are asked to fill in (for all measures) STT and TT level at this point (STT level if KPI is monitored for a measure/solution, TT level if KPI is monitored for a group of measures/solutions).
2. WP9 will, based on the cross-check of overall KPI repository and performance data, suggest possible aggregation of indicators to LC and IL levels.

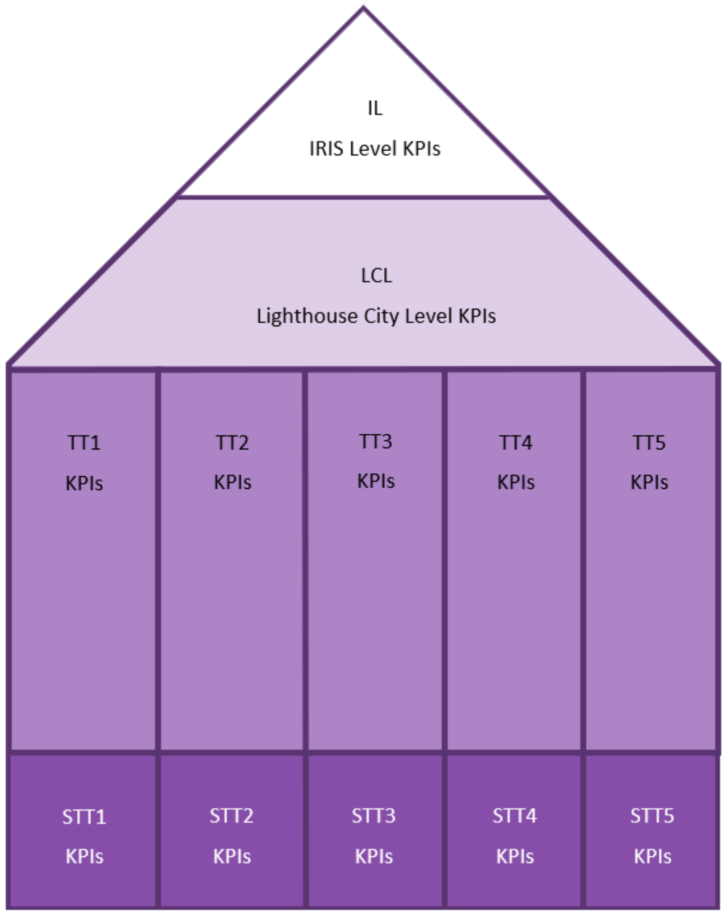

Figure 75 IRIS KPI-house. The KPIs presented in Tables 4-6 are, if possible, aggregated to transition track level (TT1-5) or higher.

Utrecht / Nice / Gothenburg

Table 77. Relation and possible aggregation of KPIs to solutions and the IRIS KPI-house.

KPIs	Solution	Proposed position in IRIS KPI-house
Access to vehicle sharing solutions for city travel	V2G e-car sharing system 'We Drive Solar'	
Advantages for end users	Evaluation and co-creation using the local innovation HUB given by TOON	
Carbon dioxide emission reduction	District-scale integrated PV-system RES and LT district heating Energy savings towards nZEB Smart hybrid electric heating and ventilation Small-scale demonstration of hybrid AC/DC switchbox Smart DC street lighting 18 Smart solar V2G chargers 10 Smart solar/wind V2G charging spots for e-buses in Westraven V2G e-car sharing system 'We Drive Solar'	

A7. Excerpt of table representing progress of monitoring plans

Utrecht Demonstration measure tracker

		KPI's are well defined	Clear monitoring pla	Appendices for eac	Clear planning with	Targets are specified	Baseline	Comments
		90%	50%	25%	0%			
Transition Track 1: Retrofit								
Measure 1	District wide PV							
Measure 2	LT district heating							
Measure 3	HEMS TOON							
Measure 4	NZEB refurbishment							
Measure 5	Smart (hybrid) e-heating systems							
Measure 6	AC/DC home switchboxes							
Measure 7	Smart DC Street Lighting							
Transition Track 2: Placement								
Measure 1	Solar V2G charging points for e-cars/e-vans (demand driven)							
Measure 2	Solar V2G charging point for e-buses							
Measure 3	EMSs- Smart Energy Management System							
Measure 4								
Transition Track 3								
Measure 1	V2G e-cars (demand driven)							
Measure 2	V2G e-buses							
Measure 3	V2G maintenance vans							
Transition Track 4								
Measure 1	Monitoring E-Mobility with LoRa network							
Measure 2	Smart Street Lighting with multi-sensoring							
Measure 3	3D Utrecht City Innovation Model							
Measure 4	Monitoring Grid Flexibility							
Measure 5	Fighting Energy Poverty							
Transition Track 5								
Measure 1	Community building by change agents							
Measure 2	Campaign District School Involvement							
Measure 3	Campaign Smart Street Lighting							
Measure 4	Co-creation in Local Innovation Hub							
Measure 5	VR New Home and District Experience							

A8. KPI list Utrecht

Demonstrating Transition Track #1: Smart renewables and near zero energy district

The demonstration activities of TT#1 on Smart renewables and near zero energy district in the lighthouse city of Utrecht comprise of the integration of a set of solutions integrated and deployed in 12 four-storey apartment buildings of social housing corporation BOEX (8 buildings with gas-infra; 4 with DH-infra, 644 apartments in total) and 3 school buildings (Kaleidoscoop, Schatkamer, MBO Utrecht). In particular:
- ***District-scale integrated PV-system*** installed on 12 apartment buildings and 3 schools and by means of open ICT interconnected to a district smart energy grid, leading in a high share of locally produced and consumed renewable power at district scale making PV profitable without subsidies.
- ***RES*** and ***LT district heating*** (to be demonstrated in 4 apartment buildings).
- ***Energy savings*** towards ***nZEB*** (***refurbishment*** of 12 apartment buildings from label E/F to A
- Installation of innovative HEMS (***home EMS TOON***) in all 644 apartments, providing feedback on energy consumption, the PV-system, hybrid E/G heating and ventilation and facilitating citizen engagement.
- ***Smart hybrid electric heating*** and ***ventilation*** will be demonstrated in 8 apartment buildings, using novel smart hybrid heat pumps for heating and hot water.
- Energy savings thanks to Small-scale demonstration of ***hybrid AC/DC switchbox*** power grid in 8 apartments.
- Medium-scale demonstration of ***smart DC street lighting*** (50 lamp posts allowing DC), powered by ***renewable energy***, providing district WiFi, dynamic and energy efficient lighting, powered by renewable energy.
- Installing performance testing and measurement equipment.

Targets:
(i) Energy savings in households of 81 %-86 %, resulting in 4,6 million kWh/year and 1.300 tonnes CO_2 reduction/year (BEST table),
(ii) Energy savings in street lighting of 20 MWh or 9 tonnes CO_2 reduction in 5 years, and
(iii) Increase renewables: from 0 MWp to 1,8 MWp PV-power integrated in the district micro-grid, or 100% of building power demand, and 667 MWh/yr wind power at sea for e-bus charging (BEST table)

A8.1 Transition track 1 KPIs at TT level

KPI	Unit	Definition	Source	Target
Energy savings	(kWh/(m2 year); MWh/(year))	The reduction of the energy consumption to reach the same services (e.g. comfort levels) after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(i)
Carbon dioxide emission reduction	tonnes CO_2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	(i)
Reduced energy costs for consumers	Euro/m2	Reduction in cost for energy consumption on an aggregated level, based on energy savings and current energy prices.	IRIS	
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

Degree of energetic self-supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	(iii)

A8.1.1 District-scale integrated PV-system

KPI	Unit	Definition	Source	Target
Degree of local renewable energy production	%	Ratio of produced energy from renewable production over a period (e.g. month, year)	CITYkeys	(iii)
Degree of energetic self-supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	
Carbon dioxide emission reduction	tonnes CO_2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	

A8.1.2 RES and LT district heating

Measured at TT level

A8.1.3 Energy savings towards nZEB

Measured at TT level

A8.1.4 Installation of innovative HEMS (home EMS TOON)

KPI	Unit	Definition	Source	Target
Increased awareness of energy usage/Increased environmental awareness	Likert	The extent to which the project has used opportunities for increasing awareness of energy use	IRIS	

A8.1.5 Smart hybrid electric heating and ventilation

Measured at TT level

A8.1.6 Small-scale demonstration of hybrid AC/DC switchbox

KPI	Unit	Definition	Source	Target
Energy savings	MWh/year	The reduction of the energy use compared to a situation without the switchbox.	SCIS	
Carbon dioxide emission reduction	tonnes CO_2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	

CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A8.1.7 Smart DC street lighting

KPI	Unit	Definition	Source	Target
Reduction in annual final energy consumption by street lighting	(kWh/yr)	The reduction of the energy consumption for street lighting	CITYkeys	
Energy savings	MWh/year	The reduction of the energy consumption to reach the same services (e.g. comfort levels) after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(ii)
Carbon dioxide emission reduction	tonnes CO_2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	(ii)

A8.2 Transition Track #2: Smart energy management and storage for flexibility

Demonstrating Transition Track #2: Smart energy management and storage for flexibility

In a front running solar and EV city like Utrecht, grid flexibility and self-consumption, provided by storage and smart energy management, are prerequisites for accommodating high shares of both PV-generation and shared e-mobility. Grid operator STED needs to accommodate large shares of renewables and e-mobility, while preventing grid stress due to PV-generation and e-charging peaks on the grid. Therefore, grid flexibility is crucial. Pre-proposal efforts have demonstrated the feasibility of
the Smart Solar Charging system: shared e-cars and public transport e-buses are charged with solar power, demand driven and bi-directional (V2G), to be able to sell solar power to the highest profit. Activities will be focusing on the integration of a district wide power storage system for maximum grid flexibility and self-consumption, consisting of primary storage (V2G batteries of e-cars and public transport e-buses) and additional secondary storage (stationary batteries in all buildings including 2nd life batteries), demonstrating how grid stress and grid investments are minimalized and how to best deploy storage at district level, supported by an open ICT system for interconnection, performance monitoring and cost effective new information services for aggregators, grid operators, municipality and citizens. The demonstration activities will comprise of the installation of:
- 18 ***smart solar V2G chargers*** in the district, at district scale ***interconnected with the PV-systems***
- 10 ***smart solar/wind V2G charging spots*** for ***e-buses*** in Westraven
- ***district-wide*** additional ***stationary storage*** in 12 apartment buildings, including ***2nd life batteries***, interconnected to primary V2G-storage and PV-systems by green ICT.
- ***district EMS***, the district ICT platform providing interconnection and monitoring at district scale, allowing deployment of the Universal Smart Energy Framework (USEF, fundament of the business model 'Value of Flexibility).

By further installing performance testing and measurement equipment, the ratio storage needed in e-car batteries to supplementary stationary storage will be analysed, allowing the optimisation of algorithms for integrated energy system, matching USEF standards.

Targets:

(i) Smart storage capacity of 396 kWh primary storage in V2G e-cars/ 3.600 kWh secondary storage (stationary batteries).
(ii) Local emissions of 1.300 ton CO_2 /year will be avoided from peak reduction.

A8.2.1 18 Smart solar V2G chargers

KPI	Unit	Definition	Source	Target
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS	

A8.2.2 10 Smart solar/wind V2G charging spots for e-buses in Westraven

KPI	Unit	Definition	Source	Target

Peak load reduction	%	Reduction in maximum peak load for the charging spots.	SCIS	
Reduced energy curtailment of RES and DER	%	Reduction of energy curtailment due to technical and operational problems	SCIS	
Carbon dioxide emission reduction	tonnes CO2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	(ii)
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year (input data may be difficult to obtain)	CITYkeys	

A8.2.3 District-wide additional stationary storage in 12 apartment buildings, including 2nd life batteries

KPI	Unit	Definition	Source	Target
Storage capacity installed	kWh	kWh storage capacity installed		(i)
Peak load reduction	%	Ratio of the peak demand reduction and peak demand before the measure	SCIS	
Increased Self-consumption of PV-energy by e-cars	kWh	Increase in use of solar energy generated in the district by the e-cars	IRIS	

A8.2.4 District EMS

KPI	Unit	Definition	Source	Target
Increased system flexibility for energy stakeholders	%	The change in load capacity participating in demand side management before and after the measure.	SCIS	

A8.3 Transition Track #3: Smart e-mobility

Demonstrating Transition Track #3: Smart e-mobility

Utrecht is a frontrunner in e-mobility, regarding the number of 4.035 e-cars and 260 charging stations in the city (as of December 2015). Furthermore, Utrecht introduced the first small-scale solar powered V2G pilot for public use in Europe in June 2015. Building upon this experience, a district wide V2G e-car sharing system will be installed, offering zero-emission mobility, decreasing household mobility costs, mostly powered by the sun. The sharing system is integrated with smart solar charging, using V2G charging systems that can load and unload the solar power stored in V2G batteries. As a result, the e-cars are mostly solar powered, grid stress is reduced thanks to the V2G storage, local air quality is improved and children get more room to play since less parking space is needed. LOM is provider of the Smart Solar Charging system, developed with STED in the preceding research pilot in the Lombok district in Utrecht (2012-2015).

The main demonstration activities in this task will focus on the **V2G e-car sharing system '*We Drive Solar*'**, consisting of 14 V2G e-cars (specially prepared Renault ZOEs) plus 4 V2G maintenance vans, along with 10 smart solar V2G e-buses that can be charged and discharged with locally produced solar and wind power for public transport. Furthermore, an analysis will be contacted on how citizens actually use the smart solar powered e-car sharing system 'We Drive Solar' and testing and co-creation of IT interfaces and **apps motivating citizens** to change their mobility patterns, adopting the mobility provided by the district wide V2G e-cars sharing system.

Targets:

(i) Air quality: Direct CO2 emission reduction: 308 tonnes in 5 yr (e-cars & e-vans) and 4785 tonnes in 5 yr (e-buses); Direct CO emission reduction: 3 tonnes in 5 y (e-cars & e-vans) and 1,6 tonnes (e-buses); Direct Fine dust emission reduction (PM10): 0,02 tonnes in 5 yr (e-cars & e-vans) and 0,26 tonnes in 5 yr (e-buses); Direct Soot emission reduction: 0,2 tonnes in 5 yr (e-cars & e-vans) and 0,6 tonnes in 5 yr (e-buses); Direct NOx emission reduction: 1 tonnes in 5 yr (e-cars & e-vans) and 22 tonnes in 5 yr (e-buses), and

(ii) Yearly 270.000 km are made through the e-car sharing system instead of private conventional cars (210.000 by e-cars and 60.000 by e-vans)

A8.3.1 V2G e-car sharing system 'We Drive Solar'

KPI	Unit	Definition	Source	Target
NOx emissions	%	Percentage reduction in NOx emissions (NO and NO2) achieved by the measure	CITYkeys	(i)
Fine particulate matter emissions (PM10)	%	Percentage reduction in PM10 emissions achieved by the measure	CITYkeys	(i)
CO emission reduction	%	Percentage reduction in carbon monoxide emissions achieved by the measure	IRIS	(i)
Carbon dioxide emission reduction	tonnes CO2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	(i)

Improved access to vehicle sharing solutions	Likert scale through observations/interviews	Improved accessibility to vehicle sharing solutions	CITYkeys	
Access to vehicle sharing solutions for city travel	Number of vehicles/100 000 inhabitants	Number of vehicles per 100 000 inhabitants	CITYkeys	
Yearly km driven in e-car sharing system	Km/year	Yearly km driven through the e-car sharing system instead of private conventional cars	IRIS	(ii)

A8.4 Transition Track #4: City Innovation Platform (CIP)

Demonstrating Transition Track #4: City Innovation Platform (CIP)

Cross-cutting ICT enables the integration of the above-mentioned solutions, maximising the profitability of the integrated infrastructure. To achieve this, open ICT-system and open APIs are necessary, providing the CIP and meaningful data services serving households, municipality and other stakeholders, together allowing for the new business models that emerge in the Utrecht lighthouse project. T5.6 concerns a large-scale demonstration of ICT enabling the integration of the above-mentioned energy and mobility solutions, and providing a CIP for meaningful information services, serving households, municipality and other stakeholders, including:
- Citizen info services: 3D Utrecht City Innovation Model, Smart Street Lighting Multi-sensoring,
- Municipality info services: City Data Market, Monitoring e-Mobility with LoRa network,
- Stakeholder info services: Monitoring Grid Flexibility, Fighting Energy Poverty

Targets:
(i) Information services realized, evaluated, optimized,
(ii) Green ICT: All V2G charging operations and EMSs are solar powered

A8.4.1 City Innovation Platform (CIP) and information services

KPI	Unit	Definition	Source	Target
Developer engagement	Number of API calls per month	Use of open datasets by developers	IRIS (WP1)	
Data safety	Attempts per month/ year	Number of blocked malicious hacking attempts	IRIS (WP1)	
Data loss prevention	Number of lost datapoints in a timeframe.	Lost datapoints in a period.	IRIS (WP1)	
Usage of open source software	Likert	How easy is it to connect systems	IRIS (WP1)	
Expiration date of open data	% of obsolete data on city data platform	Number of outdated datasets on a city platform per week	IRIS (WP1)	

Quality of open data	Number of standardized datasets	% of data that uses DCAT standards	IRIS (WP1)
Platform downtime	Minutes of downtime per (hour/day/ week/month)	Downtime per day	IRIS (WP1)
Open data-based solutions	New solutions per quarter	Number of services based on open data	IRIS (WP1)
User engagement	Number of users	Number of users involved	IRIS

A8.5 Transition Track #5: Citizen engagement and motivating feedback

Demonstrating Transition Track #5: Citizen engagement and motivating feedback

The Utrecht LH district Kanaleneiland is a challenging district, characterized by mainly social housing and schools. It is a densely populated district, home to in majority low-income and multicultural families. This calls for demonstrating extensive and innovative citizen engagement methods, resulting in citizens who understand, trust, use and feel ownership of the integrated energy and mobility solutions offered in their homes and district.

This task involves demonstration of **user-centred design methods for engaging households** in ***renewables***, ***energy efficiency*** and ***shared e-mobility***, based on the baseline definition (in ***T5.1***) of actual ***citizen energy*** and ***mobility behaviour***, ***citizen engagement***, ***neighbourhood dynamism***, ***demographic situation***, ***citizen concerns*** and other barriers hampering implementation. Housing corporation BOEX is very experienced in citizen engagement methods. Lessons learnt in pilots in the Utrecht and other Dutch cities will be applied: intrinsic motivation seems to be strongly related to personal interests (low and predictable bills and increased quality of life) and fun (infotainment), while ease of use, a sense of ownership and trust in the system and its providers are crucial preconditions.

Citizen engagement activities will include:

- ***Community building*** by means of ***change agents***, outdoor community building events and social media campaigns
- ***Campaign District school involvement*** to involve children and parents (through primary schools Kaleidoscoop and Schatkamer) and to provide ***training*** and ***possibly jobs*** to youngsters living in the district, while installing and maintaining the integrated smart solutions in the demo district (through professional school MBO Utrecht)
- ***Evaluation*** and ***co-creation*** using the Local Innovation Hub of the feedback given by the ***home EMS TOON*** in homes, to what extent is the interface motivating, easy to use, trusted, offering fun and lower energy bills. Citizen co-creation to develop a personal interface of HEMS and/or apps, suiting their specific needs (e.g. language, complexity).
- ***Campaign*** using ***Smart lamp posts*** for dynamic street lighting, powered by local renewable power, making a visible connection between renewables and improved quality of the living environment, safety and wellbeing.
- ***New Home & District Experience***, demonstrating a ***virtual reality platform***, extending the existing Oculus Rift VR experience for BOEX apartment buildings so households can experience their future 'new' home

and district, including infotainment and interactive training about the new smart energy and mobility services they may expect.

Targets:

(i) Citizen engagement is a conditional factor for reaching the energy savings of the renovations and of the e-car sharing system. In that sense, the energy saving of citizen engagement is 4.6 million kWh/year or 1.300 tonnes CO_2 reduction/year for the buildings. Plus 308 tonnes CO_2 reduction/year for the e-cars.

(ii) Actively engaging 200 out of 644 households through the measures mentioned above.

A8.5.1 Community building

KPI	Unit	Definition	Source	Target
Increased environmental awareness	Likert scale	The extent to which the project has used opportunities for increasing environmental awareness and educating about sustainability and the environment	CITYkeys (IRIS)	(i)
People reached	# people	Percentage of people in the target group that have been reached and/or are activated by the project	CITYkeys (IRIS)	(ii)
Local community involvement in planning/ implementation phase	Likert/ # change agents/ #events	The extent to which residents/users have been involved in the planning process (satisfaction of the involvement)	CITYkeys/ Eurbanlab; Green Digital Charter (IRIS, workshop)	

A8.5.2 Campaign District school involvement

KPI	Unit	Definition	Source	Target
People reached	# of students	People in the target group that have been reached and/or are activated by the project	CITYkeys (IRIS)	(ii)

A8.5.3 Evaluation and co-creation

KPI	Unit	Definition	Source	Target
Ease of use for end users of the solution	Likert	The extent to which the solution is perceived as difficult to understand and use for potential end users. (Satisfaction of tenants)	CITYkeys/ Eurbanlab (workshop)	
Advantages for end users	Likert / # lowered energy bills	The extent to which the project offers clear advantages for end users	CITYkeys/ Eurbanlab (IRIS)	
Local community involvement in	Local community	Survey	NA	3 on the scale of 1-

planning/ implementation phase	involvement in the planning/ implementation phase			5 (Likert Scale)

A8.5.4 Campaign using Smart lamp posts

KPI	Unit	Definition	Source	Target
Local community involvement in implementation phase	Likert/	The extent to which residents/users have been involved in the implementation process	CITYkeys (IRIS)	

A8.5.5 New Home & District Experience

KPI	Unit	Definition	Source	Target
Ease of use for end users of the solution	Likert	The extent to which the solution is perceived as difficult to understand and use for potential end users. (Satisfaction of tenants)	CITYkeys/ Eurbanlab	

A9. KPI list Nice

A9.1 Transition Track #1: Smart renewables and near zero energy district

The demonstration activities of TT#1 on smart renewables and near zero energy district in the lighthouse city of Nice will include a set of energy-efficient solutions and dedicated applications for users to raise awareness and promote behavioural change, integrated and deployed in 2 high-rise positive energy office buildings under construction and 3 high-rise apartment buildings (133 flats built in the sixteen's) refurbished with the objective to bring their energy performance close to nZEB in Nice. More specifically, activities carried out in the LH of Nice will try to demonstrate that energy consumption in new or existing buildings at an urban scale can be significantly reduced by:

- Promoting ***self-consumption of PV electricity*** in new office buildings equipped with battery systems
- Improving ***energy efficiency*** of 2 high-rise apartment buildings (social housing) by:
  - Rolling out a large panel of energy conservation measures (not funded through IRIS project)
  - Installing smart appliances for ***optimization of the heating load*** curve (from heating plant to end-users) in ***refurbished*** apartment buildings
  - Developing and testing ***energy awareness services***, including smart metering to track water and energy consumptions (hot water, cold water, electricity, space heating, internal temperature), data collection through wireless sensors network mesh (concentrators and data transmitters) for tenants (apartment buildings) and users (office buildings) to raise awareness and promote behavioural change
- A ***dedicated commissioning process will be put in place*** to check from the design to the operation that energy efficient technologies have been correctly implemented in refurbished apartment buildings. This process will be associated to a measurement and verification protocol to verify that other actions generate the expected energy savings.

- Developing and testing ***energy awareness services***, including smart metering to track water and energy consumptions (hot water, cold water, electricity, space heating, internal temperature), data collection through wireless sensors network mesh (concentrators and data transmitters) for tenants (apartment buildings) and users (office buildings) to raise awareness and promote behavioural change
- Installing an ***advanced and energy efficient urban waste heat recovery solution*** from sewage water ensuring primary energy and GHG emission savings (not funded through IRIS project). A dashboard that provides on real-time the energy balance of the district, the instantaneous energy available and the calculation of the optimal configuration will be developed, implemented and tested accordingly.

Targets: Success is measured in terms of (by 2022):

(i) Energy savings: 9.1 million kWh/year and 1.620 tonnes CO_2 reduction/year, and
(ii) Increase renewables: from almost 0 MWp to 4 MWp of installed PV power capacity in the 3 demonstration and replication areas.
(iii) 90 % of new buildings in Nice-Meridia connected to a geothermal district heating & cooling network.

A9.1.1 Collective self-consumption at building scale

KPI	Unit	Definition	Source	Target
Increase in local renewable energy production	% in kWh	Ratio of produced energy from renewable production over a period (e.g. month, year)	CITYkeys	(ii)
Degree of energetic self-supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	
Storage capacity installed	kWh	kWh storage capacity installed	IRIS	
Carbon dioxide Emission Reduction	tonnes CO_2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A9.1.2 Optimization of heating load curve

KPI	Unit	Definition	Source	Target
Energy savings	kWh/m2 year; MWh/year	The reduction of the energy consumption to reach the same services (e.g. comfort levels) after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(i)
Reduced energy costs for consumers	Euro/m2	Reduction in cost for energy consumption on an aggregated level, based on energy savings and current energy prices.	IRIS	
Carbon dioxide Emission Reduction	tonnes CO_2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	(i)
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A9.1.3 Commissioning process from the design to the operation

KPI	Unit	Definition	Source	Target
Energy savings	MWh/year	The reduction of the energy consumption to reach the same services (e.g. comfort levels) after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(i)
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS	

Carbon dioxide Emission Reduction	tonnes CO_2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	(i)
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A9.1.4 Dashboard

KPI	Unit	Definition	Source	Target
Energy savings	kWh/m2 year; MWh/year	The reduction of the energy consumption to reach the same services (e.g. comfort levels) after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(i)
Carbon dioxide Emission Reduction	tonnes CO_2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	(i)
Reduced energy costs for consumers	Euro/m2	Reduction in cost for energy consumption on an aggregated level, based on energy savings and current energy prices.	IRIS	
Increased awareness of energy usage	Likert	The extent to which the project has used opportunities for increasing awareness of energy use	IRIS	
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A9.2 Transition Track #2: Smart energy management and storage for flexibility

Activities carried out on TT#2 in the LH of Nice will try to demonstrate that smart energy management and storage at an urban scale can have a significant impact on reducing peak load and fuel spending, deferring investment in network reinforcement while still meeting carbon targets and reducing the need for a significant increase in reserve generation capacity. More specifically, the following activities will be supported by the IRIS project:

- Rolling out of around 403 000 smart meters (together with the supporting infrastructure) by the end of 2020 over the Metropolis of Nice Cote d'Azur (not funded through IRIS project).
- In case of bankable business model, development and test of a ***LEM*** on two areas: Grand Arenas and Nice Meridia. This solution will optimize at a district scale **a)** the energy consumption and energy bill reduction, reached through demand side response (to reduce peak demand), **b)** the implementation and management of self-consumption measures at building and district scales, **c)** the injection of PV surplus power into the grid properly remunerated, **d)** the management of EV charging ports, including peak shaving for distribution grids management, **e)** the deployment of a strategy to aggregate flexibilities, up- or downwards, to be valued on energy markets or through DSOs to release grid constraints and **f)** energy storage managements.
- Creation of a ***LT district heating and cooling network*** connected to a ***geothermal*** plant together with a centralized heat pump as backup (not funded through IRIS project).
- Deployment and test of smart DHC optimization algorithms, aggregating DHC connected building consumptions and production forecast, to minimize the production of heat/cold/electricity, by optimally matching production with the actual and forecasted needs.
- Deployment and test in the IMREDD building of ***2nd life batteries*** (associated to PV) as a reliable and cost-effective solution to manage at building scale peak loads and reduce demand charges and at urban scale as a reserve power.

Targets: Success is measured in terms of (by 2022):

(i) Energy savings: 1 million kWh/year and 420 tonnes CO_2 reduction/year, and
(ii) Storage capacity of 2120 kWh in the 2 demonstration and replication areas, and
(iii) V2G battery storage: 41 000 kWh/year.
(iv) Peak shaving: 3,1 MW
(v) CO2 reduction/year: 300 tonnes

A9.2.1 IS 2.1 - Flexible electricity grid networks

KPI	Unit	Definition	Source	Target
Energy savings	MWh/year	The reduction of the energy consumption to reach the same services (e.g. comfort levels) after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(i)
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS	(iv)
Storage capacity installed	kWh	kWh storage capacity installed	IRIS	(ii)
Reduced energy costs for consumers	Euro/m2	Reduction in cost for energy consumption on an aggregated level, based on energy savings and current energy prices.	IRIS	
Increased awareness of energy usage	Likert	The extent to which the project has used opportunities for increasing awareness of energy use	IRIS	
Increased system flexibility for energy players	%	The change in load capacity participating in demand side management before and after the measure.	SCIS	
Degree of energetic self-supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	
Reduced energy curtailment of RES and DER	%	Reduction of energy curtailment due to technical and operational problems	SCIS	
Carbon dioxide Emission Reduction	tonnes CO_2 /year	Reduction of emissions of carbon dioxide related to measure.	SCIS	(i), (v)
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A9.2.2 IS 2.2 – Smart district heating with innovative storage

KPI	Unit	Definition	Source	Target
Energy savings	MWh/year	The reduction of the energy consumption to reach the same services (e.g. comfort levels) after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(i)
Degree of energetic self-supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	
Carbon dioxide Emission Reduction	tonnes CO_2 /year	Reduction of emissions of carbon dioxide related to measure.	SCIS	

CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS

A9.2.3 Utilizing 2nd life batteries for smart large scale storage schemes

KPI	Unit	Definition	Source	Target
Storage capacity installed	kWh	kWh storage capacity installed	IRIS	(ii)
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS	(iv)
Battery degradation rate	%	Capacity losses of the batteries used in the project after use for a certain number of cycles or a specific time period.	InteGRIDy	
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year (input data may be difficult to obtain)	CITYkeys	(v)

A9.3 Transition Track #3: Smart e-mobility

Activities carried out on TT#3 on ***smart e-mobility*** will try to demonstrate that electric mobility could be boosted by the implementation of a second generation of EV car sharing system: the Free Floating project. To summarize this project: a simplified access to car anywhere anytime in such a way that the car rotation is five to ten times more than the former model (like actual AUTOBLEUE). This leads to a sustainable service having a real impact on the modal shift from private to public transport. The following activities will prepare the transition from AUTOBLEUE, launched in 2011, to Free Floating project:

- Developing and testing tools for positioning and operate rapid charge to optimize fleet rotation.
- Developing and testing tools for public/professional car sharing efficient mixt (mixing service like AUTOBLEUE & city Car Pool, working days and week end for example).
- Installing and testing a new SW module of supervision and business intelligence centre, on the operating mode.
- Applying business model for data collection such as air & noise.
- Developing a dynamic charge plan and car/charger interface.

Targets: Success is measured in terms of (by 2022):

(i) Number of EV: 2000,
(ii) Number of EV charging stations: 1000,
(iii) Number of Free Floating subscribers (resident, workers and long stay tourists): 100.000.
(iv) 1,829 ton CO_2 reduction/year
(v) NO_2 reduction/year: 7 %
(vi) PM10 reduction/year: 6%
(vii) PM2,5 reduction/year: 6%
(viii) 15 300 000 km yearly travelled with V2G cars
(ix) Peak shaving: 3,1 MW
(x) CO2 reduction/year: 300 tonnes

KPI	Unit	Definition	Source	Target
Improved access to vehicle sharing solutions	Likert scale through observations/interviews	Improved accessibility to vehicle sharing solutions	CITYkeys	
Access to vehicle sharing solutions for city travel	Number of vehicles/100 000 inhabitants	Number of vehicles per 100 000 inhabitants	CITYkeys	
Number of e-charging stations deployed in the area	#	Number of e-charging stations deployed in the defined area before and after implementation	SCIS	(ii)
Yearly km driven in e-car sharing system	Km/year	Yearly km driven through the e-car sharing system instead of private conventional cars	IRIS	
Number of efficient vehicles deployed in the area	Vehicles/km2	Number of efficient vehicles per square kilometre	SCIS	(i)

Number of Free Floating subscribers	# of subscribers	Number of subscribers in the free floating system	IRIS	(iii)
Ease of use for end users of the solution	Likert/app rating	The extent to which the solution is perceived as difficult to understand and use for potential end users	CITYkeys	
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year (input data may be difficult to obtain)	CITYkeys	

A9.4 Transition Track #4: City Innovation Platform (CIP)

Since 2011, Nice metropolis has been developing a ***digital data infrastructure*** as the backbone of the City Innovation platform to collect, aggregate and share all data generated on its territory by the activities of the local authority departments. The activities carried out by the TT #4 to build the CIP are:

- Build a ***Data Hub architecture*** to register and manage all connected sensors deployed on the territory (IoT) and to collect urban data produced by these sensors to fuel the existing mutualized city data warehouse;
- Architecture definition and Implementation of a generic programming interface based on standards (such as CitySDK) allowing external accesses to shared data and full interoperability with external databases implementing similar standard based programming interface and communication protocols;
- Architecture definition and implementation of a services oriented layer on top of the data Hub based on standards (such as FIWARE) to enable the development of value services by the city departments and by 3rd parties for both city operation purposes or commercial applications;
- Implements the IT resources in the platform to support big data processing based on local data analytics tools or cloud based tools in a SaaS mode;
- Develop a data management system to operate a city smart lab (called in Nice Smart City Innovation Centre) to enable the use of city data by academic research or industry;

The use of industry and European standards to design the open architecture model of the CIP will be instrumental to replicate the CIP model in any cities and to offer the required scaling flexibility.

Targets (by 2022):

(i) Implementation of standards such as FIWARE and CitySDK when relevant in the CIP model
(ii) Number of connected urban objects: >100.000
(iii) Support of mobile connected objects: connectivity with city fleet vehicles and city public transportation (tramways)
(iv) Development of applications using data retrieved simultaneously from the three CIPs of the LH cities Nice, Utrecht and Gothenburg.
(v) Apps developed & launched: 5

KPI	Unit	Definition	Source	Target
Number of connected urban objects	Number of objects	Number of connected urban objects in the CIP	IRIS	(ii)
Developer engagement	Number of API calls per month	Use of open datasets by developers	IRIS (WP1)	
Data safety	Attempts per month/ year	Number of blocked malicious hacking attempts	IRIS (WP1)	
Data loss prevention	Number of lost datapoints in a timeframe.	Lost datapoints in a period.	IRIS (WP1)	
Usage of open source software	Likert	How easy is it to connect systems	IRIS (WP1)	
Expiration date of open data	% of obsolete data on city data platform	Number of outdated datasets on a city platform per week	IRIS (WP1)	

Quality of open data	Number of standardized datasets	% of data that uses DCAT standards	IRIS (WP1)
Platform downtime	Minutes of downtime per (hour/day/ week/month)	Downtime per day	IRIS (WP1)
Open data-based solutions	New solutions per quarter	Number of services based on open data	IRIS (WP1) (v)
User engagement	Number of users	Number of users involved	IRIS

A9.5 Transition Track #5: Citizen engagement and motivating feedback

Activities carried out on TT#5 in the LH of Nice will demonstrate a set of user-centred design methods and activities for citizen engagement into energy efficiency and smarter cities solutions. Citizen engagement activities will include:

- Evaluation of the conditions leading households to change their behaviour in response to requests and notifications from energy providers (CITYOPT/ EnergyABC app) – this activity will highlight how a community approach, serious gaming and crowdfunding mechanisms can enhance citizen engagement and participation.
- Demonstration of the Civocracy online platform currently being implemented by Nice in the context of a collaboration agreement with the Civocracy start-up based in Amsterdam through Nice Metropolis. The IRIS demonstration will aim at connecting other cities in Europe using the same tool and launching joint discussions to exchange on best practices and exchange on common issues.
- Evaluation of energy feedback and awareness solutions in social housing (CUSA solution)

Targets:

(i) Feedback mechanism for households motivating them to save energy with 10%, to shift 10% of their energy consumption to off-peak periods.
(ii) Active engagement of 500+ households in the above-mentioned demonstration activities.

In addition to this, Nice will act as receiver for the following solutions demonstrated by Utrecht and Gothenburg: Citizen's engagement through Living Labs

A9.5.1 SERVICE BLEU (app for citizens to interact with the municipality by reporting small incidents)

KPI	Unit	Definition	Source	Target
People reached	# of people	People in the target group that have been reached and/or are activated by the project	CITYkeys (IRIS)	(ii)
Ease of use for end users of the solution	Likert	The extent to which the solution is perceived as difficult to understand and use for potential end users. (Satisfaction of tenants)	CITYkeys/ Eurbanlab (workshop)	(i)
Local community involvement in implementation phase	# of co-creation sessions	The extent to which residents/users have been involved in the implementation process	CITYkeys (IRIS)	(i)

A9.5.2 Smart Management of Peak Pollution

KPI	Unit	Definition	Source	Target
Increased environmental awareness	Likert	The extent to which the project has used opportunities for increasing environmental	CITYkeys (IRIS)	(i)

		awareness and educating about sustainability and the environment		
People reached	# of people	People in the target group that have been reached and/or are activated by the project	CITYkeys (IRIS)	(ii)
Ease of use for end users of the solution	Likert	The extent to which the solution is perceived as difficult to understand and use for potential end users. (Satisfaction of tenants)	CITYkeys/ Eurbanlab (workshop)	(i)

A9.5.3 CIVOCRACY

KPI	Unit	Definition	Source	Target
People reached	# of people	People in the target group that have been reached and/or are activated by the project	CITYkeys (IRIS)	(ii)
Ease of use for end users of the solution	Likert	The extent to which the solution is perceived as difficult to understand and use for potential end users. (Satisfaction of tenants)	CITYkeys/ Eurbanlab (workshop)	(i)
Local community involvement in planning phase	# of ideas being used by the city	The extent to which residents/users have been involved in the planning process (use of the involvement)	CITYkeys/ Eurbanlab; Green Digital Charter (workshop)	

A10. KPI list Gothenburg

A10.1 Demonstrating Transition track #1 Smart renewables and closed-loop energy positive districts

Gothenburg will demonstrate a positive energy sub-district consisting of 6 buildings (132 apartments). These buildings will be connected to a further 55 buildings on the Chalmers campus for trading surplus heating and cooling solar PV, Planned activities include:

1. Demonstration of at least 200 kWh electricity storage in 2nd life automotive (bus) batteries powered by 140kW local PV
2. Demonstration of heating from geo energy with heat pumps (2-300 m deep boreholes),
3. Demonstration of cooling from geo energy without chillers.
4. Demonstration of local energy storages consisting of water buffer tanks, structural (thermal inertia of the building) storage and long-term storage in boreholes
5. Demonstration of seasonal energy trading (cooling in summer season) with adjacent office block
6. Development and demonstration of advanced Energy Management System to integrate PV, DH, grid and all abovementioned storage options to achieve peak shaving and minimal environmental impact
7. Demonstration of how Building Integrated Photovoltaics (BIPV) can be used in façade renovation process

Targets:

(i) Sub-district energy consumption (target: <24 kWh/m2/a),
(ii) Peak power shaving (target: >80% reduction in peak power compared to control)
(iii) Net energy surplus on annual basis (target: >10 MWh/a)
(iv) Energy savings: 67 kWh/m2/y, or totally 1,5 GWh/y energy saving compared to average Swedish buildings
(v) Integrated PV power (420 kW)

A10.1.1 At least 200 kWh electricity storage in 2nd life automotive (bus) batteries powered by 140kW local PV

KPI	Unit	Definition	Source	Target
Carbon dioxide Emission Reduction	tonnes CO_2 /year	Reduction of emissions of carbon dioxide related to measure.	SCIS	
Energy savings	MWh/year	The reduction of the energy consumption to reach the same services (e.g. comfort levels) after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(iv)
Degree of energetic self-supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	(iii)

A10.1.2 Heating from geo energy with heat pumps (2-300 m deep boreholes)

KPI	Unit	Definition	Source	Target
Degree of energetic self-supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	(iii)
Carbon dioxide Emission Reduction	tonnes CO_2 /year	Reduction of emissions of carbon dioxide related to measure.	SCIS	
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A10.1.3 Cooling from geo energy without chillers

KPI	Unit	Definition	Source	Target
Degree of energetic self-supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	(iii)
Carbon dioxide Emission Reduction	tonnes CO_2 /year	Reduction of emissions of carbon dioxide related to measure.	SCIS	
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A10.1.4 Local energy storages

KPI	Unit	Definition	Source	Target

Storage capacity installed	kWh	kWh storage capacity installed	IRIS	(iii)
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS	
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A10.1.5 Seasonal energy trading (cooling in summer season) with adjacent office block

KPI	Unit	Definition	Source	Target
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS	(ii)
Reduced energy cost for consumers	Euro/m2	Reduction in cost for energy consumption on an aggregated level, based on energy savings and current energy prices.	IRIS	
Carbon dioxide Emission Reduction	tonnes CO_2 /year	Reduction of emissions of carbon dioxide related to measure.	SCIS	
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A10.1.6 Energy Management System to integrate PV, DH, grid and storage

KPI	Unit	Definition	Source	Target
Reduced energy cost for consumers	Euro/m2	Reduction in cost for energy consumption on an aggregated level, based on energy savings and current energy prices.	IRIS	
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS	(ii)
Increased system flexibility for energy players	%	The change in load capacity participating in demand side management before and after the measure.	SCIS	
Degree of energetic self-supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	(iii)
Carbon dioxide Emission Reduction	tonnes CO_2 /year	Reduction of emissions of carbon dioxide related to measure.	SCIS	

A10.1.7 Demonstration of how Building Integrated Photovoltaics (BIPV) can be used in roof and façade renovation process

KPI	Unit	Definition	Source	Target
Increase in local renewable energy production	% in kWh	Ratio of produced energy from renewable production over a period (e.g. month, year)	CITYkeys	(iii), (v)
Degree of energetic self-supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	
Carbon dioxide Emission Reduction	tonnes CO_2 /year	Reduction of emissions of carbon dioxide related to measure.	SCIS	
CO_2 reduction cost efficiency	Euro/ton CO_2 saved per year	Costs in euros per ton of CO_2 saved per year	CITYkeys	

A10.2 Demonstrating Transition Track #2: Smart energy management and storage for flexibility

In this task, Gothenburg will demonstrate:

1. A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage. The demonstration will include (i) PV and battery integration with energy management system, (ii) DC installations in building (e.g. LED lighting, pumps, fans and actuators), (iii) Regulatory and legislator aspects of DC installations in buildings
2. A low temperature DH 45/30 system for six buildings in Riksbyggen sub-district. Including a shallow geo energy solution where the boreholes also are used as long-time thermal storage and to cool nearby office buildings in summertime.
3. A 1 700 kWh PCM (Phase Change Material) pilot facility inside the JSP2-building in order to test different ways of storing energy for cooling purposes to reduce peak cooling power requirement
4. Integration and evaluation of a 200kWh energy storage with 10-14 2nd life Li-Ion batteries from electrical buses during 5-year operation in the Riksbyggen sub-district with 132 apartments that will be finalized in 2018. The batteries will store energy from solar PVs, balancing in that way the load of the building, including the charging of an electric vehicle pool, and providing energy to the grid

In addition to this, GOT will act as receiver for the following solutions demonstrated by UTR and NICE: Smart solar V2G EV charging and Wireless inductive charging.

Targets:

- (i) Electric storage capacity (target: 400 kWh),
- (ii) Cooling PCM storage capacity (target: 1 700 kWh),
- (iii) Peak power shaving from DC/PV/PCM installation (target >80 % peak power reduction).
- (iv) 105 MWh geothermal storage
- (v) 88 kWh V2G battery storage

A10.2.1 A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage

KPI	Unit	Definition	Source	Target
Degree of self-energetic supply by RES	%	Ratio of locally produced energy from RES and the energy consumption over a period (e.g. month, year)	SCIS	
Storage capacity installed	kWh	kWh storage capacity installed	IRIS	(i)
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS	(iii)

A10.2.2 A low temperature DH 45/30 system for six buildings in Riksbyggen sub-district

KPI	Unit	Definition	Source	Target

A10.2.3 A 1700 kWh PCM (Phase Change Material) pilot facility

KPI	Unit	Definition	Source	Target
Storage capacity installed	kWh	kWh storage capacity installed	IRIS	(ii)
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS	(iii)
Storage capacity installed	kWh	kWh storage capacity installed	IRIS	(i)

A10.2.4 Integration and evaluation of a 200kWh energy storage with 10-14 2nd life Li-Ion batteries

KPI	Unit	Definition	Source	Target
Storage capacity installed	kWh	kWh storage capacity installed	IRIS	(i)
Peak load reduction	%	Reduction in maximum peak load of a building or a group of buildings.	SCIS	
Battery degradation rate	%	Capacity losses of the batteries used in the project after use for a certain number of cycles or a specific time period.		

A10.3 Demonstrating Transition Track #3: smart e-mobility

One example is Riksbyggen's BRF Viva in Johanneberg, where the city has allowed the construction of a property of 132 apartments with no regular parking included. In this project, these two developments are brought together as the new MaaS concept EC2B is implemented in the district of Johanneberg.

EC2B is a new mobility concept that offers customers an attractive alternative to owning their own car, allowing easy a variety of transport modes (e-cars, e-bikes, public transport etc) in connection to where customers live and make their everyday choices for transport. A variety of electric vehicles and public transport suppliers already active in the district will provide the transportation services. The service will be augmented by an ICT system that will offer the users a seamless transport experience and also includes the possibility to create a sharing community among users. Furthermore, EC2B draws upon recent research about how users can be "nudged" towards more sustainable travel habits through receiving personalised information about their travel. EC2B will reduce car ownership and hence demand for parking space, which creates value for property developers as building parking lots and underground garages is very expensive. This also means space is released that can be used for other purposes, creating a more liveable city. In district Johanneberg, the EC2B e-mobility service will be implemented at two different levels.

a) In Riksbyggen's BRF Viva, tenants in the 132 apartments will get direct access to EC2B through accommodation, with specific measures implemented in connection to the building. They will have exclusive access to 4 electric cars (Renault), 2 light e-vehicles (Renault Twizy or similar), 4 electric cargo bikes and 5 electric bikes, as well as charging infrastructure for all types of electric vehicles (55 recharging polls for e-bikes, 4 for e-cars and 2 for light e-vehicles).

b) The other 15 000 residents/employees in the district (e.g. tenants to HSB and Akademiska Hus) will get access to a light version of EC2B, which includes information, community and access to e-mobility vehicles at several locations around the district but does not include specific measures in connection to each building.

Targets:

- (i) Direct CO_2 reduction: 1040 tonnes in 5 years;
- (ii) Car mileage among tenants and employees in the district reduced by 1 360 500 km/year
- (iii) Yearly, 904 000 km are made through EC2B (car-sharing, public transport etc) instead of with private, conventional cars.
- (iv) 5000 MWh/a saved in reduced car driving and shift to e-car

A10.3.1 EC2B for tenants of Brf VIVA

KPI	Unit	Definition	Source	Target
Improved access to vehicle sharing solutions	Likert scale through observations/ interviews	Improved accessibility to vehicle sharing solutions	CITYkeys	
Yearly km driven in e-car sharing system	Km/year	Yearly km driven through the e-car sharing system instead of private conventional cars	IRIS	(iii)
Reduction in driven km by tenants	Km/year	Km driven by employees and tenants in the district before and after implementation of the measure	IRIS	(ii)
Ease of use for end users of the solution	Likert/app rating	The extent to which the solution is perceived as difficult to understand and use for potential end users	CITYkeys	
Carbon dioxide Emission Reduction	tonnes CO_2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	(i)
Reduction in car ownership among tenants	Number of cars per apartment among tenants in Brf Viva	Number of care ownership among tenants before and after moving in to the demonstration area.	IRIS	
Energy savings	MWh/year	The reduction of the energy consumption to reach the same services after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(iv)

A10.3.2 EC2B for the Campus Joanneberg

KPI	Unit	Definition	Source	Target
Improved access to vehicle sharing solutions	Likert scale through observations/ interviews	Improved accessibility to vehicle sharing solutions	CITYkeys	
Yearly km driven in e-car sharing system	Km/year	Yearly km driven through the e-car sharing system instead of private conventional cars	IRIS	(iii)
Reduction in driven km by employees in the district	Km/year	Km driven by employees and tenants in the district before and after implementation of the measure	IRIS	(ii)
Ease of use for end users of the solution	Likert/app rating	The extent to which the solution is perceived as difficult to understand and use for potential end users	CITYkeys	

Carbon dioxide Emission Reduction	tonnes CO_2/year	Reduction of emissions of carbon dioxide related to measure.	SCIS	(i)
Reduction in car ownership among tenants	Number of cars per apartment among tenants in Brf Viva	Number of care ownership among tenants before and after moving in to the demonstration area.	IRIS	
Energy savings	MWh/year	The reduction of the energy consumption to reach the same services after the interventions, taking into consideration the energy consumption from the reference period.	SCIS	(iv)

A10.4 Demonstrating Transition Track #4: City Innovation Platform

Gothenburg will demonstrate the following solutions.

1. Implementation of a CIM (City Information Model) pilot that facilitates city management and planning by including building information, infrastructure, geodata and planning data in the Johanneberg district. In a digital model of the city, decisions, documents and plans can be connected to geographic locations, and forecasts, taking benefit of the visualization and planning application innovations provided by combining GIS (Geographical Information Systems) data with BIM (Building Information Model) data and 3D data in a way that captures both existing and planned structures to support the Urban area with analyses and maps. An innovation challenge will be held to stimulate the development of new applications making use of the CIM data.
2. Development and implementation an “Energy Cloud” on the Chalmers Campus. Near real-time data from energy (electricity, heat, water) consumption will be collected, integrated and made available for further analysis, thereby opening up for new applications to optimise energy supply and management on campus. For instance, setting maximum power limits dynamically adapting to varying consumption, predicting energy use automatically, analysing energy mix and calculating resulting CO_2 footprint and more. Additionally, a connection with Gothenburg City’s open data is foreseen to further enhance the scope and usefulness of potential applications. An innovation contest will be held to stimulate the development of new application making use of the Energy Cloud.

This task is closely linked to the work carried out in WP4 and will make use of those common features and structures that are developed within that work package. Targets:

(i) > 10 applications developed and launched by 3rd parties: new applications using the CIM (target: >5) and Energy Cloud (target: >5), respectively.
(ii) Peak shaving for the Chalmers Campus Area (target >80 % peak power reduction).
(iii) Green ICT - >50 % RE powers all ICT

A10.4.1 City Information Model (CIM)

KPI	Unit	Definition	Source	Target
Usage of open source software	Likert	How easy is it to connect systems	IRIS (WP1)	
Quality of open data	Number of standardized datasets	% of data that uses DCAT standards	IRIS (WP1)	
Open data-based solutions	New solutions per quarter	Number of services based on open data	IRIS (WP1)	(i)
Ease of use for end users of the solution	Likert/app rating	The extent to which the solution is perceived as difficult to understand and use for potential end users	CITYkeys	
Advantages for end users				

A10.4.2 Energy Cloud

KPI	Unit	Definition	Source	Target
Open data-based solutions	New solutions per quarter	Number of services based on open data	IRIS (WP1)	(i)
Quality of open data	Number of standardized datasets	% of data that uses DCAT standards	IRIS (WP1)	

A10.5 Demonstrating Transition track #5: Citizen engagement and motivating feedback

In Gothenburg, four solutions will be demonstrated that engage and involve citizens from different parts of society as participants and co-creators, thereby creating a strong momentum for innovation and ultimately, impact:

- **Spatial planning design contest** for children and youths based on a Minecraft® model of Gothenburg;
- **Citizen engagement** in the city of Gothenburg: a) Further develop the city's online citizen sourcing platform "Min Stad" (My City) b) Release more available data (smart city hub) c) Investigate and evaluate how to increase citizen interaction and engagement based on models of co-creation and collaborative innovation d) Invite and collect innovative ideas from citizens from an "Inclusive Life Competition"
- Demonstrate a BIM (Building Information Modelling) based **3D Virtual Reality Environment** that will virtually immerse users in the inner workings and properties of a building, providing deeper understanding and involvement in the building's processes. This demonstrator will be housed in the HSB Living Lab, where the innovative environment and extensive sensor network will provide relevant inputs to the demonstrator.
- Demonstrate the **Personal Energy Threshold** (PET), to motivate actively engaged users to change their energy consumption behaviour. This tool will integrate real-time data on energy production and consumption (availability and demand), and thus enable end-users in their homes to actively contribute to peak shaving in smart energy networks by providing them with alternatives on how to modulate their energy needs, matching the currently available energy mix from the grid, local PV, local energy storages, etc.

Targets:

(i) Number of participants in spatial planning contest (target: >100),
(ii) Inflow of ideas for "Green Life" contest (target: 200),
(iii) Infrastructure added to "Min Stad" (>25 % of existing infrastructure in the district).

A10.5.1 Min Stad (My City) as a dialogue tool for citizen engagement

KPI	Unit	Definition	Source	Target
User engagement	# of participants and/or ideas (yearly)	People participating in online platform (Min stad)	CITYkeys (workshop)	
Local community involvement in planning phase	# of workshops with citizens / Likert (survey/ interviews)	The extent to which residents/users have been involved in the planning process (Workshops and satisfaction of involvement)	CITYkeys/ Eurbanlab; Green Digital Charter (workshop)	

A10.5.2 Minecraft as a dialogue tool for citizen engagement

KPI	Unit	Definition	Source	Target
Local community involvement in planning phase	Likert scale by interviews, survey or observation	The extent to which residents/users have been involved in the planning process (satisfaction of the involvement in the competition)	CITYkeys/ Eurbanlab; Green Digital Charter (IRIS, workshop)	

A10.5.3 VR/AR visualisation of BIM and sensor data

KPI	Unit	Definition	Source	Target
Increased environmental awareness	Likert	The extent to which the project has used opportunities for increasing environmental awareness and educating about sustainability and the environment	CITYkeys	
Ease of use for end users of the solution	Likert/app rating	The extent to which the solution is perceived as difficult to understand and use for potential end users	CITYkeys	

A10.5.4 Personal Energy Threshold (PET)

KPI	Unit	Definition	Source	Target
Increased environmental awareness	Likert scale	The extent to which the project has used opportunities for increasing environmental awareness and educating about sustainability and the environment	CITYkeys	

A11. Data Utrecht

A11.1 TT1

For the KPIs for this Transition Track, the main data parameters consist of energy usage data at apartment building level. As part of IRIS, Civity has made a data connection in the CIP aggregated data from Eneco Toon. The data from Eneco Toon will primarily be used to report on the different KPIs.

Table 78 Description of Energy usage data for KPIs in TT#1.

No	Parameter	Value
1	Data Variable Name	Energy usage data
2	Measure Number	KPIs at TT#1 level Measures 1-6
3	KPI Number	5, 13, 34
4	Units of measurement	kWh / m^2 GFA m^3 gas / m^2 GFA GJ / m^2 GFA
5	Baseline (of data variable)	Current energy consumption
6	Meter	Electricity: Eneco Toon and central meter Gas: Eneco Toon and central meter DH: central meter
7	Location of measurement	Apartment building
8	Data accuracy	Standard required accuracy of meters
9	Collection interval	15 minutes, but aggregated to hourly data for Eneco Toon data
10	Start of measurements	Eneco Toon: after installation Central meters: already started before IRIS
11	End of measurements	Measurements will continue after the project.
12	Expected availability	Confidential; Eneco Toon data are gathered by Eneco and provided to the CIP as aggregated data (hourly and at building level). Stedin and Eneco can supply aggregated data of the central meters.
13	Expected accessibility	Online, but requires authentication
14	Data format	Data link between Eneco and CIP.
15	Data owner	Eneco and Stedin
16	Comments	

Table 79 Description of Construction costs for TT#1

No	Parameter	Value
1	Data Variable Name	Construction costs
2	Measure Number	KPI at TT#1 level
3	KPI Number	7
4	Units of measurement	Euro
5	Baseline (of data variable)	n/a
6	Meter	n/a
7	Location of measurement	n/a
8	Data accuracy	n/a
9	Collection interval	Yearly
10	Start of measurements	Start of refurbishment of apartment building
11	End of measurements	After refurbishment of apartment building
12	Expected availability	Confidential
13	Expected accessibility	Offline
14	Data format	Excel
15	Data owner	Bo-Ex
16	Comments	

Table 80 Description of Electricity generated by PV-panels for measure 1

No	Parameter	Value
1	Data Variable Name	Electricity generated by PV-panels
2	Measure Number	1
3	KPI Number	10, 20, 5
4	Units of measurement	kWh
5	Baseline (of data variable)	0
6	Meter	Eneco Toon
7	Location of measurement	Apartment building
8	Data accuracy	Standard required accuracy of meters
9	Collection interval	15 minutes, but aggregated to hourly data
10	Start of measurements	After installation PV-panels
11	End of measurements	Measurements will continue after the project.
12	Expected availability	Confidential
13	Expected accessibility	Online, but requires authentication
14	Data format	Data link between Eneco and CIP.
15	Data owner	Eneco
16	Comments	

Table 81 Description of Opinion of tenants for measure 4

No	Parameter	Value
1	Data Variable Name	Opinion of tenants
2	Measure Number	4
3	KPI Number	17
4	Units of measurement	Likert scale
5	Baseline (of data variable)	n/a
6	Meter	Questionnaire
7	Location of measurement	Apartment building
8	Data accuracy	n/a
9	Collection interval	Once
10	Start of measurements	After refurbishment of apartment building
11	End of measurements	After refurbishment of apartment building
12	Expected availability	Confidential
13	Expected accessibility	Offline
14	Data format	Excel with anonymized results
15	Data owner	Bo-Ex
16	Comments	

Table 82 Description of Electricity consumption for measure 7

No	Parameter	Value
1	Data Variable Name	Electricity consumption
2	Measure Number	7
3	KPI Number	37
4	Units of measurement	kWh
5	Baseline (of data variable)	Current electricity consumption street lighting
6	Meter	Electricity meter
7	Location of measurement	District
8	Data accuracy	Standard required accuracy of meters
9	Collection interval	Daily
10	Start of measurements	Already started before IRIS
11	End of measurements	Measurement continues after IRIS
12	Expected availability	Confidential
13	Expected accessibility	Online, but requires authentication
14	Data format	TBD
15	Data owner	Municipality of Utrecht
16	Comments	

A11.2 TT2

The Peak Power will be measured using a set of electricity meters in the district, measuring powers of:

- Apartment buildings (apartments, solar power systems)
- V2G E-car charging stations
- Stationary battery
- Transformers in the district.

All these meters will be owned and operated by Stedin using their normal hard- and software. Exactly what meters will appear where, is currently being engineered. Here, a table is filled in for a generic electricity meter.

Table 83 Description of parameter Peak Power

No	Parameter	Value
1	Data Variable Name	Electric power / peak power
2	Measure Number	2
3	KPI Number	1
4	Units of measurement	W
5	Baseline (of data variable)	Power through same meter in absence of smart energy management
6	Meter	Smart meter
7	Location of measurement	- Apartment buildings (apartments, solar power systems) - V2G E-car charging stations - Stationary battery - Transformers in the district
8	Data accuracy	Standard required accuracy of smart meter
9	Collection interval	15 minutes
10	Start of measurements	2020
11	End of measurements	Measurements will continue after the project.
12	Expected availability	Confidential; Stedin can supply aggregated data on demand.
13	Expected accessibility	Online, but requires authentication
14	Data format	To be decided.
15	Data owner	Stedin
16	Comments	

A11.3 TT3

For the KPIs for this Transition Track, the main data parameter is the total number of kilometers driven by the shared e-cars. Civity has a data connection to the LomboXnet car management system that will be used to report on the different KPIs.

Table 84 Description of km driven measurements for Measure 1.

No	Parameter	Value
1	Data Variable Name	Km driven by shared e-cars in the district
2	Measure Number	1
3	KPI Number	1, 2, 3, 4, 6
4	Units of measurement	km total for all shared e-cars
5	Baseline (of data variable)	Zero
6	Meter	Km-counters in all shared e-cars
7	Location of measurement	In the e-cars
8	Data accuracy	Standard car km-counter accuracy
9	Collection interval	After each car sharing transaction
10	Start of measurements	2019
11	End of measurements	Measurements will continue after end of project.
12	Expected availability	Confidential
13	Expected accessibility	Online but requires authentication
14	Data format	OCPI-connection between Civity and We Drive Solar
15	Data owner	We Drive Solar
16	Comments	

A12. Data Nice

A12.1 TT1

Measure 1 – IMREDD Building

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Locally produced electrical energy (electricity generated by the PV panels)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Local renewable energy production
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	Measurements are done by PV inverters and are located on the 2nd floor of the building in a technical room.
9	Data accuracy How accurate is the measurement	±5% with output power below 20% ±3% with output power above 20% ±4% for all statistical data
10	Collection interval *How often the data is recorded*	1 min
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	2-3-2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	2-3-2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	JSON standard FIWARE
16	Data owner *i.e. the name of the company that will give access to data*	IMREDD

17	Comments *Further info*	Data will be available on the CIP

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity demand only for building common areas)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	Distributed measurement
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	2-3-2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	2-3-2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	JSON standard FIWARE
16	Data owner *i.e. the name of the company that will give access to data*	IMREDD
17	Comments *Further info*	Data will be available on the CIP

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (total building electricity demand)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	Electrical room
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	Once a year (maximum precision every 10 min)
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	2-3-2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	2-3-2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	JSON standard FIWARE
16	Data owner *i.e. the name of the company that will give access to data*	IMREDD
17	Comments *Further info*	Data will be available on the CIP and provided by ENEDIS

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity imported from the grid)
2	Transition Track Number	TT1

3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	Electrical room
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	Once a year (maximum precision every 10 min)
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	2-3-2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	2-3-2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	JSON standard FIWARE
16	Data owner *i.e. the name of the company that will give access to data*	IMREDD
17	Comments *Further info*	Data will be available on the CIP and provided by ENEDIS

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity exported to the grid)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency

5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	Electrical room
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	Once a year (maximum precision every 10 min)
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	2-3-2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	2-3-2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	JSON standard FIWARE
16	Data owner *i.e. the name of the company that will give access to data*	IMREDD
17	Comments *Further info*	Data will be available on the CIP and provided by ENEDIS

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity provided by the battery to the building)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable)	No baseline (new building)

	e.g. relating to BaU or previous performance data	
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	2-3-2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	2-3-2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	JSON standard FIWARE
16	Data owner *i.e. the name of the company that will give access to data*	IMREDD
17	Comments *Further info*	Data will be available on the CIP provided by the EMS

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity demand of auxiliary equipments of storage room - ventilation, micro controllers from EMS)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter	Digital smart electricity meter

	i.e. smart meter, survey, energy bill, etc.	
8	Location of measurement *Where the measurements take place*	2nd floor, EMS technical room
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	2-3-2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	2-3-2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	JSON standard FIWARE
16	Data owner *i.e. the name of the company that will give access to data*	IMREDD
17	Comments *Further info*	Data will be available on the CIP

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity demand of auxiliary equipments of storage room - ventilation, micro controllers from BMS etc)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter

8	Location of measurement *Where the measurements take place*	Underground parking area, battery technical room
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	2-3-2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	2-3-2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	JSON standard FIWARE
16	Data owner *i.e. the name of the company that will give access to data*	IMREDD
17	Comments *Further info*	Data will be available on the CIP

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Thermal energy consumption (total building **heat** demand)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart thermal meter
8	Location of measurement *Where the measurements take place*	Heating Substation
9	Data accuracy *How accurate is the measurement*	±2% between Qmin et Qmax

10	Collection interval *How often the data is recorded*	4 seconds
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	2-3-2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	2-3-2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	JSON standard FIWARE
16	Data owner *i.e. the name of the company that will give access to data*	IMREDD
17	Comments *Further info*	Data will be available on the CIP Pollutherm WFD FS DN100 70m3/h + Carte MOD-Bus RTU V3 pollutherm/pollustat E-24VAC + Bloc Alim 24V Pour Pollutherm/Stat FW2 E

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Thermal energy consumption (total building **cool** demand)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart thermal meter
8	Location of measurement *Where the measurements take place*	Cooling Substation
9	Data accuracy *How accurate is the measurement*	±2% between Qmin et Qmax
10	Collection interval *How often the data is recorded*	4 seconds

11	Start of measurements *i.e. 1-1-2019, 0:00CET*	2-3-2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	2-3-2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	JSON standard FIWARE
16	Data owner *i.e. the name of the company that will give access to data*	IMREDD
17	Comments Further info	Data will be available on the CIP Pollutherm WFD FS DN125 100m3/h + Carte MOD-Bus RTU V3 pollutherm/pollustat E-24VAC + Bloc Alim 24V Pour Pollutherm/Stat FW2 E

Measure 1 – PALAZZO MERIDIA Building

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Locally produced electrical energy (electricity generated by the PV panels)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Local renewable energy production
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	

11	Start of measurements *i.e. 1-1-2019, 0:00CET*	20/01/2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	30/09/2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	
16	Data owner *i.e. the name of the company that will give access to data*	NEXITY
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity demand only for building common areas)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	20/01/2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	30/09/2022

13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	
16	Data owner *i.e. the name of the company that will give access to data*	NEXITY
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (total building electricity demand)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	20/01/2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	30/09/2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility	Online, but requires authentication

	i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline	
15	Data format *i.e. csv file, json…*	
16	Data owner *i.e. the name of the company that will give access to data*	NEXITY
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity imported from the grid)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	20/01/2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	30/09/2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication

15	Data format *i.e. csv file, json…*	
16	Data owner *i.e. the name of the company that will give access to data*	NEXITY
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity exported to the grid)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	20/01/2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	30/09/2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	
16	Data owner	NEXITY

	i.e. the name of the company that will give access to data	
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity provided by the battery to the building)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	20/01/2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	30/09/2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	
16	Data owner *i.e. the name of the company that will give access to data*	NEXITY
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Electrical energy consumption (electricity demand of auxiliary equipments of storage room - ventilation, micro controllers from EMS and BMS etc)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Degree of energy self-supply Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart electricity meter
8	Location of measurement *Where the measurements take place*	
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	20/01/2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	30/09/2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	
16	Data owner *i.e. the name of the company that will give access to data*	NEXITY
17	Comments *Further info*	

No	Parameter	Value

1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Thermal energy consumption (total building heat and cool demand)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M1- Collective self-consumption at building scale
4	KPI *KPI('s) that are related to the data*	Carbon dioxide emission reduction Energy savings CO2 reduction cost efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	kWh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	No baseline (new building)
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart thermal meter
8	Location of measurement *Where the measurements take place*	
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	20/01/2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	30/09/2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Public
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	
16	Data owner *i.e. the name of the company that will give access to data*	NEXITY
17	Comments *Further info*	

Measure 2

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Energy Savings
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M2 - Optimization of heating load curve
4	KPI *KPI('s) that are related to the data*	Energy Savings
5	Units of measurement *i.e. KWh, Euro, etc.*	Kwh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	Heating energy for previous year(s) (e.g. 2018) times CO2 factor for natural gas
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Existing smart meter
8	Location of measurement *Where the measurements take place*	Substation
9	Data accuracy *How accurate is the measurement*	Margin of error : 1%
10	Collection interval *How often the data is recorded*	Monthly
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	June 2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	September 2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Confidential
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication,
15	Data format *i.e. csv file, json…*	CSV
16	Data owner *i.e. the name of the company that will give access to data*	CAH
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	C02 Reduction Cost Efficiency

2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M2 - Optimization of heating load curve
4	KPI *KPI('s) that are related to the data*	C02 Reduction Cost Efficiency
5	Units of measurement *i.e. KWh, Euro, etc.*	MWH, €
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	*PGO = 39,62€/MWh* *PH0 = 61,8€/MWh*; PH includes the heating losses between the boiler room and the substation Invoices of January 2019 for energy price
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Smart Meter, Energy Bill
8	Location of measurement *Where the measurements take place*	Substation
9	Data accuracy *How accurate is the measurement*	Margin of A0 : 1%
10	Collection interval *How often the data is recorded*	Monthly
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	June 2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	September 2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Confidential
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online but requires authentication
15	Data format *i.e. csv file, json…*	CSV
16	Data owner *i.e. the name of the company that will give access to data*	CAH
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Carbon Dioxide Emission Reduction
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M2 - Optimization of heating load curve

4	KPI *KPI('s) that are related to the data*	Carbon dioxide emission reduction
5	Units of measurement *i.e. KWh, Euro, etc.*	Kwh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	Heating energy for previous year(s) (e.g. 2018) times CO2 factor for natural gas
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Existing smart meter
8	Location of measurement *Where the measurements take place*	Substation
9	Data accuracy *How accurate is the measurement*	Margin of error : 1%
10	Collection interval *How often the data is recorded*	Monthly
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	June 2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	September 2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Confidential
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication,
15	Data format *i.e. csv file, json…*	CSV
16	Data owner *i.e. the name of the company that will give access to data*	CAH
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Carbon Dioxide Emission Reduction
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M2 - Optimization of heating load curve
4	KPI *KPI('s) that are related to the data*	Carbon dioxide emission reduction
5	Units of measurement *i.e. KWh, Euro, etc.*	Kwh
6	Baseline (of data variable)	Heating energy for previous year(s) (e.g. 2018) times CO2 factor for natural gas

	e.g. relating to BaU or previous performance data	
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Existing smart meter
8	Location of measurement *Where the measurements take place*	Substation
9	Data accuracy *How accurate is the measurement*	Margin of error : 1%
10	Collection interval *How often the data is recorded*	Monthly
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	June 2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	September 2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Confidential
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication,
15	Data format *i.e. csv file, json…*	CSV
16	Data owner *i.e. the name of the company that will give access to data*	CAH
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Return on Investment
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M2 - Optimization of heating load curve
4	KPI *KPI('s) that are related to the data*	Return on Investment
5	Units of measurement *i.e. KWh, Euro, etc.*	MWH, €
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	*PGO = 39,62€/MWh* *PH0 = 61,8€/MWh*; PH includes the heating losses between the boiler room and the substation Invoices of January 2019 for energy price
7	Meter	Smart Meter, Energy Bill

	i.e. smart meter, survey, energy bill, etc.	
8	Location of measurement *Where the measurements take place*	Substation
9	Data accuracy *How accurate is the measurement*	Margin of error : 1%
10	Collection interval *How often the data is recorded*	Monthly
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	June 2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	September 2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Confidential
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online but requires authentication
15	Data format *i.e. csv file, json…*	CSV
16	Data owner *i.e. the name of the company that will give access to data*	CAH
17	Comments *Further info*	

Measure 3

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Thermal energy consumption (building heat demand per distribution system)
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M3 - Commissioning process from the design to the operation
4	KPI *KPI('s) that are related to the data*	Data loss prevention Energy savings
5	Units of measurement *i.e. KWh, Euro, etc.*	Kwh
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	Monitoring periods before IS2 is implemented
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Digital smart thermal meter
8	Location of measurement *Where the measurements take place*	District heating substation room

9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	
12	End of measurements *i.e. 31-12-2020, 24:00CET*	
13	Expected availability *i.e. open data, public, confidential, no data available*	Open data
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	
16	Data owner *i.e. the name of the company that will give access to data*	COFELY
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Indoor Air Temperature
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M3 - Commissioning process from the design to the operation
4	KPI *KPI('s) that are related to the data*	Data loss prevention Energy savings
5	Units of measurement *i.e. KWh, Euro, etc.*	°C
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	Monitoring periods before IS2 is implemented
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Air temperature sensor
8	Location of measurement *Where the measurements take place*	In each housing living room.
9	Data accuracy *How accurate is the measurement*	0.3-0.5 °C
10	Collection interval *How often the data is recorded*	
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	

12	End of measurements *i.e. 31-12-2020, 24:00CET*	
13	Expected availability *i.e. open data, public, confidential, no data available*	Open data
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online, but requires authentication
15	Data format *i.e. csv file, json…*	
16	Data owner *i.e. the name of the company that will give access to data*	COFELY
17	Comments *Further info*	50% of apartments must be equipped with air temperature sensors at least

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Outdoor Air Temperature
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M3 - Commissioning process from the design to the operation
4	KPI *KPI('s) that are related to the data*	Data loss prevention Energy savings
5	Units of measurement *i.e. KWh, Euro, etc.*	°C
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	Monitoring periods before IS2 is implemented
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Air temperature sensor
8	Location of measurement *Where the measurements take place*	In nearby NICE airport station
9	Data accuracy *How accurate is the measurement*	0.1 °C
10	Collection interval *How often the data is recorded*	1 hour
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	01/01/1990
12	End of measurements *i.e. 31-12-2020, 24:00CET*	01/01/2100
13	Expected availability *i.e. open data, public, confidential, no data available*	Open data
14	Expected accessibility	Open data

	i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline	
15	Data format *i.e. csv file, json…*	csv
16	Data owner *i.e. the name of the company that will give access to data*	Meteo France
17	Comments *Further info*	

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	Solar Radiation
2	Transition Track Number	TT1
3	Measure Number *As it is stated in the measure tracker*	M3 - Commissioning process from the design to the operation
4	KPI *KPI('s) that are related to the data*	Data loss prevention Energy savings
5	Units of measurement *i.e. KWh, Euro, etc.*	W/m^2
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	Monitoring periods before IS2 is implemented
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Air temperature sensor
8	Location of measurement *Where the measurements take place*	In nearby NICE airport station
9	Data accuracy *How accurate is the measurement*	Estimation of accuracy of the data is provided in this publication : https://hal-mines-paristech.archives-ouvertes.fr/hal-01074107/document
10	Collection interval *How often the data is recorded*	1 hour
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	01/01/2005
12	End of measurements *i.e. 31-12-2020, 24:00CET*	01/01/2100
13	Expected availability *i.e. open data, public, confidential, no data available*	Open data
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Open data

15	Data format *i.e. csv file, json…*	csv
16	Data owner *i.e. the name of the company that will give access to data*	CAMS radiation Service (COPERNICUS)
17	Comments *Further info*	

A12.2 TT2

Parameter	Value	PV production	Energy injected into the grid	Flexibility volume	Heating energy provided	Cooling energy provided	Electricity peak	HVAC heating peak	HVAC cooling peak	Elec consumption	PV production injected into the grid
Data Variable Name	i.e. Thermal energy consumption, locally produced electrical energy, etc.	Volume of PV energy produced	Volume of energy injected into the grid	Total activations of flexibility volume	DHCN supply - heat	DHCN supply - cold	Maximal electricity peak			Annual energy consumption	PV injected into the grid with batteries
Measure Number As it is stated in the measure tracker	As described in the measure tracker, https://docs.google.com/spreadsheets/d/...	5.2.1	5.2.1	5.2.1	5.2.2	5.2.2	5.2.1, 5.2.2	5.2.2	5.2.2	5.2.1, 5.2.2	5.2.1
KPI Number	KPI(s) that are related to the data as described	11, 5, 5.4, 56	11	5, 21	11, 5, 56, 58	11, 5, 56, 14	11, 21	11	11	56	56 (Ratio of self-consumed PV)
Units of measurement	i.e. kWh, Euro, etc.	[MWh]	[MWh]	[MWh]	[MWh]	[MWh]	[MW]	[MW]	[MW]	[MWh]	[MWh]
Baseline (of data variable)	e.g. relating to BAU or previous performance data	N/A	N/A	N/A	N/A	N/A	Calculated	Calculated	Calculated	N/A	N/A
Meter	i.e. smart meter, survey, energy bill, ...	Inverter	Smart Meter	Server	Smart Meter	Smart Meter	Smart Meter	Smart Meter	Smart Meter	Smart Meter	Smart meter
Location of measurement	Where the measurements take place	Inverter (UNS/IMREDD/Nexity buildings)	Substation (UNS/IMREDD/Nexity buildings)	Substation (UNS/IMREDD/Nexity buildings)	NM Energy station	NM Energy station	Substation (UNS/IMREDD/Nexity buildings)	NM Energy station	NM Energy station	Substation (UNS/IMREDD/Nexity buildings), NM Energy station	Substation (UNS/IMREDD/Nexity buildings)
Data accuracy	How accurate is the measurement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Collection interval	How often the data is recorded	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly
Start of measurements	i.e. 1-1-2019, 0:00:01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
End of measurements	i.e. 31-12-2020, 24:00:01	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project
Expected availability	i.e. open data, public, confidential, ...	Public	Public	Public	Public	Public	Public	Public	Public	Public	Public
Expected accessibility	i.e. 1) online without access	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline
Data format	i.e. csv file, json, ...	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv
Data owner	i.e. the name of the company that owns the data	UNS/IMREDD, Nexity/Nexity PM	UNS/IMREDD, Nexity, others	UNS/IMREDD, Nexity, MNCA	IDEX, MNCA	IDEX, MNCA	UNS/IMREDD, Nexity/Nexity PM, IDEX, MNCA	IDEX, MNCA	IDEX, MNCA	UNS/IMREDD, Nexity/Nexity PM, IDEX, MNCA	UNS/IMREDD, Nexity/Nexity PM, IDEX, MNCA
Data provider	i.e. the name of the company that will give access to data	UNS/IMREDD, Nexity, EDF SEI, [illegible]	UNS/IMREDD, Nexity, EDF SEI, IMREDD	EDF SEI	MNCA	MNCA	IMREDD, MNCA	MNCA	MNCA	IMREDD	EDF / EDF SEI
Comments	Further info										

No.	Parameter	Value	Activated 1st life BESS capacity	Activated V2G BESS capacity (public and private)	Activated 2nd life BESS capacity	Activated V2G BESS capacity	Nominal 1st life battery storage	Final 1st life battery storage capacity	Number of cycles of 1st life BESS	Nominal 2nd life BESS capacity	Nominal V2G BESS capacity	Final 2nd life battery storage capacity
1	Data Variable Name	i.e. Thermal energy consumption, locally produced electrical energy, etc.	Storage capacity mobilised by the demonstration	Storage capacity mobilised by the demonstration	Storage capacity mobilised by the demonstration	Storage capacity mobilised by the demonstration	Battery capacity as by constructor	Battery capacity as by test	Charge/discharge cycles for the BESS	Battery capacity as by constructor	Battery capacity as by constructor	Battery capacity as by test
2	Measure Number As it is stated in the measure tracker	As described in the measure tracker, https://docs.google.com/spreadsheets/d/...	2.1	2.1	2.3	2.3	2.3	2.3	2.3	2.2	2.3	2.3
3	KPI Number	KPI(s) that are related to the data as described	56 (Useful storage capacity)	56	56	56	4	4	1	1	4	4
4	Units of measurement	i.e. kWh, Euro, etc.	[MWh]	[MWh]	[MWh]	[kWh]	[Ah]	[Ah]	[-]	[Ah]	[Ah]	[Ah]
	Baseline (of data variable)	e.g. relating to BAU or previous performance data	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	Meter	i.e. smart meter, survey, energy bill, ...	Server	Server	Server	Server	Server	Server	Server	Server	Server	Server
7	Location of measurement	Where the measurements take place	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server
8	Data accuracy	How accurate is the measurement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	Collection interval	How often the data is recorded	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly
10	Start of measurements	i.e. 1-1-2019, 0:00:01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	End of measurements	i.e. 31-12-2020, 24:00:01	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project
12	Expected availability	i.e. open data, public, confidential, ...	Public	Public	Public	Public	Public	Public	Public	Public	Public	Public
13	Expected accessibility	i.e. 1) online without access	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline
14	Data format	i.e. csv file, json, ...	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv
15	Data owner	i.e. the name of the company that owns the data	UNS/IMREDD, Nexity/Nexity PM	IMREDD, MNCA	IMREDD	IMREDD	UNS/IMREDD, Nexity/Nexity PM	UNS/IMREDD, Nexity/Nexity PM	UNS/IMREDD, Nexity/Nexity PM	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD
15	Data provider	i.e. the name of the company that will give access to data	EDF / EDF SEI	EDF / EDF SEI	IMREDD	IMREDD	EDF / EDF SEI	EDF / EDF SEI	EDF / EDF SEI	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD
16	Comments	Further info										

Parameter	Value	Final V2G battery storage capacity	Number of cycles of 2nd life battery	Number of cycles of V2G battery	Number of activations per year	Average Power flexibility	Average Energy flexibility	Average activation duration	Expenses electricity	Income PV injection	Income energy services
Data Variable Name	i.e. Thermal energy consumption, locally produced electrical energy, etc.	Battery capacity as by test	Charge/discharge cycles for the BESS	Charge/discharge cycles for the BESS	Number of flexibility activations	Average capacity of flexibility activations	Average volume of the capacity provided during activation	Average duration of activation	Electricity bill	Income generated by PV re-sell	Income generated by flexibility activations
Measure Number As it is stated in the measure tracker	As described in the measure tracker, https://docs.google.com/spreadsheets/d/...	2.3	2.3	2.3	2.1, 2.3	2.1, 2.3	2.1, 2.3	2.1, 2.3	2.1	2.1	2.1
KPI Number	KPI(s) that are related to the data as described	4	4	4	21	21	21	21	44	44	44
Units of measurement	i.e. kWh, Euro, etc.	[Ah]	[-]	[-]	[-]	[MW]	[MWh]	[hour]	[EUR]	[EUR]	[EUR]
Baseline (of data variable)	e.g. relating to BAU or previous performance data	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Calculated	N/A	N/A
Meter	i.e. smart meter, survey, energy bill, ...	Server	Server	Server	Server	Server	Server	Server	Energy bill	Energy bill	Energy bill
Location of measurement	Where the measurements take place	BESS/Server	Server	Server	Server	Server	Server	Server	N/A	N/A	N/A
Data accuracy	How accurate is the measurement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Collection interval	How often the data is recorded	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly
Start of measurements	i.e. 1-1-2019, 0:00:01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
End of measurements	i.e. 31-12-2020, 24:00:01	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project
Expected availability	i.e. open data, public, confidential, ...	Public	Public	Public	Public	Public	Public	Public	Public	Public	Public
Expected accessibility	i.e. 1) online without access	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline
Data format	i.e. csv file, json, ...	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv
Data owner	i.e. the name of the company that owns the data	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD, Nexity/Nexity PM, MNCA	UNS/IMREDD, Nexity/Nexity PM, MNCA	UNS/IMREDD, Nexity/Nexity PM, MNCA	UNS/IMREDD, Nexity/Nexity PM, MNCA	UNS/IMREDD, Nexity/Nexity PM, MNCA	UNS/IMREDD, Nexity/Nexity PM, MNCA	UNS/IMREDD, Nexity/Nexity PM, MNCA
Data provider	i.e. the name of the company that will give access to data	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	EDF / EDF SEI	EDF / EDF SEI	EDF / EDF SEI	EDF / EDF SEI	UNS/IMREDD, Nexity/Nexity PM, MNCA	UNS/IMREDD, Nexity/Nexity PM, MNCA, EDF / EDF SEI	UNS/IMREDD, Nexity/Nexity PM, MNCA, [illegible]
Comments	Further info										

No.	Parameter	Value	Heating expenses (fixed-variable)	Cooling expenses (fixed-variable)	2nd life - Number of activations per year	2nd life - Average Power Flexibility	2nd life - Average Energy Flexibility	2nd life - Average activation duration	V2G - Number of activations per year	V2G - Average Power Flexibility	V2G - Average Energy Flexibility	V2G - Average activation duration
1	Data Variable Name	i.e. thermal energy consumption, locally produced electrical energy, etc.	Heating bill	Heating bill	Number of flexibility activations	Average capacity of flexibility activations	Average volume of the capacity provided during activation	Average duration of activation	Number of flexibility activations	Average capacity of flexibility activations	Average volume of the capacity provided during activation	Average duration of activation
2	Measure Number As it is stated in the measure tracker	As described in the measure tracker, https://docs.google.com/spreadsheets/d/1D...	2.2	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
3	KPI Number	KPI(s) that are related to the data as described	[illegible]	[illegible]	21	21	21	21	21	21	21	21
4	Units of measurement	i.e. kWh, Euro, etc.	[EUR]	[EUR]	[-]	[kW]	[kWh]	[hours]	[-]	[kW]	[kWh]	[hours]
	Baseline (if data variable)	e.g. relating to BAU or previous performance data	Calculated	Calculated	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	Method	i.e. smart meter, survey, energy bill,	Energy bill	Energy bill	Sensor	Sensor	Sensor	Sensor	Sensor	Sensor	Sensor	Sensor
7	Location of measurement	Where the measurements take place	N/A	N/A	Sensor	Sensor	Sensor	Sensor	Sensor	Sensor	Sensor	Sensor
8	Data accuracy	How accurate is the measurement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	Collection interval	How often the data is recorded	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly
10	Start of measurements	i.e. 1-1-2019, 01:00:00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	End of measurements	i.e. 31-12-2020, 24:00:00	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project
12	Expected availability	i.e. open data, public, confidential,	Public	Public	Public	Public	Public	Public	Public	Public	Public	Public
13	Expected accessibility	i.e. (i) online without access	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline
14	Data format	i.e. csv file, json, ...	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv
15	Data owner	i.e. the name of the company that owns the data	UNS/IMREDD, NCAH/NCAH PM, MNCA, CAUCA	UNS/IMREDD, NCAH/NCAH PM, MNCA, CAUCA	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD
15	Data provider	i.e. the name of the company that will give access to data	EDF, MNCA	EDF, MNCA	UNS/IMREDD, EDF	UNS/IMREDD, EDF	UNS/IMREDD, EDF	UNS/IMREDD, EDF	UNS/IMREDD, EDF	UNS/IMREDD, EDF	UNS/IMREDD, EDF	UNS/IMREDD, EDF
16	Comments	Further info										

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List of monitoring parameters for IS 3.1

No	Parameter	Flexibility volume	Max elec peak	Activated useful storage capacity	Number of activations per year	Average Power flexibility	Average Energy flexibility	Average activation duration	Expenses electricity	Income energy services	Supervised fast charging poles
1	*Data Variable Name*	Total activated flexibility volume	Maximal electricity peak	Cumulative V1G/V2G BESS capacity activated	Number of yearly flexibility activations	Average capacity of flexibility activations	Average volume of the capacity provided during activation	Average duration of activation	Electricity bill	Income generated by flexibility activations	Number of charging poles which have been connected to the smart charging platform
2	*Measure Number*	IS 3.1	IS 3.1	IS 3.1	IS 3.1	IS 3.1	IS 3.1	IS 3.1	IS 3.1	IS 3.1	IS 3.1
3	*KPI Number*	1	2	3	4	5	6	7	8	9	10
4	*Units of measurement*	kWh or MWh	kW or MW	kWh or MWh	number	kW or MW	kWh or MWh	hours	EUR	EUR	number
	Baseline (of data variable)	Calculated	Calculated	N/A	N/A	N/A	N/A	N/A	Previous energy bills	N/A	N/A
6	*Meter*	Server	Server	Server	Server	Server	Server	Server	Energy bill	N/A	Server
7	*Location of measurement*	Nice, France	Nice, France	Nice, France	Nice, France	Nice, France	Nice, France	Nice, France	Nice, France	Nice, France	Nice, France
8	*Data accuracy*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	*Collection interval*	At least yearly	At least yearly	At least yearly	At least yearly	At least yearly	At least yearly	At least yearly	At least yearly	At least yearly	At least yearly

10	*Start of measurements*	Depending on charging stations availability	Depending on charging stations availability	Depending on charging stations availability	Depending on charging stations availability	Depending on charging stations availability	Depending on charging stations availability	Depending on charging stations availability	Depending on charging stations availability	Depending on charging stations availability	Depending on charging stations availability
11	*End of measurements*	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project
12	*Expected availability*	Confidential	Confidential	Confidential	Confidential	Confidential	Confidential	Confidential	Confidential	Confidential	Public
13	*Expected accessibility*	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline
14	*Data format*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	*Data owner*	MNCA or EDF	EDF or MNCA or ENEDIS	MNCA or EDF	EDF	EDF	EDF	EDF	MNCA	EDF or MNCA	EDF or MNCA
16	*Comments*	To be updated once demonstration plan and related legal arrangements are settled	To be updated once demonstration plan and related legal arrangements are settled	To be updated once demonstration plan and related legal arrangements are settled	To be updated once demonstration plan and related legal arrangements are settled	To be updated once demonstration plan and related legal arrangements are settled	To be updated once demonstration plan and related legal arrangements are settled	To be updated once demonstration plan and related legal arrangements are settled	To be updated once demonstration plan and related legal arrangements are settled	To be updated once demonstration plan and related legal arrangements are settled	To be updated once demonstration plan and related legal arrangements are settled

List of monitoring parameters for IS 3.2

No	Parameter	Value
1	Data Variable Name	**Access to vehicle sharing solutions for city travel**
2	Measure Number	Measure 3 : IS 3.2 Innovative mobility services for the citizen
3	KPI Number	2
4	Units of measurement	Number of trips per week
5	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	Number of booking persons
6	Meter *i.e. smart meter, survey, energy bill, etc.*	AIMA (VULOG platform)
7	Location of measurement	France, Nice
8	Data accuracy *How accurate is the measurement*	100%
9	Collection interval	daily
10	Start of measurements	Depending on charging stations availability
11	End of measurements	Date + 3 months
12	Expected availability *i.e. open data, public, confidential, no data available*	confidential
13	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	*online, but requires authentication*
14	Data format *i.e. csv file, json…*	CSV
15	Data owner	MNCA
16	Comments	

No	Parameter	Value
1	Data Variable Name	**Number of efficient vehicles deployed in the area**
2	Measure Number	Measure 3 : IS 3.2 Innovative mobility services for the citizen
3	KPI Number	27
4	Units of measurement	Number of trips per week
5	Baseline (of data variable)	Use ratio of shared EVs before the operation and total mileage per day
6	Meter	AIMA (VULOG platform)
7	Location of measurement	France, Nice
8	Data accuracy	100%
9	Collection interval	daily
10	Start of measurements	Depending on charging stations availability
11	End of measurements	Date + 3 months
12	Expected availability	confidential
13	Expected accessibility	*online, but requires authentication*
14	Data format	CSV
15	Data owner	MNCA
16	Comments	

No	Parameter	Value
1	Data Variable Name	**Number of free floating subscribers**
2	Measure Number	Measure 3 : IS 3.2 Innovative mobility services for the citizen
3	KPI Number	28
4	Units of measurement	Number of trips per week
5	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	Number of booking persons
6	Meter *i.e. smart meter, survey, energy bill, etc.*	AIMA (VULOG platform)

7	Location of measurement	France, Nice
8	Data accuracy *How accurate is the measurement*	100%
9	Collection interval	daily
10	Start of measurements	Depending on charging stations availability
11	End of measurements	Date + 3 months
12	Expected availability *i.e. open data, public, confidential, no data available*	Confidential
13	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	*online, but requires authentication*
14	Data format *i.e. csv file, json…*	CSV
15	Data owner	MNCA
16	Comments	

A12.4 TT5

List of monitoring parameters for IS 5.2

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	**10-17 : INCREASE AWARENESS OF ENERGY USAGE**
2	Transition Track Number	TT 5
3	Measure Number *As it is stated in the measure tracker*	M#2 - Public awareness campaign Energy – School & Collège; Youth & Family
4	KPI *KPI('s) that are related to the data*	10-17 - INCREASE AWARENESS OF ENERGY USAGE
5	Units of measurement *i.e. KWh, Euro, etc.*	%
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	NC
7	Meter *i.e. smart meter, survey, energy bill, etc.*	survey
8	Location of measurement *Where the measurements take place*	During session
9	Data accuracy *How accurate is the measurement*	medium
10	Collection interval *How often the data is recorded*	3 times a year
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	may 2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	End of project 2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Open data
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	offline
15	Data format *i.e. csv file, json…*	csv
16	Data owner *i.e. the name of the company that will give access to data*	Cofely
17	Comments *Further info*	-

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	**10.19-INCREASED ENVIRONMENTAL AWARENESS**
2	Transition Track Number	TT 5
3	Measure Number *As it is stated in the measure tracker*	M#2 - Public awareness campaign Energy – School & Collège; Youth & Family
4	KPI *KPI('s) that are related to the data*	10-19-INCREASED ENVIRONMENTAL AWARENESS
5	Units of measurement *i.e. KWh, Euro, etc.*	%
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	NC
7	Meter *i.e. smart meter, survey, energy bill, etc.*	survey
8	Location of measurement *Where the measurements take place*	School & college
9	Data accuracy *How accurate is the measurement*	medium
10	Collection interval *How often the data is recorded*	3 times a year
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	01.10.2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	30.06 2021
13	Expected availability *i.e. open data, public, confidential, no data available*	open data
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	offline
15	Data format *i.e. csv file, json…*	Csv file
16	Data owner *i.e. the name of the company that will give access to data*	Cofely
17	Comments *Further info*	-

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	**10.18 - INCREASED CONSCIOUSNESS OF CITIZENS**
2	Transition Track Number	TT 5
3	Measure Number *As it is stated in the measure tracker*	M#2 - Public awareness campaign Energy – School & Collège; Youth & Family
4	KPI *KPI('s) that are related to the data*	10.18- INCREASED CONSCIOUSNESS OF CITIZENS
5	Units of measurement *i.e. KWh, Euro, etc.*	number
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	NC
7	Meter *i.e. smart meter, survey, energy bill, etc.*	VISIT
8	Location of measurement *Where the measurements take place*	Group of individuals – workshop
9	Data accuracy *How accurate is the measurement*	good
10	Collection interval *How often the data is recorded*	At each workshop
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	01.10.2019
12	End of measurements *i.e. 31-12-2020, 24:00CET*	30.06 2021
13	Expected availability *i.e. open data, public, confidential, no data available*	open data
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	*online, but requires authentication*
15	Data format *i.e. csv file, json…*	Csv file
16	Data owner *i.e. the name of the company that will give access to data*	Cofely
17	Comments *Further info*	-

List of monitoring parameters for IS 5.3

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	**10.32- PEOPLE REACHED**
2	Transition Track Number	TT 5
3	Measure Number *As it is stated in the measure tracker*	M#3 – Citizens individual engagement - IOT invoices
4	KPI *KPI('s) that are related to the data*	PEOPLE REACHED
5	Units of measurement *i.e. KWh, Euro, etc.*	Number,%
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	0
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Agreement
8	Location of measurement *Where the measurements take place*	Tower 13 & 14
9	Data accuracy *How accurate is the measurement*	good
10	Collection interval *How often the data is recorded*	year
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	may 2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	End of project 2022
13	Expected availability *i.e. open data, public, confidential, no data available*	confidential data
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	*offline*
15	Data format *i.e. csv file, json…*	Csv file
16	Data owner *i.e. the name of the company that will give access to data*	CAH & Cofely
17	Comments *Further info*	-

No	Parameter	Value
1	Data Variable Name *i.e. Thermal energy consumption, locally produced electrical energy, etc.*	**10.45- USER ENGAGEMENT**
2	Transition Track Number	TT 5
3	Measure Number *As it is stated in the measure tracker*	M#3 – Citizens individual engagement - IOT invoices
4	KPI *KPI('s) that are related to the data*	10.45- USER ENGAGEMENT
5	Units of measurement *i.e. KWh, Euro, etc.*	number
6	Baseline (of data variable) *e.g. relating to BaU or previous performance data*	0
7	Meter *i.e. smart meter, survey, energy bill, etc.*	Number of inhabitant connected to the energy page
8	Location of measurement *Where the measurements take place*	Web portal WEB DATA VERTUOZ
9	Data accuracy *How accurate is the measurement*	
10	Collection interval *How often the data is recorded*	monthly
11	Start of measurements *i.e. 1-1-2019, 0:00CET*	may 2020
12	End of measurements *i.e. 31-12-2020, 24:00CET*	End of project 2022
13	Expected availability *i.e. open data, public, confidential, no data available*	Open data
14	Expected accessibility *i.e. 1) online without access constraints, 2) online, but requires authentication, and, 3) offline*	Online
15	Data format *i.e. csv file, json…*	csv
16	Data owner *i.e. the name of the company that will give access to data*	CAH & Cofely
17	Comments *Further info*	-

A13. Data Gothenburg

A13.1 TT1

Parameters for measures included in TT1 are described in this annex.

Table 85 Description of parameter "Hourly load curve from the apartments" for measure 1.

No	Parameter	Value
1	Data Variable Name	*Hourly load curve from the apartments*
2	Measure Number	*Transition Track 1. Demonstration 1*
3	KPI Number	*5. Carbon dioxide Emission Reduction* *13. Energy savings*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meters*
7	Location of measurement	*Per apartment. i.e. within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 86 Description of parameter "Hourly electricity production from PVs" for measure 1.

No	Parameter	Value
1	Data Variable Name	*Hourly electricity production from PVs*
2	Measure Number	*Transition Track 1. Demonstration 1*
3	KPI Number	*5. Carbon dioxide Emission Reduction* *13. Energy savings*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 87 Description of parameter "Hourly electricity delivered from the grid" for measure 1.

No	Parameter	Value
1	Data Variable Name	*Hourly electricity delivered from the grid*
2	Measure Number	*Transition Track 1. Demonstration 1*
3	KPI Number	*5. Carbon dioxide Emission Reduction* *13. Energy savings*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen/Göteborg Energi*
16	Comments	

Table 88 Description of parameter "Hourly carbon intensity of the grid electricity" for measure 1.

No	Parameter	Value
1	Data Variable Name	*Hourly carbon intensity of the grid electricity*
2	Measure Number	*Transition Track 1. Demonstration 1*
3	KPI Number	*5. Carbon dioxide Emission Reduction*
4	Units of measurement	*g CO2-e/Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*Göteborg Energi*
16	Comments	

Table 89 Description of parameter "Monthly electricity production from PVs" for measure 1.

No	Parameter	Value
1	Data Variable Name	*Monthly electricity production from PVs*
2	Measure Number	*Transition Track 1. Demonstration 1*
3	KPI Number	*10. Degree of energy self-supply by RES*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 90 Description of parameter "Monthly electricity delivered from the grid" for measure 1.

No	Parameter	Value
1	Data Variable Name	*Monthly electricity delivered from the grid*
2	Measure Number	*Transition Track 1. Demonstration 1*
3	KPI Number	*10. Degree of energy self-supply by RES*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 91 Description of parameter "Monthly produced thermal energy in Viva" for measure 2.

No	Parameter	Value
1	Data Variable Name	*Monthly produced thermal energy in Viva*
2	Measure Number	*Transition Track 1. Demonstration 2*
3	KPI Number	*10. Degree of energy self-supply by RES*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 92 Description of parameter "Monthly used thermal energy" for measure 2.

No	Parameter	Value
1	Data Variable Name	*Monthly used thermal energy*
2	Measure Number	*Transition Track 1. Demonstration 2*
3	KPI Number	*10. Degree of energy self-supply by RES*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 93 Description of parameter "Hourly thermal load curve from the apartments" for measure 2.

No	Parameter	Value
1	Data Variable Name	Hourly thermal load curve from the apartments
2	Measure Number	*Transition Track 1. Demonstration 2*
3	KPI Number	*5. Carbon dioxide Emission Reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 94 Description of parameter "Hourly thermal energy production in Viva" for measure 2.

No	Parameter	Value
1	Data Variable Name	Hourly thermal energy production in Viva
2	Measure Number	*Transition Track 1. Demonstration 2*
3	KPI Number	*5. Carbon dioxide Emission Reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 95 Description of parameter "Hourly thermal energy delivered from the grid" for measure 2.

No	Parameter	Value
1	Data Variable Name	*Hourly thermal energy delivered from the grid*
2	Measure Number	*Transition Track 1. Demonstration 2*
3	KPI Number	*5. Carbon dioxide Emission Reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 96 Description of parameter "Hourly carbon intensity of the DH grid" for measure 2.

No	Parameter	Value
1	Data Variable Name	*Hourly carbon intensity of the DH grid*
2	Measure Number	*Transition Track 1. Demonstration 2*
3	KPI Number	*5. Carbon dioxide Emission Reduction*
4	Units of measurement	*g CO2-e/Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*Göteborg Energi*
16	Comments	

Table 97 Description of parameter "Yearly carbon dioxide Emission Reduction" for measure 2.

No	Parameter	Value
1	Data Variable Name	*Yearly carbon dioxide Emission Reduction*
2	Measure Number	*Transition Track 1. Demonstration 2*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*tonnes/year*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 98 Description of parameter "Investment cost" for measure 2.

No	Parameter	Value
1	Data Variable Name	*Investment cost*
2	Measure Number	*Transition Track 1. Demonstration 2*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	€
5	Baseline (of data variable)	*N/A*
6	Meter	*Calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*N/A*
14	Data format	*Unkown*
15	Data owner	*Riksbyggen*
16	Comments	

Table 99 Description of parameter “Service life” for measure 2.

No	Parameter	Value
1	Data Variable Name	*Service life*
2	Measure Number	*Transition Track 1. Demonstration 2*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*years*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*N/A*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 100 Description of parameter “Running costs” for measure 2.

No	Parameter	Value
1	Data Variable Name	*Running costs*
2	Measure Number	*Transition Track 1. Demonstration 2*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*€/year*
5	Baseline (of data variable)	*N/A*
6	Meter	*Calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Per year*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*N/A*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 101 Description of parameter "Current levels of cooling used in CTP" for measure 3.

No	Parameter	Value
1	Data Variable Name	*Current levels of cooling used in CTP*
2	Measure Number	*Transition Track 1. Demonstration 3*
3	KPI Number	*10. Degree of energy self-supply by RES* *5. Carbon dioxide Emission Reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within CTP*
8	Data accuracy	*Unknown*
9	Collection interval	*Unknown*
10	Start of measurements	*N/A*
11	End of measurements	N/A
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*CTP*
16	Comments	

Table 102 Description of parameter "Supplied amount of cooling by Viva" for measure 3.

No	Parameter	Value
1	Data Variable Name	*Supplied amount of cooling by Viva*
2	Measure Number	*Transition Track 1. Demonstration 3*
3	KPI Number	*10. Degree of energy self-supply by RES* *5. Carbon dioxide Emission Reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*Current levels of cooling used in CTP*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per year*
10	Start of measurements	*As soon as the demonstrator is implemented.*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 103 Description of parameter "Associated energy usage" for measure 3.

No	Parameter	Value
1	Data Variable Name	*Associated energy usage*
2	Measure Number	*Transition Track 1. Demonstration 3*
3	KPI Number	*5. Carbon dioxide Emission Reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*As soon as the demonstrator is implemented.*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 104 Description of parameter "Hourly carbon intensity of the electricity grid" for measure 3.

No	Parameter	Value
1	Data Variable Name	*Hourly carbon intensity of the electricity grid*
2	Measure Number	*Transition Track 1. Demonstration 3*
3	KPI Number	*5. Carbon dioxide Emission Reduction*
4	Units of measurement	*g CO2-e/Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*Göteborg Energi*
16	Comments	

Table 105 Description of parameter "Yearly carbon dioxide Emission Reduction" for measure 3.

No	Parameter	Value
1	Data Variable Name	*Yearly carbon dioxide Emission Reduction*
2	Measure Number	*Transition Track 1. Demonstration 3*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*tonnes CO2/year*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 106 Description of parameter "Investment cost" for measure 3.

No	Parameter	Value
1	Data Variable Name	*Investment cost*
2	Measure Number	*Transition Track 1. Demonstration 3*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*€*
5	Baseline (of data variable)	*N/A*
6	Meter	*Calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 107 Description of parameter “Service life” for measure 3.

No	Parameter	Value
1	Data Variable Name	*Service life*
2	Measure Number	*Transition Track 1. Demonstration 3*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*Years*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 108 Description of parameter "Running costs" for measure 3.

No	Parameter	Value
1	Data Variable Name	*Running costs*
2	Measure Number	*Transition Track 1. Demonstration 3*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*€/Years*
5	Baseline (of data variable)	*N/A*
6	Meter	*calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 109 Description of parameter "Volume of accumulator tanks" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Volume of accumulator tanks*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*42. Storage capacity installed*
4	Units of measurement	m^3
5	Baseline (of data variable)	*The baseline is 0* m^3
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Once*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 110 Description of parameter "Temperature interval of accumulator tanks" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Temperature interval of accumulator tanks*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*42. Storage capacity installed*
4	Units of measurement	*K*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Once*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 111 Description of parameter "Conditioned floor area of Viva" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Conditioned floor area of Viva*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*42. Storage capacity installed*
4	Units of measurement	*m^2*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Once*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 112 Description of parameter "Storage capacity in the structure" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Storage capacity in the structure*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*42. Storage capacity installed*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Once*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 113 Description of parameter "Space heating demand" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Space heating demand*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*31. Peak load reduction* *5. Carbon dioxide Emission Reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 114 Description of parameter "Hot tap water demand" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Hot tap water demand*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*31. Peak load reduction* *5. Carbon dioxide Emission Reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 115 Description of parameter "Heat produced by heat pumps" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Heat produced by heat pumps*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*31. Peak load reduction* *5. Carbon dioxide Emission Reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 116 Description of parameter "Purchased DH" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Purchased DH*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*31. Peak load reduction* *5. Carbon dioxide Emission Reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 117 Description of parameter "Hourly carbon intensity of the DH grid" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Hourly carbon intensity of the DH grid*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*5. Carbon dioxide Emission Reduction*
4	Units of measurement	*g CO2-e/Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*Göteborg Energi*
16	Comments	

Table 118 Description of parameter "Yearly carbon dioxide Emission Reduction" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Yearly carbon dioxide Emission Reduction*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*tonnes/year*
5	Baseline (of data variable)	*N/A*
6	Meter	*Calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 119 Description of parameter "Investment cost" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Investment cost*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*€*
5	Baseline (of data variable)	*N/A*
6	Meter	*Calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Once*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 120 Description of parameter "Service life" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Service life*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*years*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Once*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 121 Description of parameter "Running costs" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Running costs*
2	Measure Number	*Transition Track 1. Demonstration 4*
3	KPI Number	*7. CO_2 reduction cost efficiency*
4	Units of measurement	*€/year*
5	Baseline (of data variable)	*N/A*
6	Meter	*Calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Once per year*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 122 Description of parameter "Purchased power to CTP" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Purchased power to CTP*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*31. Peak load reduction*
4	Units of measurement	*W*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*CTP*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*As soon as the demonstrator is implemented.*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*CTP*
16	Comments	

Table 123 Description of parameter "Purchased power to Viva" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Purchased power to Viva*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*31. Peak load reduction*
4	Units of measurement	*W*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Brf Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 124 Description of parameter "Annual peak power in CTP" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Annual peak power in CTP*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*31. Peak load reduction*
4	Units of measurement	*W*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*CTP*
8	Data accuracy	*N/A*
9	Collection interval	*Per year*
10	Start of measurements	*As soon as the demonstrator is implemented.*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*CTP*
16	Comments	

Table 125 Description of parameter "Annual peak power in Viva" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Annual peak power in Viva*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*31. Peak load reduction*
4	Units of measurement	*W*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart Meter*
7	Location of measurement	*Within housing association Brf Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per year*
10	Start of measurements	*As soon as the demonstrator is implemented.*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 126 Description of parameter "First annual peak power in Viva" for measure 5.

No	Parameter	Value
1	Data Variable Name	*First annual peak power in Viva*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*31. Peak load reduction*
4	Units of measurement	*W*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Brf Viva*
8	Data accuracy	*N/A*
9	Collection interval	*First year*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M32. 2020-05
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 127 Description of parameter "Monthly costs in CTP" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Monthly costs in CTP*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*34. Reduced energy cost for consumers*
4	Units of measurement	€
5	Baseline (of data variable)	*N/A*
6	Meter	*Calculation*
7	Location of measurement	*CTP*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*As soon as the demonstrator is implemented.*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*CTP*
16	Comments	

Table 128 Description of parameter "Monthly costs in Viva" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Monthly costs in Viva*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*34. Reduced energy cost for consumers*
4	Units of measurement	*€*
5	Baseline (of data variable)	*N/A*
6	Meter	*Calculation*
7	Location of measurement	*CTP*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*As soon as the demonstrator is implemented.*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 129 Description of parameter "Hourly purchased electricity curves in CTP" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Hourly purchased electricity curves in CTP*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*34. Carbon dioxide emission reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*CTP*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*As soon as the demonstrator is implemented.*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*CTP*
16	Comments	

Table 130 Description of parameter "Hourly purchased electricity curves in Viva" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Hourly purchased electricity curves in Viva*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*34. Carbon dioxide emission reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Brf Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 131 Description of parameter "Hourly purchased heating curves in Viva" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Hourly purchased heating curves in Viva*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*34. Carbon dioxide emission reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Brf Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 132 Description of parameter "Monthly energy use during the first service year in Brf Viva before the seasonal energy trading is deployed." for measure 5.

No	Parameter	Value
1	Data Variable Name	*Monthly energy use during the first service year in Brf Viva before the seasonal energy trading is deployed.*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*34. Carbon dioxide emission reduction* *13. Energy savings*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Brf Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M32. 2020-05
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 133 Description of parameter "Hourly carbon intensity of the DH grid" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Hourly carbon intensity of the DH grid*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*34. Carbon dioxide emission reduction*
4	Units of measurement	*g CO2-e/Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*Göteborg Energi*
16	Comments	

Table 134 Description of parameter "Hourly carbon intensity of the electricity grid" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Hourly carbon intensity of the electricity grid*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*34. Carbon dioxide emission reduction*
4	Units of measurement	*g CO2-e/Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*Göteborg Energi*
16	Comments	

Table 135 Description of parameter "Yearly carbon dioxide Emission Reduction" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Yearly carbon dioxide Emission Reduction*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*7. CO_2 emission reduction cost efficiency*
4	Units of measurement	*tonnes/year*
5	Baseline (of data variable)	*N/A*
6	Meter	*Calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Per year*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 136 Description of parameter "Investment cost" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Investment cost*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*7. CO_2 emission reduction cost efficiency*
4	Units of measurement	*€*
5	Baseline (of data variable)	*N/A*
6	Meter	*Calculation*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Once*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 137 Description of parameter "Service life" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Service life*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*7. CO_2 emission reduction cost efficiency*
4	Units of measurement	*years*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*Once*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 138 Description of parameter "Monthly purchased electricity in CTP" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Monthly purchased electricity in CTP*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*13. Energy savings*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*CTP*
8	Data accuracy	*N/A*
9	Collection interval	*Per month*
10	Start of measurements	*As soon as the demonstrator is implemented.*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*CTP*
16	Comments	

Table 139 Description of parameter "Monthly purchased electricity in Viva" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Monthly purchased electricity in Viva*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*13. Energy savings*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per month*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 140 Description of parameter "Monthly purchased heating in Viva" for measure 5.

No	Parameter	Value
1	Data Variable Name	*Monthly purchased heating in Viva*
2	Measure Number	*Transition Track 1. Demonstration 5*
3	KPI Number	*13. Energy savings*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per month*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 141 Description of parameter "Thermal energy demand" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Thermal energy demand*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*10. Degree of energy self-supply by RES*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 142 Description of parameter "Purchased thermal energy" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Purchased thermal energy*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*10. Degree of energy self-supply by RES* *31. Peak load reduction* *34. Reduced energy cost for consumers* *5. Carbon dioxide emission reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 143 Description of parameter "Electricity demand" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Electricity demand*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*10. Degree of energy self-supply by RES* *31. Peak load reduction* *5. Carbon dioxide emission reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 144 Description of parameter “Purchased electricity” for measure 6.

No	Parameter	Value
1	Data Variable Name	*Purchased electricity*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*10. Degree of energy self-supply by RES* *31. Peak load reduction* *34. Reduced energy cost for consumers* *5. Carbon dioxide emission reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 145 Description of parameter "Mean CoP in the heat pumps" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Mean CoP in the heat pumps*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*31. Peak load reduction*
4	Units of measurement	*N/A*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart metes.*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 146 Description of parameter “Cost rates of purchased thermal energy” for measure 6.

No	Parameter	Value
1	Data Variable Name	*Cost rates of purchased thermal energy*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*34. Reduced energy cost for consumers*
4	Units of measurement	*€/Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*Göteborg Energi*
16	Comments	

Table 147 Description of parameter "Cost rates of purchased electricity" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Cost rates of purchased electricity*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*34. Reduced energy cost for consumers*
4	Units of measurement	*€/Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*Göteborg Energi*
16	Comments	

Table 148 Description of parameter "Produced electricity in PVs" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Produced electricity in PVs*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*6. Carbon dioxide emission reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	*M60. 2022-09*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 149 Description of parameter "Hourly carbon intensity of the DH grid" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Hourly carbon intensity of the DH grid*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*6. Carbon dioxide emission reduction*
4	Units of measurement	*g CO2-e/Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*Göteborg Energi*
16	Comments	

Table 150 Description of parameter "Hourly carbon intensity of the electricity grid" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Hourly carbon intensity of the electricity grid*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*6. Carbon dioxide emission reduction*
4	Units of measurement	*g CO2-e/Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*Unknown*
15	Data owner	*Göteborg Energi*
16	Comments	

Table 151 Description of parameter "Peak purchased thermal energy" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Peak purchased thermal energy*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*21. Increased system flexibility for energy players stakeholders*
4	Units of measurement	*W*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	*M60-2022-09*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 152 Description of parameter "Peak purchased electricity" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Peak purchased electricity*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*21. Increased system flexibility for energy players stakeholders*
4	Units of measurement	*W*
5	Baseline (of data variable)	*N/A*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	*M20. 2019-05*
11	End of measurements	*M60-2022-09*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 153 Description of parameter "Installed capacity of flexibility providers: Heat pumps, battery storage, accumulator tanks" for measure 6.

No	Parameter	Value
1	Data Variable Name	*Installed capacity of flexibility providers: Heat pumps, battery storage, accumulator tanks*
2	Measure Number	*Transition Track 1. Demonstration 6*
3	KPI Number	*21. Increased system flexibility for energy players stakeholders*
4	Units of measurement	*W, Wh*
5	Baseline (of data variable)	*N/A*
6	Meter	*N/A*
7	Location of measurement	*N/A*
8	Data accuracy	*N/A*
9	Collection interval	*N/A*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 154 Description of parameter "Electricity production by BIPV in HSBLL" for measure 7.

No	Parameter	Value
1	Data Variable Name	Electricity production by BIPV in HSBLL
2	Measure Number	Transition Track 1, Demonstration 7
3	KPI Number	20: Increase in Local Renewable Energy production 10: Degree of energy self-supply by RES 5: Carbon dioxide Emission Reduction
4	Units of measurement	kWh
5	Baseline (of data variable)	Baseline: HSBLL without Local Renewable Energy production
6	Meter	Smart Meter
7	Location of measurement	Within the HSBLL building
8	Data accuracy	1%
9	Collection interval	1 /sek
10	Start of measurements	01-09-2017
11	End of measurements	01-01-2025
12	Expected availability	Confidential
13	Expected accessibility	Online, but requires authentification
14	Data format	Not known
15	Data owner	HSB
16	Comments	

Table 155 Description of parameter "Electricity usage in HSBLL" for measure 7.

No	Parameter	Value
1	Data Variable Name	Electricity usage in HSBLL
2	Measure Number	TransitionTrack 1, Demonstration 7
3	KPI Number	20: Increase in Local Renewable Energy production 10: Degree of energy self-supply by RES 5: Carbon dioxide Emission Reduction
4	Units of measurement	kWh
5	Baseline (of data variable)	Energy consumption before installation of PVs
6	Meter	Smart meter
7	Location of measurement	Within the HSBLL building
8	Data accuracy	1%
9	Collection interval	1 /sek
10	Start of measurements	01-06-2015
11	End of measurements	01-01-2025
12	Expected availability	Confidential
13	Expected accessibility	Online, but requires authentification
14	Data format	Not known
15	Data owner	HSB
16	Comments	

A13.2 TT2

Parameters related to the measures included in TT2 are described in this Annex.

Table 156 Description of parameter Charging power to the batteries for measure A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage.

No	Parameter	Value
1	Data Variable Name	Charging power to the batteries
2	Measure Number	Transition track 2 Demonstration 1
3	KPI Number	31: Peak load reduction
4	Units of measurement	kW
5	Baseline (of data variable)	0
6	Meter	Smart meter
7	Location of measurement	At AWL in the installation
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open data
13	Expected accessibility	offline
14	Data format	csv
15	Data owner	Akademiska Hus
16	Comments	

Table 157 Description of parameter Charged electricity to the batteries for measure A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage.

No	Parameter	Value
1	Data Variable Name	Charged electricity to the batteries
2	Measure Number	Transition track 2 Demonstration 1
3	KPI Number	31: Peak load reduction
4	Units of measurement	kW, kWh
5	Baseline (of data variable)	0
6	Meter	Smart meter
7	Location of measurement	At AWL in the installation
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open data
13	Expected accessibility	offline
14	Data format	csv
15	Data owner	Akademiska Hus
16	Comments	

Table 158 Description of parameter Discharging power from the batteries for measure A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage.

No	Parameter	Value
1	Data Variable Name	Discharging power from the batteries
2	Measure Number	Transition track 2 Demonstration 1
3	KPI Number	31: Peak load reduction
4	Units of measurement	kW, kWh
5	Baseline (of data variable)	0
6	Meter	Smart meter
7	Location of measurement	At AWL in the installation
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open data
13	Expected accessibility	offline
14	Data format	csv
15	Data owner	Akademiska Hus
16	Comments	

Table 159 Description of parameter Discharged electricity from the batteries for measure A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage.

No	Parameter	Value
1	Data Variable Name	Discharged electricity from the batteries
2	Measure Number	Transition track 2 Demonstration 1
3	KPI Number	31: Peak load reduction
4	Units of measurement	kW, kWh
5	Baseline (of data variable)	0
6	Meter	Smart meter
7	Location of measurement	At AWL in the installation
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open data
13	Expected accessibility	offline
14	Data format	csv
15	Data owner	Akademiska Hus
16	Comments	

Table 160 Description of parameter Locally produced electricity for measure A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage.

No	Parameter	Value
1	Data Variable Name	Locally produced electricity
2	Measure Number	Transition track 2 Demonstration 1
3	KPI Number	31: Peak load reduction 10: Degree of energy self-supply by RES
4	Units of measurement	kW, kWh
5	Baseline (of data variable)	0
6	Meter	Smart meter
7	Location of measurement	At AWL in the installation
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open data
13	Expected accessibility	offline
14	Data format	csv
15	Data owner	Akademiska Hus
16	Comments	

Table 161 Description of parameter Total consumption of electricity for measure A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage.

No	Parameter	Value
1	Data Variable Name	Total consumption of electricity
2	Measure Number	Transition track 2 Demonstration 1
3	KPI Number	31: Peak load reduction 10: Degree of energy self-supply by RES
4	Units of measurement	kW, kWh
5	Baseline (of data variable)	0
6	Meter	Smart meter
7	Location of measurement	At AWL in the installation
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open data
13	Expected accessibility	offline
14	Data format	csv
15	Data owner	Akademiska Hus
16	Comments	

Table 162 Description of parameter Storage capacity in the battery or measure A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage.

No	Parameter	Value
1	Data Variable Name	Storage capacity in the battery
2	Measure Number	Transition track 2 Demonstration 1
3	KPI Number	42: Storage capacity installed
4	Units of measurement	kWh, kW
5	Baseline (of data variable)	0
6	Meter	Smart meter
7	Location of measurement	At AWL in the installation
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open data
13	Expected accessibility	offline
14	Data format	csv
15	Data owner	Akademiska Hus
16	Comments	

Table 163 Description of parameter Input cooling energy for measure 200 kWh PCM (Phase Change Material) cooling storage

No	Parameter	Value
1	Data Variable Name	Input cooling energy
2	Measure Number	Transition track 2 Demonstration 2
3	KPI Number	53: Storage energy losses
4	Units of measurement	kW, kWh
5	Baseline (of data variable)	0
6	Meter	Smart meter
7	Location of measurement	SB3
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open data
13	Expected accessibility	offline
14	Data format	csv
15	Data owner	Akademiska Hus
16	Comments	

Table 164 Description of parameter Output cooling energy for measure 200 kWh PCM (Phase Change Material) cooling storage.

No	Parameter	Value
1	Data Variable Name	Output cooling energy
2	Measure Number	Transition track 2 Demonstration 2
3	KPI Number	42: Storage capacity installed
4	Units of measurement	kW, kWh
5	Baseline (of data variable)	0
6	Meter	Smart meter
7	Location of measurement	SB3
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open data
13	Expected accessibility	offline
14	Data format	csv
15	Data owner	Akademiska Hus
16	Comments	

Table 165 Description of parameter Output cooling energy power from PCM for measure 200 kWh PCM (Phase Change Material) cooling storage.

No	Parameter	Value
1	Data Variable Name	Output cooling energy power from PCM
2	Measure Number	Transition track 2 Demonstration 2
3	KPI Number	31: Peak load reduction 53: Storage energy losses
4	Units of measurement	kW, kWh
5	Baseline (of data variable)	0
6	Meter	Smart meter
7	Location of measurement	SB3
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open data
13	Expected accessibility	offline
14	Data format	csv
15	Data owner	Akademiska Hus
16	Comments	

Table 166 Description of parameter Electricity power used for cooling [kW] calculated from cooling production in chillers for measure 200 kWh PCM (Phase Change Material) cooling storage

No	Parameter	Value
1	Data Variable Name	Electricity power used for cooling [kW] calculated from cooling production in chillers
2	Measure Number	Transition track 2 Demonstration 2
3	KPI Number	31: Peak load reduction
4	Units of measurement	kWh, kW
5	Baseline (of data variable)	+25kW compared to measurement
6	Meter	Smart meter
7	Location of measurement	Chalmers kraftcentral
8	Data accuracy	
9	Collection interval	10 sec
10	Start of measurements	20-08-15
11	End of measurements	
12	Expected availability	Open source
13	Expected accessibility	Offline
14	Data format	csv
15	Data owner	
16	Comments	

Table 167 Description of parameter "Storage capacity in the batteries" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Storage capacity in the batteries*
2	Measure Number	*Transition Track 2. Demonstration 4*
3	KPI Number	*21. Storage capacity installed* *4. Battery Degradation Rate*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*The baseline is 0 Wh for KPI: 21. Storage capacity installed* *The baseline is 200 kWh for KPI: Battery Degradation Rate*
6	Meter	*Battery specifications from supplier and/or smart meters.*
7	Location of measurement	*Within housing association Viva*
8	Data accuracy	*N/A*
9	Collection interval	*At the end of the project*
10	Start of measurements	*N/A*
11	End of measurements	*N/A*
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen/Volvo*
16	Comments	

Table 168 Description of parameter "Used electricity" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Used electricity*
2	Measure Number	*Transition Track 2. Demonstration 4*
3	KPI Number	*31. Peak load reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meters*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*Confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen*
16	Comments	

Table 169 Description of parameter "Purchased electricity" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Purchased electricity*
2	Measure Number	*Transition Track 2. Demonstration 4*
3	KPI Number	*31. Peak load reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen/Göteborg Energi*
16	Comments	

Table 170 Description of parameter "Used PV-generated electricity" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Used PV-generated electricity*
2	Measure Number	*Transition Track 2. Demonstration 4*
3	KPI Number	*31. Peak load reduction*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*Per hour*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen/Ferroamp*
16	Comments	

Table 171 Description of parameter "Energy taken out from the batteries over time" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Energy taken out from the batteries over time*
2	Measure Number	*Transition Track 2. Demonstration 4*
3	KPI Number	*4. Battery Degradation Rate*
4	Units of measurement	*Wh*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*Smart meter*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*At the end of the project*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen/Volvo*
16	Comments	

Table 172 Description of parameter "Time in use" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Time in use*
2	Measure Number	*Transition Track 2. Demonstration 4*
3	KPI Number	*4. Battery Degradation Rate*
4	Units of measurement	*years*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*N/A*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*At the end of the project*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen/Volvo*
16	Comments	

Table 173 Description of parameter "Load cycles of the batteries" for measure 4.

No	Parameter	Value
1	Data Variable Name	*Load cycles of the batteries*
2	Measure Number	*Transition Track 2. Demonstration 4*
3	KPI Number	*4. Battery Degradation Rate*
4	Units of measurement	*N/A*
5	Baseline (of data variable)	*N/A* *No previous performance data available.*
6	Meter	*N/A*
7	Location of measurement	*Within housing association Viva.*
8	Data accuracy	*N/A*
9	Collection interval	*At the end of the project*
10	Start of measurements	M20. 2019-05
11	End of measurements	M60. 2022-09
12	Expected availability	*Confidential*
13	Expected accessibility	*online, but requires authentication*
14	Data format	*.xlsx*
15	Data owner	*Riksbyggen/Volvo*
16	Comments	

A13.3 TT3

Parameters related to the measures included in TT3 are described in this Annex.

Table 174:Description of parameter "Km driven by tenants" for measure 1.

No	Parameter	Value
1	Data Variable Name	Km driven by tenants
2	Measure Number	Transition track 3 Demonstration 1
3	KPI Number	5 Carbon dioxide Emission Reduction 39 Reduction in driven km by tenants and employees in the district
4	Units of measurement	Km
5	Baseline (of data variable)	BaU taken from previous travel surveys in Gothenburg
6	Meter	Travel survey
7	Location of measurement	App-based travel survey among tenants
8	Data accuracy	26 out of approximately 200 individuals participated in the travel survey which makes data accuracy relatively low.
9	Collection interval	The travel survey was performed once.
10	Start of measurements	1-10-2019
11	End of measurements	31-10-2019
12	Expected availability	Aggregated data will be made publicly available. Data on individuals cannot be made available due to GDPR.
13	Expected accessibility	Online without access constraints
14	Data format	Tables/figures in report
15	Data owner	Trivector
16	Comments	

Table 175 Description of parameter "Km driven in e-car sharing system" for measure 1.

No	Parameter	Value
1	Data Variable Name	Km driven in e-car sharing system
2	Measure Number	Transition track 3 Demonstration 1
3	KPI Number	5 Carbon dioxide Emission Reduction 46 Yearly km driven in e-car sharing systems
4	Units of measurement	Km
5	Baseline (of data variable)	Zero, the e-car sharing system was not implemented before the start of the IRIS project
6	Meter	Data from car sharing provider(s)
7	Location of measurement	Meters installed in e-cars
8	Data accuracy	Very accurate
9	Collection interval	Continuously throughout the project
10	Start of measurements	1-10-2017
11	End of measurements	31-09-2022
12	Expected availability	Aggregated data will be made publicly available.
13	Expected accessibility	Online without access constraints
14	Data format	Tables/figures in report
15	Data owner	Trivector, through car sharing firm(s) involved in the project.
16	Comments	

Table 176: Description of parameter "Average CO2-emissions from vehicles used in the demonstration" for measure 1.

No	Parameter	Value
1	Data Variable Name	Average CO2-emissions from vehicles used in the demonstration
2	Measure Number	Transition track 3 Demonstration 1
3	KPI Number	5 Carbon dioxide Emission Reduction
4	Units of measurement	gCO2/km
5	Baseline (of data variable)	Average CO2-emissions from privately owned vehicles in Sweden (register data from SCB, Sweden Statistics)
6	Meter	Data from car sharing provider
7	Location of measurement	
8	Data accuracy	Very accurate
9	Collection interval	At the start of the demonstration and if changes are made in the composition of vehicles
10	Start of measurements	2017-10-01
11	End of measurements	2022-09-30
12	Expected availability	Aggregated data will be made publicly available.
13	Expected accessibility	Online without access constraints
14	Data format	Figures in report
15	Data owner	Trivector
16	Comments	

Table 177: Description of parameter "Ease of use for end users of the solution" for measure 1.

No	Parameter	Value
1	Data Variable Name	Ease of use for end users of the solution
2	Measure Number	Transition track 3 Demonstration 1
3	KPI Number	12 Ease of use for end users of the solution
4	Units of measurement	Likert scale
5	Baseline (of data variable)	Not relevant
6	Meter	Questionnaire Possibly in a later stage included in the EC2B app
7	Location of measurement	Electronic questionnaire combined with travel survey (but possible to fill out only questionnaire) Possibly in a later stage included in the EC2B app
8	Data accuracy	Very accurate
9	Collection interval	First measurement in October 2019 in connection to travel survey New measurement to be made during 2020
10	Start of measurements	
11	End of measurements	
12	Expected availability	Aggregated data will be made publicly available.
13	Expected accessibility	Online without access constraints
14	Data format	Tables/figures in report
15	Data owner	Trivector
16	Comments	

Table 178:Description of parameter “Access to vehicle sharing solutions” for measure 1.

	Parameter	Value
1	Data Variable Name	Access to vehicle sharing solutions
2	Measure Number	Transition track 3 Demonstration 1
3	KPI Number	16 Improved access to vehicle sharing solutions
4	Units of measurement	Shared vehicles per number of inhabitants in the area
5	Baseline (of data variable)	Relating to previous avaiability of shared vehicles in the demonstration area
6	Meter	Manual counting of number of vehicles available
7	Location of measurement	In the demonstration area
8	Data accuracy	Very accurate
9	Collection interval	Once before and once during the project
10	Start of measurements	
11	End of measurements	
12	Expected availability	Aggregated data will be made publicly available.
13	Expected accessibility	Online without access constraints
14	Data format	Tables/figures in report
15	Data owner	Trivector
16	Comments	

Table 179: Description of parameter "Car ownership among tenants" for measure 1.

No	Parameter	Value
1	Data Variable Name	Car ownership among tenants
2	Measure Number	Transition track 3 Demonstration 1
3	KPI Number	38 Reduction in car ownership among tenants
4	Units of measurement	Cars per apartment
5	Baseline (of data variable)	Relating to figures on car ownership in similar locations
6	Meter	Register data
7	Location of measurement	Official statistics on registered cars
8	Data accuracy	Very accurate
9	Collection interval	Data is registered on a yearly basis with possibility to access data for previous years
10	Start of measurements	1-10-2017
11	End of measurements	31-09-2022
12	Expected availability	Aggregated data will be made publicly available.
13	Expected accessibility	Online without access constraints
14	Data format	Tables/figures in report
15	Data owner	SCB (Statistics Sweden)
16	Comments	

Table 180:Description of parameter "Km driven by employees" for measure 2.

No	Parameter	Value
1	Data Variable Name	Km driven by employees
2	Measure Number	Transition track 3 Demonstration 2
3	KPI Number	5 Carbon dioxide Emission Reduction 39 Reduction in driven km by tenants and employees in the district
4	Units of measurement	Km
5	Baseline (of data variable)	Relating to previous travel surveys on campus
6	Meter	Travel survey
7	Location of measurement	Travel survey among tenants
8	Data accuracy	Measurement not yet performed
9	Collection interval	The travel survey will be performed once.
10	Start of measurements	
11	End of measurements	
12	Expected availability	Aggregated data will be made publicly available. Data on individuals cannot be made available due to GDPR.
13	Expected accessibility	Online without access constraints
14	Data format	Tables/figures in report
15	Data owner	Trivector
16	Comments	

Table 181:Description of parameter "Km driven in e-car sharing system" for measure 2.

No	Parameter	Value
1	Data Variable Name	Km driven in e-car sharing system
2	Measure Number	Transition track 3 Demonstration 2
3	KPI Number	5 Carbon dioxide Emission Reduction 46 Yearly km driven in e-car sharing systems
4	Units of measurement	Km
5	Baseline (of data variable)	Relating to previous use of car sharing system
6	Meter	Data from car sharing provider(s)
7	Location of measurement	Meters installed in e-cars
8	Data accuracy	Very accurate
9	Collection interval	Continuously throughout the project
10	Start of measurements	1-05-2020
11	End of measurements	31-09-2022
12	Expected availability	Aggregated data will be made publicly available.
13	Expected accessibility	Online without access constraints
14	Data format	Tables/figures in report
15	Data owner	Trivector, through car sharing firm(s) involved in the project.
16	Comments	

Table 182: Description of parameter "Average CO2-emissions from vehicles used in the demonstration"for measure 2

No	Parameter	Value
1	Data Variable Name	Average CO2-emissions from vehicles used in the demonstration
2	Measure Number	Transition track 3 Demonstration 2
3	KPI Number	5 Carbon dioxide Emission Reduction
4	Units of measurement	gCO2/km
5	Baseline (of data variable)	Average CO2-emissions from privately owned vehicles in Sweden (register data from SCB, Sweden Statistics)
6	Meter	Data from car sharing provider
7	Location of measurement	
8	Data accuracy	Very accurate
9	Collection interval	At the start of the demonstration and if changes are made in the composition of vehicles
10	Start of measurements	2020-05-01
11	End of measurements	2022-09-30
12	Expected availability	Aggregated data will be made publicly available.
13	Expected accessibility	Online without access constraints
14	Data format	Figures in report
15	Data owner	Trivector
16	Comments	

Table 183:Description of parameter "Ease of use for end users of the solution" for measure 2.

No	Parameter	Value
1	Data Variable Name	Ease of use for end users of the solution
2	Measure Number	Transition track 3 Demonstration 2
3	KPI Number	12 Ease of use for end users of the solution
4	Units of measurement	Likert scale
5	Baseline (of data variable)	Not relevant
6	Meter	Questionnaire Possibly in a later stage included in the EC2B app
7	Location of measurement	Electronic questionnaire Possibly in a later stage included in the EC2B app
8	Data accuracy	Very accurate
9	Collection interval	Once during the demonstration
10	Start of measurements	
11	End of measurements	
12	Expected availability	Aggregated data will be made publicly available.
13	Expected accessibility	Online without access constraints
14	Data format	Tables/figures in report
15	Data owner	Trivector
16	Comments	

Table 184: Description of parameter "Access to vehicle sharing solutions" for measure 2.

No	Parameter	Value
1	Data Variable Name	Access to vehicle sharing solutions
2	Measure Number	Transition track 3 Demonstration 2
3	KPI Number	16 Improved access to vehicle sharing solutions
4	Units of measurement	Shared vehicles per number of employees in the area
5	Baseline (of data variable)	Relating to previous avaiability of shared vehicles in the demonstration area
6	Meter	Manual counting of number of vehicles available
7	Location of measurement	In the demonstration area
8	Data accuracy	Very accurate
9	Collection interval	Once before and once during the project
10	Start of measurements	
11	End of measurements	
12	Expected availability	Aggregated data will be made publicly available.
13	Expected accessibility	Online without access constraints
14	Data format	Tables/figures in report
15	Data owner	Trivector
16	Comments	

TT4

Parameters related to the measures included in TT4 are described in this Annex.

Table 185 Description of parameter "Number of datasets that are DCAT compliant in CIM pilot" for measure 1.

No	Parameter	Value
1	Data Variable Name	Number of datasets that are DCAT compliant in CIM pilot
2	Measure Number	Transition track 4 Demonstration 1
3	KPI Number	47 Quality of open data
4	Units of measurement	Integer
5	Baseline (of data variable)	0, No datasets exists
6	Meter	N/A
7	Location of measurement	N/A
8	Data accuracy	N/A
9	Collection interval	Once
10	Start of measurements	M40
11	End of measurements	M40
12	Expected availability	N/A
13	Expected accessibility	N/A
14	Data format	Manual Report in IRIS KPI tool
15	Data owner	Gothenburg City
16	Comments	

Table 186. Description of parameter: "Total number of datasets in CIM pilot" for measure 1.

No	Parameter	Value
1	Data Variable Name	Total number of datasets in CIM pilot
2	Measure Number	Transition track 4 Demonstration 1
3	KPI Number	47: Quality of open data
4	Units of measurement	Integer
5	Baseline (of data variable)	0, No datasets exists
6	Meter	N/A
7	Location of measurement	N/A
8	Data accuracy	N/A
9	Collection interval	Once
10	Start of measurements	M40
11	End of measurements	M40
12	Expected availability	N/A
13	Expected accessibility	N/A
14	Data format	Manual Report in IRIS KPI tool
15	Data owner	Gothenburg City
16	Comments	

Table 187. Description of parameter:"Number of applications using the API in the CIM pilot" for measure 1.

No	Parameter	Value
1	Data Variable Name	Number of applications using the API in the CIM pilot
2	Measure Number	Transition track 4 Demonstration 1
3	KPI Number	29: Open data-based solutions
4	Units of measurement	Integer
5	Baseline (of data variable)	0, No API exists
6	Meter	N/A
7	Location of measurement	N/A
8	Data accuracy	N/A
9	Collection interval	Once
10	Start of measurements	M40
11	End of measurements	M40
12	Expected availability	N/A
13	Expected accessibility	N/A
14	Data format	Manual Report in IRIS KPI tool
15	Data owner	Gothenburg City
16	Comments	

Table 188. Description of parameter: "Number of full purchased solutions from one single company used" for measure 1.

No	Parameter	Value
1	Data Variable Name	Number of full purchased solutions from one single company used
2	Measure Number	Transition track 4 Demonstration 1
3	KPI Number	44: Usage of open source software
4	Units of measurement	Integer
5	Baseline (of data variable)	0, No solutions exists
6	Meter	N/A
7	Location of measurement	N/A
8	Data accuracy	N/A
9	Collection interval	Once
10	Start of measurements	M40
11	End of measurements	M40
12	Expected availability	N/A
13	Expected accessibility	N/A
14	Data format	Manual Report in IRIS KPI tool
15	Data owner	Gothenburg City
16	Comments	

Table 189: Description of parameter "Number of datasets that are REC (RealEstateCore) compliant in Energy Cloud demonstrator" for measure 2.

No	Parameter	Value
1	Data Variable Name	Number of datasets that are REC (RealEstateCore) compliant
2	Measure Number	Transition track 4 Demonstration 2
3	KPI Number	47: Quality of Open Data
4	Units of measurement	Integer
5	Baseline (of data variable)	0.There is no Energy Cloud demonstrator and there are no Datasets in the Energy Cloud pilot.
6	Meter	N/A
7	Location of measurement	N/A
8	Data accuracy	N/A
9	Collection interval	unknown
10	Start of measurements	Q1 2020
11	End of measurements	unknown
12	Expected availability	unknown
13	Expected accessibility	*online, but requires authentication*
14	Data format	Manual report at first
15	Data owner	e.g. Chalmers Fastigheter, AH
16	Comments	

Table 190:Description of parameter "Total number of datasets in Energy Cloud" for measure 2.

No	Parameter	Value
1	Data Variable Name	Total number of datasets in Energy Cloud
2	Measure Number	Transition track 4 Demonstration 2
3	KPI Number	47: Quality of Open Data
4	Units of measurement	Integer
5	Baseline (of data variable)	0.There is no Energy Cloud demonstrator and therefore there are no applications using it.
6	Meter	N/A
7	Location of measurement	N/A
8	Data accuracy	N/A
9	Collection interval	unknown
10	Start of measurements	2020 Q1
11	End of measurements	Unknown
12	Expected availability	Unknown
13	Expected accessibility	*online, but requires authentication*
14	Data format	Manual report at first
15	Data owner	e.g. Chalmers Fastigheter, AH
16	Comments	

Table 191:Description of parameter "Number of applications using the REC compliant datasets in the Energy Cloud demonstrator" for measure 2.

No	Parameter	Value
1	Data Variable Name	Number of applications using the REC compliant datasets in the Energy Cloud demonstrator
2	Measure Number	Transition track 4 Demonstration 2
3	KPI Number	29: Open data-based solutions
4	Units of measurement	Integer
5	Baseline (of data variable)	0.There is no Energy Cloud demonstrator and therefore there are no applications using it.
6	Meter	N/A
7	Location of measurement	N/A
8	Data accuracy	N/A
9	Collection interval	unknown
10	Start of measurements	2020 Q1
11	End of measurements	unknown
12	Expected availability	unknown
13	Expected accessibility	*online, but requires authentication*
14	Data format	Manual report at first
15	Data owner	e.g. Chalmers Fastigheter, AH
16	Comments	