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Interoperable solutions for implementing holistic **FLEXi**bility  
services in the distribution **GRID**

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## **FLEXiGRID KPIs Panel**

### Deliverable 2.4

### WP2

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## DELIVERABLE FACTSHEET

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## Approvals

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## ABBREVIATIONS

<b>A</b>	Current in Ampere
<b>BaU</b>	Business as Usual
<b>DER</b>	Distributed Energy Resources
<b>DSC</b>	Demo-Sites coordinator
<b>EV</b>	Electric Vehicles
<b>FG</b>	FLEXIGRID
<b>KPI</b>	Key Performance Indicator
<b>M</b>	Month
<b>PV</b>	Photovoltaic system
<b>R&amp;D</b>	Research and Development
<b>RES</b>	Renewable Energy Sources
<b>RMS</b>	Root Mean Squared
<b>TP</b>	Technical Partner
<b>UCS</b>	Use Case supervisor
<b>V</b>	Voltage in Volts
<b>WP</b>	Work Package

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## EXECUTIVE SUMMARY

This document sets out the guidance for the use of KPIs by the FLEXIGRID project during the deployment and testing phases. A monitoring plan and a contingency plan have been also developed.

During the execution of this task, a general list of KPIs was defined together with the leaders of the demos and the technology providers. To provide greater flexibility during the deployment stage, this list was divided into two large categories, corresponding to the central KPIs and the auxiliary KPIs. The first list covers the requirements indicated by the demo leaders, the second works as a quick backup during later stages.

The FLEXIGRID project has four defined demonstration sites (Spain, Croatia, Italy and Greece), each with particular needs to be covered, therefore four specific sets of KPIs are established, based on the KPIs panel list (see section 4 of this document), these four lists are shown in Table 1 below. If necessary, a set of auxiliary KPIs are also included for all demos, which are shown in Table 2.

Core KPI	CROATIA	ITALY	GREECE	SPAIN
Average estimation of savings per stakeholder (AeS)	X		X	
CAIDI		X	X	X
CO2 tonnes saved (CO2Sv)			X	
Customer satisfaction (DR services) (CuSa)	X			
Demand Flexibility Potential (DFP) (Baseline)	X			
DR Delivery Deviation (DRDD)	X			
Energy Consumption (EC)			X	
Exchange of Information with sub-DSOs (ExI)		X		
Fault cause detection for recurrent faults (FCD)				X
Fault location accuracy (on demo site) (FLA)				X
Forecasting Accuracy (FA)	X	X	X	X
Improved Interoperability (II)	X			X
Increased RES Hosting capacity (RESHC)		X		
Investment return for secondary substation refit (IRSSR)				X
Island mode reliability rate (IMRR)		X		
Number of Grid Events (NGE)			X	
Number of Voltage Limits Violations (VLV)		X		
Oversight variables available (OVV)				X
Peak load reduction (PLRed)	X		X	
Protections tripping time improvement (PTT)				X
Rate of successful switching operations to reconnect to grid (SSG)		X		
Reactive Energy Consumption (RE)			X	
SAIDI		X		
Self-Consumption Rate (SCRt)			X	
Self-sufficiency ratio (SSRt)		X	X	
Successful event reading index (SERI)			X	X
Successful meter reading index (SMRI)				X
Switching success ratio to islanded mode (SSR)		X		
Thermal discomfort factor (TDF)	X			

Table 1. Core KPI List

Name (ID)	Description
Demand Available Flexibility (DAF)	The amount of load that can be shifted temporally. Needs specification dependent on the method used to provide an incentive (RTP, remote operation of customer assets or other options)
Energy Consumption (EC)	Total energy consumed in a period
Energy not supplied (ENS)	The amount of energy that normally would be delivered, but which has not been supplied because of an outage
Flexibility actions taken (FAT)	Number of flexibility actions taken to reduce demand, load control, network configuration, etc. in a period
Generation Available Flexibility (GAF)	The amount of generation that can be shifted temporally
Grid investment deferral (GID)	Savings (avoided costs) by employing new proposed solutions vs traditional (e.g. line reinforcement)
Increased EV Hosting capacity (EVHC)	The additional EV capacity that can be accommodated on the distribution network after the deployment of the FLEXIGRID solution, compared to the EV capacity that can be accommodated on the distribution network without it.
Line overload occurrence (LOO)	Number of line overloading events up to 15 minutes within a year
Load curve valley filling (VF)	It is defined as the ability to shift load to valley hours, by means of the direct control of assets or by tariff strategy.
NADIR	Minimum frequency reached after a contingency event (by node)
Number of frequency out of range events (FOR)	Calculates times that the average value of the fundamental frequency measured over periods of 10 s goes out of the stated ranges (FCE).
Rate of successful switching operations to reconnect to grid (SSG)	Number of successful reconnections to grid divided by number of all attempts to reconnect to grid in a year
Reduction in Energy Losses (REL)	Amount of electrical energy lost on grid's conductors, transformers, etc.
Reverse Power Flow (RPF)	Power/energy flow from distribution feeder/system upward due to excess of RES power generation
ROCOF	Corresponds with the frequency gradient after an active power imbalance.
SAIFI	The System Average Interruption Frequency Index (SAIFI) indicates how often the average customer experiences a sustained interruption over a predefined period.
Voltage Unbalance Factor (VUF)	Voltage unbalance is defined as the ratio of the negative sequence voltage component to the positive sequence voltage component

Table 2. Auxiliary KPI List

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## 1 INTRODUCTION

The FLEXIGRID project contemplates the use of innovative solutions to provide flexibility under different use cases and configurations of electrical networks. Proposed solutions will allow the distribution grid to operate securely and stably when a large share of variable generation electricity sources is connected to low and medium voltage grids.

FLEXIGRID proposes a three-level approach aiming at Flexibility, Reliability, and Economic Efficiency through the development of innovative hardware and software solutions. These solutions will be demonstrated in four Demo-Sites across Europe ensuring their interoperability through its integration into an open-source platform able to harmonize the data flow between the FLEXIGRID solutions and the actual grid.

This document is part of the WP2 deliverables, the scope of WP2 consists of the definition of the baseline and key aspects for the proper development and subsequent deployment of FLEXIGRID solutions as well as to guide the monitoring process to be defined in WP6.

## 2 OBJECTIVE

This report brings together a specific set of KPIs defined in Task 2.3 (part of WP2) to evaluate the innovation and effectiveness of FLEXIGRID solutions over the duration of the project. These KPIs include a complete set of instructions needed to calculate them as well as the data required to do so.

In addition, solutions for monitoring and backup plans for KPI troubleshooting will be shown, based on procedures to be used during the demonstration stage.

## 3 KPI DEFINITION

### 3.1 Selection methodology

The first set of KPIs was launched at the beginning of WP2, based on earlier projects that focused on flexibility and smart grid control assets (see references). Feedback from all the leaders of the demonstration sites on this first KPI list was collected and analyzed, and each leader proposed new KPIs considering their specific needs.

As a result of the first iteration, a second list of KPIs was sent, this time to all technology partners (software and hardware solutions), analogous to the initial list, all responses were collected and taken into account to improve all aspects to be monitored.

Finally, the last iteration was carried out to eliminate redundant and less relevant KPIs and the complete KPIs Panel list was defined (see Annex A.2). The outline of the process mentioned above is shown in Figure 1.



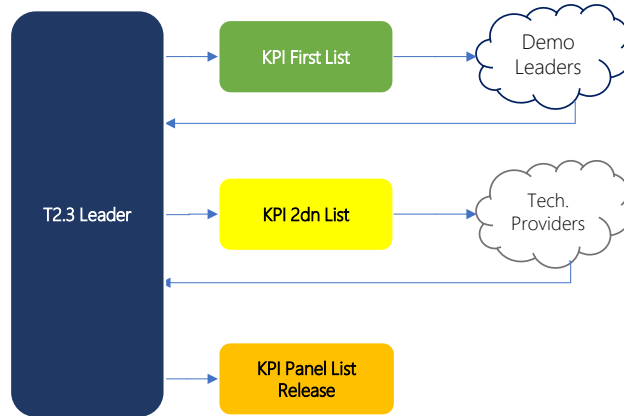


Figure 1. KPI Definition workflow

### 3.2 Categories and implementation

The FLEXIGRID project has four demonstration sites and eight solutions (two per demonstration) and an special solution (9th) shared ,as a result, there are a significant number of KPIs on the panel list, therefore, to provide an effective set of performance indicators for each demonstration the KPI Panel list was divided into several categories.

These categories correspond to two classifications: core KPI and auxiliary KPI. The core KPI contains a minimum number of essential indicators (usually less than 10) that will be measured in the testing stage following the strategies defined in the monitoring plan proposed in this document. In addition, a list of auxiliary KPIs will be established for rapid deployment if demonstration needs arise or change during the demonstration campaign activities. The general classification scheme of the KPI groups is shown in Figure 2.

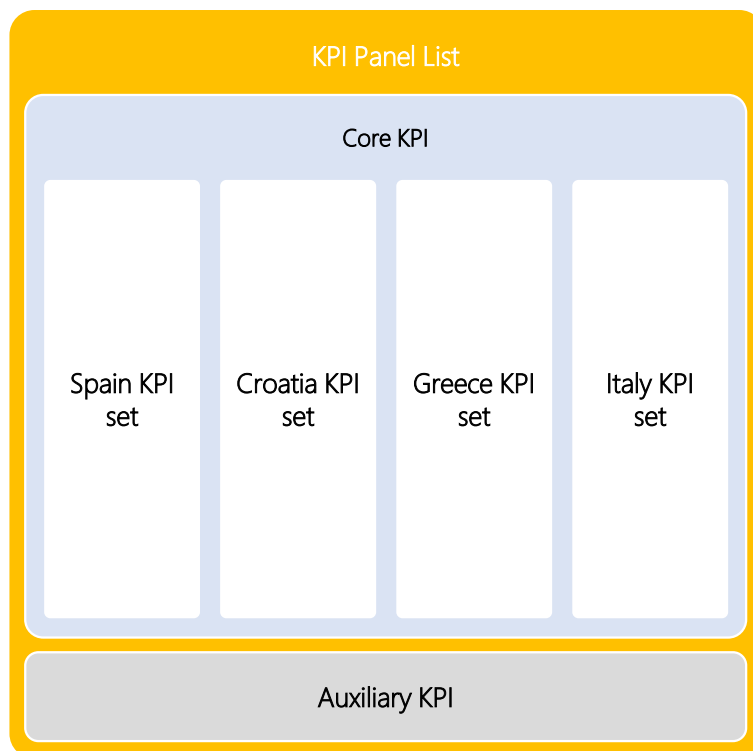


Figure 2. KPI Classification

## 4 KPI PANEL LIST

After following the procedure described in section 3.1, the KPI panel list is defined and contains both the core and auxiliary KPIs along with their names, IDs and a high-level description, as shown in **Error! Reference source not found.**

Name (ID)	Description	Classification	HR	IT	GR	ES
Average estimation of savings per stakeholder (AeS)	Total savings from avoided energy consumption or purchase (depending on concerned stakeholder) over the sum of that avoided energy.	Core KPI	X		X	
CAIDI	The Customer Average Interruption Duration Index (CAIDI) represents the average time required to restore service.	Core KPI		X	X	X
CO2 tonnes saved (CO2Sv)	Amount of CO2 reduction due to substitution of fossil power generation by additional RES units inside the distribution network under analysis (Using FLEXIGRID solution)	Core KPI			X	
Customer satisfaction (DR services) (CuSa)	Satisfaction rating (define the rating range, e.g. from 1 to 5 with 5 being extremely satisfied and 1 being extremely dissatisfied) in Questionnaires	Core KPI	X			
Demand Available Flexibility (DAF)	The amount of load that can be shifted temporally. Needs specification dependent on the method used to provide an incentive (RTP, remote operation of customer assets or other options)	Auxiliary KPI	(1)			
Demand Flexibility Potential (DFP) (Baseline)	The amount of potential Demand Flexibility reflects the amount of energy consumption reduction participating Customers (i.e. End Users) could potentially accept and apply	Core KPI	X			
DR Delivery Deviation (DRDD)	The difference between the DR the Customer has committed to deliver and the DR that the Customer actually delivered	Core KPI	X			
Energy Consumption (EC)	Total energy consumed in a period	Core KPI			X	
Energy not supplied (ENS)	The amount of energy that normally would be delivered, but which has not been supplied because of an outage	Auxiliary KPI	(1)			
Exchange of Information with sub-DSOs (ExI)	Number of new information exchanges with sub-DSOs	Core KPI		X		
Fault cause detection for recurrent faults (FCD)	It is the ratio between the number of fault events (with defined reason) and the total fault events	Core KPI				X
Fault location accuracy (on demo site) (FLA)	Accuracy in fault distance determination using FLEXIGRID solutions	Core KPI				X
Flexibility actions taken (FAT)	Number of flexibility actions taken to reduce demand, load control, network configuration, etc. in a period	Auxiliary KPI	(1)			

Table 3. KPI panel List

Name (ID)	Description	Classification	HR	IT	GR	ES
Forecasting Accuracy (FA)	Deviation between the forecasted values and the corresponding measurements for the demand/generation by node	Core KPI	X	X	X	
Generation Available Flexibility (GAF)	The amount of generation that can be shifted temporally	Auxiliary KPI	(1)			
Grid investment deferral (GID)	Savings (avoided costs) by employing new proposed solutions vs traditional (e.g. line reinforcement)	Auxiliary KPI	(1)			
Improved Interoperability (II)	Interoperability is the ability of a system (or product) to work with other systems (or products). This is made by exchanging information and services to enable them to operate effectively together (ISO/TS 37151). The indicator assesses the improvement in interoperability in a qualitative manner without going into details.	Core KPI	X			X
Increased EV Hosting capacity (EVHC)	The additional EV capacity that can be accommodated on the distribution network after the deployment of the FLEXIGRID solution, compared to the EV capacity that can be accommodated on the distribution network without it.	Auxiliary KPI	(1)			
Increased RES Hosting capacity (RESHC)	The RES hosting capacity is the total installed capacity of RES that can be connected without endangering system stability and reducing system reliability	Core KPI		X		
Investment return for secondary substation refit (IRSSR)	Saved money due to the refit of non-smart secondary substations. Avoided costs by employing new proposed solutions vs traditional (e.g. reduction of energy not supplied, improve time to restore service, etc.)	Core KPI				X
Island mode reliability rate (IMRR)	Effective time operation in a islanded mode divided by period of time that should had been operate in islanded mode because a grid failure in a year	Core KPI		X		
Line overload occurrence (LOO)	Number of line overloading events up to 15 minutes within a year	Auxiliary KPI	(1)			
Load curve valley filling (VF)	It is defined as the ability to shift load to valley hours, by means of the direct control of assets or by tariff strategy.	Auxiliary KPI	(1)			
NADIR	Minimum frequency reached after a contingency event (by node)	Auxiliary KPI	(1)			
Number of frequency out of range events (FOR)	Calculates times that the average value of the fundamental frequency measured over periods of 10 s goes out of the stated ranges (FCE).	Auxiliary KPI	(1)			
Number of Grid Events (NGE)	Number of events that change the network, as lines aperture, tripping of protection in substations, OLTC operation.	Core KPI			X	
Number of Voltage Limits Violations (VLV)	Number of times than voltage in a node exceeds (under or over) the tolerance limit (usually 5%) for more than 2 seconds in a period.	Core KPI		X		

Table 3. KPI panel List (cont.)

Name (ID)	Description	Classification	HR	IT	GR	ES
Oversight variables available (OVV)	Oversight level of secondary substation for maintenance purposes. Number of signals to determine predictive and corrective maintenance actions.	Core KPI				X
Peak load reduction (PLRed)	This KPI shows the reduction in the maximum electricity demand. The KPI is the difference between the two peaks, the power peak with respect to the baseline and the power peak with respect to the Demand Response event with the FLEXIDRIG solutions.	Core KPI	X		X	
Protections tripping time improvement (PTT)	Effective reduction of tripping time by implementation of new algorithms	Core KPI				X
Rate of successful switching operations to reconnect to grid (SSG)	Number of successful reconnections to grid divided by number of all attempts to reconnect to grid in a year	Auxiliary KPI	(1)			
Reactive Energy Consumption (RE)	Total reactive energy consumed in a period	Core KPI			X	
Reduction in Energy Losses (REL)	Amount of electrical energy lost on grid's conductors, transformers, etc.	Auxiliary KPI	(1)			
Reverse Power Flow (RPF)	Power/energy flow from distribution feeder/system upward due to excess of RES power generation	Auxiliary KPI	(1)			
ROCOF	Corresponds with the frequency gradient after an active power imbalance.	Auxiliary KPI	(1)			
SAIDI	It is the average duration of all interruptions per utility customer during the period of analysis. Here, the total customer minutes of interruption are added together and divided by the total number of customers in the system.	Core KPI		X		
SAIFI	The System Average Interruption Frequency Index (SAIFI) indicates how often the average customer experiences a sustained interruption over a predefined period.	Auxiliary KPI	(1)			
Self-Consumption Rate (SCRT)	It is the ratio of consumed renewable energy over the sum of all renewable electricity generated on site.	Core KPI			X	
Self-sufficiency ratio (SSRt)	It is the ratio of total power provided by RES consumed locally and total power required by local demand in a period	Core KPI		X	X	
Successful event reading index (SERI)	This KPI has been defined to analyze if all the meters or IED's are sending their registers	Core KPI			X	X
Successful meter reading index (SMRI)	Indicator to evaluate the performance of the metering infrastructure, covering all kind of queries to request meter data	Core KPI				X

Table 3. KPI panel List (cont.)

Name (ID)	Description	Classification	HR	IT	GR	ES
Switching success ratio to islanded mode (SSR)	Number of successful switching operations to islanded mode divided by the total number of switching attempts to islanded mode in a year	Core KPI		X		
Thermal discomfort factor (TDF)	Assessing people's satisfaction in regards to their thermal environment	Core KPI	X			
Voltage Unbalance Factor (VUF)	Voltage unbalance is defined as the ratio of the negative sequence voltage component to the positive sequence voltage component	Auxiliary KPI	(1)			

(1) Auxiliary KPIs can be used in any demo that requires it

*Table 3. KPI panel List (cont.)*

## 5 KPI DATASHEET

### 5.1 Common Format

A common data sheet format was developed for all KPIs. This data sheet defined the calculation process, the necessary data and those responsible for providing the information.

FLEXIGRID KPI DATASHEET <span style="float: right;">v 0.2</span>							
<b>Basic Information</b>							
<b>Name:</b>		Customer Average Interruption Duration Index			<b>KPI ID:</b>		CAIDI
<b>Description:</b>		The Customer Average Interruption Duration Index (CAIDI) represents the average time required to restore service.					
<b>Location</b>							
<b>Demo site (Use Case)</b>	<b>Spain</b>		<b>Greece</b>		<b>Croatia</b>		<b>Italy</b>
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	<i>UC1 (X)</i>	<i>UC2 (X)</i>	<i>UC3 ()</i>	<i>UC4 ()</i>	<i>UC5 (X)</i>	<i>UC6 (X)</i>	<i>UC7 (X)</i> <i>UC8 (X)</i>
<b>Calculation</b>							
<b>Formula or Calculation procedure</b>		$CAIDI = \frac{\sum r_i N_i}{\sum N_i} = \frac{SAIDI}{SAIFI} \quad r_i = SI_{st} - SI_{en}$ <p>Where:  <i>r<sub>i</sub></i>: Restoration time for each interruption event [minutes]  <i>N<sub>i</sub></i>: Number of interrupted customers for each sustained interruption event during the reporting period [integer]</p>					
<b>Scenarios to be measured / calculated</b>		<b>Baseline</b>		<b>Business as usual (BaU)</b>		<b>FLEXIGRID (R&amp;D)</b>	
		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>Units</b>	[minutes]						
<b>Other KPIs related</b>	SAIDI, SAIFI						
<b>Calculation Methodology</b>							
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>
CAIDI_01	Detect number and duration of interruptions						Example
CAIDI_02	Detect or estimate the number of affected customers						Example
CAIDI_03	Calculate CAIDI in FLEXIGRID scenario						Example
CAIDI_04	Compare to baseline scenario						Example
<b>Data sources / types</b>							
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>
Service interruption event timestamp	SI_st	Sequence of events logging	Various	DSO, SCADA DB or SoE	once at the end of the monitoring period	one year	Example
Restoration command timestamp	SI_en	Sequence of events logging	Various	DSO, SCADA DB or SoE	once at the end of the monitoring period	one year	Example
Number of interrupted customers	Ni	Adding the number of customers in the affected areas	Various	DSO, Costumers DB	once at the end of the monitoring period	one year	Example
<b>Baseline</b>							
<b>Source of baseline condition</b>			<b>Literature</b>		<b>Historical data</b>		<b>Measured at start</b>
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
			<b>Simulation</b>		<b>Laboratory</b>		<b>Field</b>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>Details of baseline</b>		Previous CAIDI values in the same area.					
<b>Responsible</b>	Example						
<b>Comments</b>							

Figure 3. KPI Datasheet common format sections

## 5.2 Sections

The form includes all elements shown in Figure 3 and indicated as follow:

- A. Basic information: where the short name (ID) and a brief description of the KPI will be indicated.
- B. Location: Demo sites and use cases where the performance indicator can be applied will be indicated. (It may change according to the criteria set out in the demonstration stage)
- C. Calculation: This section describes the KPI calculation process and indicates the scenarios to be calculated. At the beginning of the demonstration phase the baseline or business as usual will be calculated, and a final scenario based on the use of FLEXIGRID solutions will be calculated at the end of the demonstration phase.
- D. Calculation methodology: The methodology indicates the steps to perform the KPI calculation, including the necessary input data, the intermediate processes, and the final value, as well as the engineering units.
- E. Data sources/types: In this section the required data, its sources, and the way to obtain it, as well as the responsible for providing the data can be found. Information on the data collection period is also included.
- F. Baseline: This section defines the method used to determine the baseline conditions of the KPI, either through historical data, simulations, reference to literature or others.
- G. Comments: General section for comments and notes.
- H. Versioning: Indicates the version of the data sheet.

The blank form is shown in Annex A.1, the completed data sheets are in Annex A.2.

## 5.3 Monitoring plan

During the demonstration campaign, the effectiveness of the different solutions proposed will be evaluated through all the previously defined KPIs. At the beginning of the demonstration campaign, an internal workshop will be held to define the definitive actions and procedures to be used during all the deployment and testing stages. As a guide for the mentioned workshop, this document provides the main actions and schedules considering the solution development periods as well as the internal milestones in WP6. At least once KPIs will be measured at the beginning and end of the demonstration phase by phase by the use cases supervisors and demo-sites coordinators (as mentioned in task T6.6 description) to assess the impacts achieved through the use of FLEXIGRID technologies and services at the four demonstration sites.

The proposed monitoring plan consists of the following steps:

1. Internal workshop to discuss and define the common plan for demonstration and monitoring common protocols for demonstration activities, including reporting and data collection procedures. The key performance indicators defined in Task 2.3 (contained in this document) will be measured at the beginning and end of the demonstration phase by use case monitors and demonstration site coordinators to assess the effects achieved through the use of FLEXIGRID technologies and services at the four demonstration sites.

2. Calculation of the baseline and BaU: This will allow to define the status of the demos before the implementation of the solutions proposed in the FLEXIGRID project, as indicated in the corresponding datasheet.
3. First evaluation of the KPI list: It is recommended to perform the calculation of all core indicators contained in the final KPI list. The objective is to determine the feasibility to perform the calculation without problems and make a first performance evaluation. If any drawbacks are detected in the calculation procedure, the problem-solving scheme shown in section six of this document should be followed.
4. Evaluation of the KPI in the medium term: at the discretion of the plan defined in the workshop, a follow-up analysis of the progress of the KPIs can be carried out. A review schedule can be followed every four months or in any other period defined in the WP6 workshop.
5. General evaluation of the KPIs (end of test): Calculate all indicators at the end of the test phase, this value will be used as input for task T6.6 to compare the progress made after the implementation of the FLEXIGRID project solutions.
6. Deliverable D6.6 (first draft): Following the main presentation scheme indicated in the proposal document, the first draft of the KPI assessment should be made at the end of M47.
7. Submission of deliverable D6.6.

An outline of the proposed monitoring plan is shown in Figure 4, with all steps and milestones considered as references that could be modified during the main workshop held at the beginning of WP6. Note that the period called 'KPI corrective actions' corresponds to the end of WP3 (M27), WP4 (M30) and WP5 (M36), considering possible interactions to solve KPI problems with the help of these WPs before they are completed.

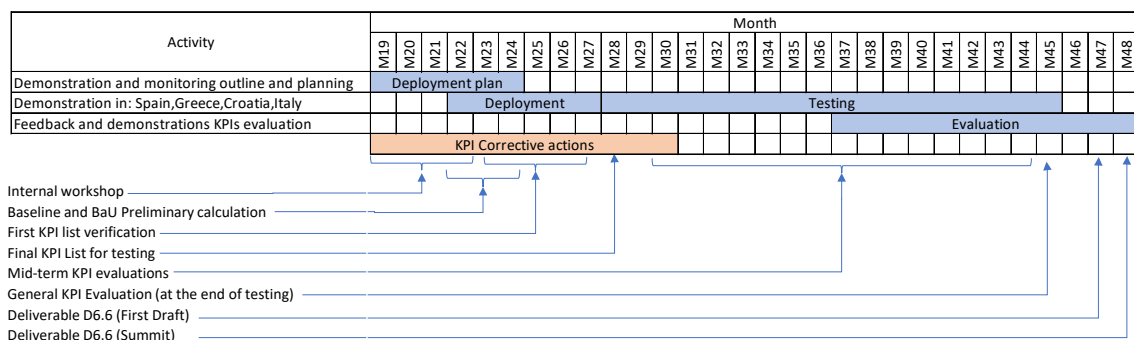


Figure 4. Monitoring plan: main scheme



## 6 CONTINGENCY PLAN

Due to the nature of the project, problems could arise in the calculation or application of the original list of key performance indicators. To address this situation, three alternatives are proposed depending on the level of difficulty encountered.

### 6.1 Auxiliary KPIs

Initially, only the base KPI will be calculated, but to address the need for a new performance indicator, there is the possibility to include an existing auxiliary KPI to the master list if required. The demonstration leader or solution provider can address this scenario during any stage of the deployment and test period by sending the request to the WP6 leader, pre-checking the availability of all inputs and the calculation procedure of the new KPI.

### 6.2 KPI Datasheet modification

Modification of an existing KPI (basic or auxiliary) is possible, this request comes from a demonstration coordinator or a use case supervisor. If the modification only affects the involved demonstration (the KPI is not used in another demonstration) the data sheet of the modified KPI can be updated to the final list (by increasing the version number), in case the KPI to be modified is also applied in another demonstration, the modified version is issued and it is indicated that it only affects to a particular demonstration the version number is changed and the suffix ES, IT, GR or HR is used according to the country concerned. For example, the modification of a datasheet with original version 0.2 for the Croatian demo gives as new version the 0.3HR, this code must be indicated in the section "G" of the datasheet.

The modification of the datasheet must be carried out by the applicant of the change, in which case he will check the availability of all data and the calculation process.

### 6.3 New KPI procedure

There is an option to create a new KPI, this option will be limited to only the supervisor of the use case, who must present the new KPI, the calculation method and required data (datasheet filled) to the leader of the demo for approval. After that it is included in the main list indicating in the comments section that it is a new KPI attachment.

It should be noted that creating a new KPI may require the assistance of work packages 3, 4 or 5 depending on the type of KPI, the application should be requested before these packages are finalized (see monitoring plan in section 5.3), the general process for solving KPI calculation problems is shown in Figure 5.

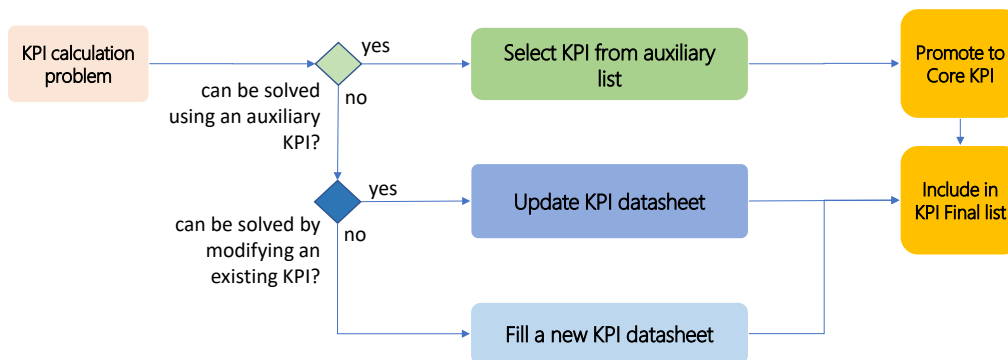


Figure 5. KPI troubleshooting procedure

## 7 REFERENCES

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UPGRID – Report about KPI analysis and methods of comparison.

inteGRIDy - integrated Smart GRID Cross-Functional Solutions for Optimized Synergetic Energy Distribution, Utilization & Storage Technologies - inteGRIDy Global Evaluation Metrics and KPIs.

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## 8 ANNEXES

A.1 KPI Form Template

A.2 All KPI Datasheets filled



**Document:** D2.4 FLEXIGRID KPIs Panel  
**Author:** CIRCE

**Version:** Final Version  
**Date:** 30/06/2020

## ANNEXE A.1 KPI FORM TEMPLATE

FLEXIGRID KPI DATASHEET								
<b>Basic Information</b>								
<b>Name:</b>						<b>KPI ID:</b>		
<b>Description:</b>								
<b>Location</b>								
<b>Demo site (Use Case)</b>	<b>Spain</b>		<b>Greece</b>		<b>Croatia</b>		<b>Italy</b>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<i>UC1 (X)</i>	<i>UC2 (X)</i>	<i>UC3 (X)</i>	<i>UC4 (X)</i>	<i>UC5 (X)</i>	<i>UC6 (X)</i>	<i>UC7 (X)</i>	<i>UC8 (X)</i>
<b>Calculation</b>								
<b>Formula or Calculation procedure</b>								
	<b>Scenarios to be measured / calculated</b>		<i>Baseline</i> <input type="checkbox"/>	<i>Business as usual (BaU)</i> <input type="checkbox"/>	<i>FLEXIGRID (R&amp;D)</i> <input type="checkbox"/>			
<b>Units</b>								
<b>Other KPIs related</b>								
<b>Calculation Methodology</b>								
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>		
<b>Data sources / types</b>								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
<b>Baseline</b>								
<b>Source of baseline condition</b>			<i>Literature</i> <input type="checkbox"/>	<i>Historical data</i> <input type="checkbox"/>	<i>Measured at start</i> <input type="checkbox"/>			
<b>Sites to be Calculated</b>			<i>Simulation</i> <input type="checkbox"/>	<i>Laboratory</i> <input type="checkbox"/>	<i>Field</i> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>								
<b>Comments</b>								



**Document:** D2.4 FLEXIGRID KPIs Panel  
**Author:** CIRCE

**Version:** Final version  
**Date:** 30/06/2020

## ANNEXE A.2 All KPI Datasheets filled

Core (orange)

Auxiliary (blue)

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Average estimation of savings per stakeholder			<b>KPI ID:</b>	AeS			
<b>Description:</b>	Total savings from avoided energy consumption or purchase (depending on stakeholder concerned) over the sum of that avoided energy.							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)      UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)      UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)      UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)      UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$AeS = \frac{\sum S_n}{n}$ $\%AeS = 100 \frac{AeS_{fg}}{AeS_{BaU}} (*)$ <p>Where:            AeS: Average estimation of savings [€]            S_n: Savings in category n [€]            n: Total number of categories for savings [-]            AeS_fg: Average estimations savings in FLEXIGRID scenario [€]            AeS_Bau: Average estimations savings in BaU scenario [€]            (*) Complementary formula</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input type="checkbox"/>		<b>Business as usual (BaU)</b> <input checked="" type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	€							
<b>Other KPIs related</b>	-							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
AeS_01	Determine all categories to be included in savings						DSC	
AeS_02	Define a BaU scenario for each category in AeS_01						DSC	
AeS_03	Define a FLEXIGRID scenario for each category in AeS_01						DSC	
AeS_04	Perform calculation for BaU and FLEXIGRID scenarios (savings)						DSC	
AeS_05	Define a FLEXIGRID scenario for each category in AeS_01						DSC	
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Associated cost per category	AC	DWP6	DWP6	DWP6	once	-	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input checked="" type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET							
Basic Information							
Name:	Customer Average Interruption Duration Index				KPI ID:	CAIDI	
Description:	The Customer Average Interruption Duration Index (CAIDI) represents the average time required to restore service.						
Location							
Demo site (Use Case)	Spain <input type="checkbox"/> UC1 (X) UC2 (X)		Greece <input type="checkbox"/> UC3 (X) UC4 (X)		Croatia <input type="checkbox"/> UC5 (X) UC6 (X)		Italy <input type="checkbox"/> UC7 (X) UC8 (X)
Calculation							
Formula or Calculation procedure	$CAIDI = \frac{\sum r_i N_i}{\sum N_i} = \frac{SAIDI}{SAIFI} \quad r_i = SI_{st} - SI_{en}$ <p>Where:  <math>r_i</math> : Restoration time for each interruption event [minutes]  <math>N_i</math> : Number of interrupted customers for each sustained interruption event during the reporting period [integer]</p>						
Scenarios to be measured / calculated	Baseline <input checked="" type="checkbox"/>		Business as usual (BaU) <input type="checkbox"/>		FLEXIGRID (R&D) <input checked="" type="checkbox"/>		
Units	[minutes]						
Other KPIs related	SAIDI, SAIFI						
Calculation Methodology							
Nº	Step description						Responsible
CAIDI_01	Detect number and duration of interruptions						DSC
CAIDI_02	Detect or estimate the number of affected customers						DSC
CAIDI_03	Calculate CAIDI in FLEXIGRID scenario						UCS
CAIDI_04	Compare to baseline scenario						UCS
Data sources / types							
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible
Service interruption event timestamp	SI_st	Sequence of events logging	Various	DSO, SCADA DB or SoE	once at the end of the monitoring period	one year	DSC
Restoration command timestamp	SI_en	Sequence of events logging	Various	DSO, SCADA DB or SoE	once at the end of the monitoring period	one year	DSC
Number of interrupted customers	Ni	Adding the number of customers in the affected areas	Various	DSO, Costumers DB	once at the end of the monitoring period	one year	DSC
Baseline							
Source of baseline condition			Literature <input type="checkbox"/>		Historical data <input checked="" type="checkbox"/>		Measured at start <input type="checkbox"/>
			Simulation <input type="checkbox"/>		Laboratory <input type="checkbox"/>		Field <input checked="" type="checkbox"/>
Details of baseline	Previous CAIDI values in the same area.						
Responsible	UCS / DSC						
Comments							
DSC = Demo-Sites coordinator UCS = Use Case supervisor							



## FLEXIGRID KPI DATASHEET

Basic Information								
<b>Name:</b>	Customer satisfaction				<b>KPI ID:</b>	CuSa		
<b>Description:</b>	Satisfaction rating (define the rating range, e.g. from 1 to 5 with 5 being extremely satisfied and 1 being extremely dissatisfied) in Questionnaires							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b>			<b>Greece</b>			<b>Croatia</b>	<b>Italy</b>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<i>UC1 (X)</i>	<i>UC2 (X)</i>	<i>UC3 (X)</i>	<i>UC4 (X)</i>	<i>UC5 (X)</i>	<i>UC6 (X)</i>	<i>UC7 (X)</i>	<i>UC8 (X)</i>
Calculation								
<b>Formula or Calculation procedure</b>	Questionnaires with 1 to 5 scale, analysis from psychometric scale							
<b>Scenarios to be measured / calculated</b>			<b>Baseline</b>	<b>Business as usual (BaU)</b>	<b>FLEXIGRID (R&amp;D)</b>			
			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
<b>Units</b>	Likert scale (1 to 5)							
<b>Other KPIs related</b>	--							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
CuSa_01	Create a questionnaire model for each demo (questions)						DSC	
CuSa_02	Define deploy system (online, mail, etc) for each #Cu						DSC	
CuSa_03	Gather all feedbacks						DSC	
CuSa_04	Perform calculation of results #CuSa						UCS	
Data sources / types								
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible	
Customers to deliver the questionnaire	#Cu	Diffusion targeting	DSO DB	DSO	once	DWP6	DSC	
Customers satisfaction	#CuSa	analysis from psychometric scale	CuSa_03	DWP6	DWP6	DWP6	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b>	<b>Historical data</b>	<b>Measured at start</b>			
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
			<b>Simulation</b>	<b>Laboratory</b>	<b>Field</b>			
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
<b>Basic Information</b>								
<b>Name:</b>	Demand Flexibility Potential			<b>KPI ID:</b>	DFP			
<b>Description:</b>	The amount of potential Demand Flexibility reflects the amount of energy consumption reduction participating Customers (i.e. End Users) could potentially accept and apply							
<b>Location</b>								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> <i>UC1 (X) UC2 (X)</i>		<b>Greece</b> <input type="checkbox"/> <i>UC3 (X) UC4 (X)</i>		<b>Croatia</b> <input type="checkbox"/> <i>UC5 (X) UC6 (X)</i>		<b>Italy</b> <input type="checkbox"/> <i>UC7 (X) UC8 (X)</i>	
<b>Calculation</b>								
<b>Formula or Calculation procedure</b>	$DAP = \sum Df_n$ <p>Where:  <i>DfP: Demand available for flexibility [MW]</i>  <i>Df_n: Amount of load that can be shifted in node n [MW]</i></p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[MW]							
<b>Other KPIs related</b>	Generation Available Flexibility (GAF)							
<b>Calculation Methodology</b>								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
GAF_01	Power grid assets characteristics (lines, transformers, generatos, etc.) #GD						DSC	
GAF_02	Modeling power grid for LPF using #GD						DSC	
GAF_03	Determine potencial load available to be shifted in a baseline scenario in node (Gf_n)						UCS	
<b>Data sources / types</b>								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Grid data	#GD	Power grid	DSO registers	DSO registers	once	-	DSO	
<b>Baseline</b>								
<b>Source of baseline condition</b>			<b>Literature</b> <input checked="" type="checkbox"/>		<b>Historical data</b> <input checked="" type="checkbox"/>		<b>Measured at start</b> <input type="checkbox"/>	
			<b>Simulation</b> <input checked="" type="checkbox"/>		<b>Laboratory</b> <input type="checkbox"/>		<b>Field</b> <input type="checkbox"/>	
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
<b>Comments</b>								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

## FLEXIGRID KPI DATASHEET

Basic Information							
Name:	DR Delivery Deviation			KPI ID:	DRDD		
Description:	The difference between the DR requested to be delivered by the Customer and the DR that the Customer actually delivered						
Location							
Demo site (Use Case)	Spain		Greece		Croatia		Italy
	<input type="checkbox"/> UC1 (X)	<input type="checkbox"/> UC2 (X)	<input type="checkbox"/> UC3 (X)	<input type="checkbox"/> UC4 (X)	<input type="checkbox"/> UC5 (X)	<input type="checkbox"/> UC6 (X)	<input type="checkbox"/> UC7 (X) <input type="checkbox"/> UC8 (X)
Calculation							
Formula or Calculation procedure	$DRDD_i = ADFD_i - DFR_i$ <p>Where:            ADFD<sub>i</sub>: Actual Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t            DFR<sub>i</sub>: Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t</p> <p>The calculation of ADFD<sub>i</sub> and DFR<sub>i</sub> can be carried out using the following process:</p> <p>The following time series are assumed to be available for the calculation (per asset / customer premise):  <math>\hat{P}_t</math>: The forecasted baseline power (blue line), which is the forecast of the load given no activation is requested  <math>\hat{P}_t^{min}</math>: The forecasted minimum power (orange line) that can be applied for providing downwards flexibility (reduced load)  <math>\hat{P}_t^{max}</math>: The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increased load)</p> <p>These time series represent the flexibility which was "promised" for a specific time period and afterwards in the evaluation period they are the reference power which the actual measured power must be compared against, in order to measure how much flexibility was actually delivered by Customers.</p> <p>The requested flexibility should be between the limits of the promised flexibility. None, all or part of it should be available for delivery (when requested).</p> <p>Let's assume that <math>a_t \in [0,1]</math> is the signal that represents the requested flexibility (ranging from 0 indicating no activation to 1 indicating full activation). In what follows, we consider the case that the signal refers to decreased consumption (i.e. request to provide downwards flexibility). A similar approach should be followed for requests to provide upwards flexibility (i.e. increased consumption).            The requested load reduction (downwards flexibility) (i.e. the DFR<sub>i</sub>) is:  <math>P_t^{(down, req)} = a_t \cdot (\hat{P}_t - \hat{P}_t^{min})</math>,            while the delivered downwards flexibility at time t (i.e. the ADFD<sub>i</sub>) is:  <math>P_t^{(down, del)} = a_t \cdot (\hat{P}_t - \max(P_t, \hat{P}_t^{min}))</math></p> <p>From the above equations, it is evident that:            If <math>P_t &gt; \hat{P}_t^{min}</math>, the promised but not delivered flexibility at time t is equal to <math>a_t \cdot (P_t - \hat{P}_t^{min})</math>            If <math>P_t = \hat{P}_t^{min}</math>, the flexibility requested is equal to the one delivered at time t            If <math>P_t &lt; \hat{P}_t^{min}</math>, the flexibility delivered is greater than the one requested at time t. The additional flexibility delivered is equal to <math>a_t \cdot (\hat{P}_t^{min} - P_t)</math>.</p>						
	Scenarios to be measured / calculated	Baseline <input type="checkbox"/> X		Business as usual (BAU) <input type="checkbox"/>		FLEXIGRID (R&D) <input type="checkbox"/> X	
Units	kWh						
Other KPIs related	Energy Consumption (EC)						
Calculation Methodology							
Nº	Step description						Responsible
DRDD_01	Calculate the Demand Response requested as the difference between the forecasted baseline power and the forecasted minimum power and then multiply it by the flexibility request signal						DSC
DRDD_02	Calculate the actual delivered Demand Response using the relevant formula provided above						UCS
DRDD_03	The difference between DRDD_01 and DRDD_02 gives the DR Delivery Deviation						UCS
Data sources / types							
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible
Forecasted baseline power	#FBP	Historical data measured	Local meter (IED or other type of meter)	Customer premises / Mains and/or controllable asset	Every minute	Day	DSC
Forecasted minimum power	#FMIP	Thermal comfort model calculation based on customer preferences	Sensors installed at customer premises	Participating customer premises' zones	Every minute	Day	DSC
Forecasted maximum power	#FMAP	Thermal comfort model calculation based on customer preferences	Sensors installed at customer premises	Participating customer premises' zones	Every minute	Day	DSC
Actual power consumption	#APC	Measurement	Local meter (IED or other type of meter)	Customer premises / Mains and/or controllable asset	Every minute	Day	DSC
Baseline							
Source of baseline condition	Literature		Historical data		Measured at start		
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Simulation		Laboratory		Field		
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Details of baseline	--						
Responsible	UCS / DSC						
Comments							
DSC = Demo-Sites coordinator UCS = Use Case supervisor  We assume that one activation can be requested only to one side (i.e. either upwards or downwards) at any given time t. We also assume that we either have available historical consumption data for the participating customers or we have allowed enough time before starting with any DR events to collect baseline consumption data.							

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Exchange of Information with sub-DSOs				<b>KPI ID:</b>	ExI		
<b>Description:</b>	Number of new information exchanges with sub-DSOs							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)      UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)      UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)      UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)      UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$ExI = I_{end} - I_{start}$ <p>Where:  <math>I_{start}</math>: Available information at the start of the project  <math>I_{end}</math>: Available information at the end of the project</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input type="checkbox"/>		<b>Business as usual (BaU)</b> <input checked="" type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	Number							
<b>Other KPIs related</b>	Improved Interoperability (II)							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>		
ExI_01	Evaluation of $I_{start}$					UCS		
ExI_02	Evaluation of $I_{end}$					UCS		
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Number of information (at the beginning)	ExI_01	count data type by engineering unit	SCADA systems / DSO database	SCADA systems / DSO database	once	Start of the testing phase	DSC	
Number of information (at the end)	ExI_02	count data type by engineering unit	SCADA systems / DSO database	SCADA systems / DSO database	once	End of the testing phase	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input type="checkbox"/>	<b>Measured at start</b> <input checked="" type="checkbox"/>			
			<b>Simulation</b> <input type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input checked="" type="checkbox"/>			
<b>Details of baseline</b>	--							
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

## FLEXIGRID KPI DATASHEET

Basic Information								
<b>Name:</b>	Forecasting Accuracy				<b>KPI ID:</b>	FA		
<b>Description:</b>	Deviation between the forecasted values and the corresponding measurements for the demand/generation by node							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> <small>UC1 (X)    UC2 (X)</small>	<b>Greece</b> <input type="checkbox"/> <small>UC3 (X)    UC4 (X)</small>	<b>Croatia</b> <input type="checkbox"/> <small>UC5 (X)    UC6 (X)</small>	<b>Italy</b> <input type="checkbox"/> <small>UC7 (X)    UC8 (X)</small>				
Calculation								
<b>Formula or Calculation procedure</b>	$FA = \sqrt{\frac{1}{N} \sum_{n=1}^N (e_n(t))^2}$ <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><i>Where:</i></p> <p><i>N:</i> total number of nodes where have both a forecast and demand/generation value [-]</p> <p><i>en:</i> absolute error for forecast in node n at time t [W]</p> <p><i>fn:</i> demand/generation forecasted value in node n at time t [W]</p> <p><i>dn:</i> demand value from the grid in node n at time t [W]</p> <p><i>gn:</i> generation value from the grid in node n at time t [W]</p> </div> <div style="width: 50%;"> <p><math>e_n(t) = f_n(t) - d_n(t)</math> ; for demand</p> <p><math>e_n(t) = f_n(t) - g_n(t)</math> ; for generation</p> </div> </div>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>	<b>Business as usual (BaU)</b> <input type="checkbox"/>			<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[W]							
<b>Other KPIs related</b>	--							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
FA_01	Get forecasts for the N load/production nodes in a LV network, generated at time instant t						UCS	
FA_02	Get the available measurements from the data exchange system that correspond to the forecasts in node n at time t						DSC	
FA_03	Calculate the FA value of the total demand/generation nodes in the grid						UCS	
Data sources / types								
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible	
Forecasted demand/generation	fn	Calculated by forecast algorithm	Directly from forecast algorithm	Data base	To be determined	24h	UCS	
Measured demand/generation	dn; gn	Obtained from data base registers	IED, SCADA, DSC	Data base	To be determined	24h	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input checked="" type="checkbox"/>	<b>Historical data</b> <input type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Fault cause detection for recurrent faults				<b>KPI ID:</b>	FCD		
<b>Description:</b>	It is the ratio between the number of fault events (with defined reason) and the total fault events							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)    UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)    UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)    UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)    UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$FCD = \sum SFD_n$ <p>Where:            FCD: Total fault cause detected [-]            SFD_n: Successful fault cause detection "n" [-]</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[-]							
<b>Other KPIs related</b>	Fault location accuracy (FLA)							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
FCD_1	Obtain total faults detected in demo site location #TFD						DSC	
FCD_2	Obtain effective cause for fault event "n" in #TFD in a baseline scenario #SFD_n						DSC	
FCD_3	Obtain effective cause for fault event "n" in #TFD in a FLEXIGRID scenario #SFD_n						DSC	
FCD_3	Perform calculation of FCD (compare baseline with FLEXIGRID)						UCS	
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Total faults detections	#TFD	incidence reporting	Field / SCADA reporting	DSO DB / registers	monthly	one year	DSC	
Effective fault cause detection	#SFD_n	incidence reporting	Field reporting	DSO DB / registers	monthly	one year	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>	<b>Measured at start</b> <input checked="" type="checkbox"/>			
			<b>Simulation</b> <input type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input checked="" type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor (*) If needed / possible								

## FLEXIGRID KPI DATASHEET

Basic Information							
<b>Name:</b>	Fault location accuracy (on demo site)				<b>KPI ID:</b>	FLA	
<b>Description:</b>	Accuracy in fault distance determination using FLEXIGRID solutions						
Location							
<b>Demo site (Use Case)</b>	<b>Spain</b>	<b>Greece</b>		<b>Croatia</b>		<b>Italy</b>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	UC1 (X)	UC2 (X)	UC3 (X)	UC4 (X)	UC5 (X)	UC6 (X)	UC7 (X) UC8 (X)
Calculation							
<b>Formula or Calculation procedure</b>	$FLA = \frac{100}{n} \sum \frac{R_{FLn} - E_{FLn}}{R_{FLn}}$						
	Where: FLA: Fault location accuracy [m] E_FLn: Estimated fault location in fault "n" [m] R_FLn: Real fault location in fault "n" [m] n: Total number of faults [-]						
<b>Scenarios to be measured / calculated</b>		<b>Baseline</b>		<b>Business as usual (BaU)</b>		<b>FLEXIGRID (R&amp;D)</b>	
		<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
<b>Units</b>	[%]						
<b>Other KPIs related</b>	-						
Calculation Methodology							
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>	
FLA_01	Indicate distance and characteristics of fault in the tested network (per event)					DSC	
FLA_02	Determine estimated fault distance using FLEXIGRID solutions [m]					UCS	
FLA_03	Perform calculation of total accuracy in fault distance estimation FLA					UCS	
Data sources / types							
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible
Distance to fault	RLF_n	real distance to fault	IED / DB	DSO registers	per fault	per fault	DSC
Estimated distance to fault	ELF_n	Estimated distance to fault	IED / DB	IED / DB	per fault	per fault	UCS
Baseline							
<b>Source of baseline condition</b>			<b>Literature</b>	<b>Historical data</b>		<b>Measured at start</b>	
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
			<b>Simulation</b>	<b>Laboratory*</b>		<b>Field</b>	
			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>Details of baseline</b>							
<b>Responsible</b>		UCS / DSC					
Comments							
DSC = Demo-Sites coordinator UCS = Use Case supervisor (*) If needed / possible							

## FLEXIGRID KPI DATASHEET

Basic Information								
<b>Name:</b>	Improved Interoperability			<b>KPI ID:</b>	II			
<b>Description:</b>	Interoperability is the ability of a system (or product) to work with other systems (or products) by providing services to and accepting services from other systems and to use the services so exchanged to enable them to operate effectively together (ISO/TS 37151). The indicator assesses the improvement in interoperability in a qualitative manner without going into details.							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> <i>UC1 (X)      UC2 (X)</i>	<b>Greece</b> <input type="checkbox"/> <i>UC3 (X)      UC4 (X)</i>	<b>Croatia</b> <input type="checkbox"/> <i>UC5 (X)      UC6 (X)</i>	<b>Italy</b> <input type="checkbox"/> <i>UC7 (X)      UC8 (X)</i>				
Calculation								
<b>Formula or Calculation procedure</b>	<p>The indicator provides a qualitative measure and is rated on a five-point Likert scale as follows:</p> <ol style="list-style-type: none"> <li>1. Not at all: the project does not increase interoperability.</li> <li>2. Poor: the project does little to increase interoperability.</li> <li>3. Somewhat: the project somewhat increases interoperability.</li> <li>4. Good: the project increases interoperability sufficiently.</li> <li>5. Excellent: the project increases interoperability extensively.</li> </ol>							
<b>Scenarios to be measured / calculated</b>	<i>Baseline</i> <input checked="" type="checkbox"/>		<i>Business as usual (BaU)</i> <input type="checkbox"/>		<i>FLEXIGRID (R&amp;D)</i> <input checked="" type="checkbox"/>			
<b>Units</b>	N/A							
<b>Other KPIs related</b>	N/A							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>		
II_01	Create a questionnaire model (questions)					DSC		
II_02	Gather all feedbacks					DSC		
II_03	Perform calculation of results					UCS		
Data sources / types								
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible	
Evaluation (at the end)	EV	qualitative measure and is rated on a five-point Likert scale	Form	UCS	once	End of the testing phase	DSC	
Baseline								
<b>Source of baseline condition</b>			<i>Literature</i> <input type="checkbox"/>	<i>Historical data</i> <input type="checkbox"/>	<i>Measured at start</i> <input checked="" type="checkbox"/>			
			<i>Simulation</i> <input type="checkbox"/>	<i>Laboratory</i> <input type="checkbox"/>	<i>Field</i> <input checked="" type="checkbox"/>			
<b>Details of baseline</b>	--							
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								



FLEXIGRID KPI DATASHEET								
<b>Basic Information</b>								
<b>Name:</b>	Island mode reliability rate			<b>KPI ID:</b>	IMRR			
<b>Description:</b>	Effective time operation in a islanded mode divided by period of time that should had been operate in islanded mode because a grid failure in a year							
<b>Location</b>								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)      UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)      UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)      UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)      UC8 (X)	
<b>Calculation</b>								
<b>Formula or Calculation procedure</b>	$IMRR = 100 \cdot \left( \frac{ET_{im}}{RT_{im}} \right)$			$ET_{im} = \sum De_n - Ds_n$				
	Where: <i>IMRR</i> : Island mode reliability rate [%] <i>ET<sub>im</sub></i> : Effective time operating in islanded mode [h] <i>RT<sub>im</sub></i> : Time that it should has been operating in islanded mode [h] <i>De<sub>n</sub></i> : Disconnection event n start time [timestamp] <i>Ds<sub>n</sub></i> : Disconnection event n end time [timestamp] <i>Ie<sub>n</sub></i> : Island event n start time [timestamp] <i>Is<sub>n</sub></i> : island event n end time [timestamp]			$RT_{im} = \sum Ie_n - Is_n$				
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	%							
<b>Other KPIs related</b>	Rate of successful switching operations to reconnect to grid (SSG) Switching success ratio to islanded mode (SSR)							
<b>Calculation Methodology</b>								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
IMRR_01	Get all disconnections events from main grid systems (De <sub>n</sub> , Ds <sub>n</sub> )						DSC	
IMRR_02	Get all successful switching to islanded mode (Ie <sub>n</sub> , Is <sub>n</sub> )						DSC	
IMRR_03	Perform calculation of ET <sub>im</sub> and RT <sub>im</sub>						UCS	
IMRR_04	preform calculation of IMRR						UCS	
<b>Data sources / types</b>								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Disconnection grid event	IMRR_01	Grid connection status	IEDs / Others	DSO SCADA /DB	hourly	one year	DSC	
Islanded mode switching event	IMRR_02	Islanded mode status	IEDs / Others	DSO SCADA /DB	hourly	one year	DSC	
<b>Baseline</b>								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>		<b>Measured at start</b> <input type="checkbox"/>		
			<b>Simulation</b> <input type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>		<b>Field</b> <input checked="" type="checkbox"/>		
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
<b>Comments</b>								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Investment return for secondary substation refit			<b>KPI ID:</b>	IRSSR			
<b>Description:</b>	Saved money due to the refit of non-smart secondary substations. Avoided costs by employing new proposed solutions vs traditional (e.g. reduction of energy not supplied, improve time to restore service, etc.)							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)      UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)      UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)      UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)      UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$IRSSR = \sum SBaU_n - Sc_n$ <p>Where:            IRSSR: Total amount of savings [€]            SBaU_n: Amount of savings by substation / category "n" in the grid as result of BaU scenario [€]            Sc_n: Amount of savings by substation / category "n" in the grid using FLEXIGRID solutions [€]</p>							
<b>Scenarios to be measured / calculated</b>			<b>Baseline</b> <input type="checkbox"/>	<b>Business as usual (BaU)</b> <input checked="" type="checkbox"/>	<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[€]							
<b>Other KPIs related</b>	Grid investment deferral (GID)							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
IRSSR_1	Define categories to be monitored for possible savings (to include in #SAC)						DSC	
IRSSR_2	Define each category to be simulated or field data to determine saving/costs in a BaU scenario SBaU_n based in #SAC information						DSC	
IRSSR_3	Define each category to be simulated or field data to determine saving/costs in a FLEXIGRID scenario Sc_n						UCS	
IRSSR_4	Perform calculation of IRSSR						UCS	
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Structure / associated cost	#SAC	determine cost per category	DSO Registers	DSO DB	once	--	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input checked="" type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

## FLEXIGRID KPI DATASHEET

Basic Information							
<b>Name:</b>	Number of grid events				<b>KPI ID:</b>	NGE	
<b>Description:</b>	Number of events that change the network, as lines aperture, tripping of protection in substations, OLTC operation.						
Location							
<b>Demo site (Use Case)</b>	<b>Spain</b>	<b>Greece</b>		<b>Croatia</b>		<b>Italy</b>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<i>UC1 (X)</i>	<i>UC2 (X)</i>	<i>UC3 (X)</i>	<i>UC4 (X)</i>	<i>UC5 (X)</i>	<i>UC6 (X)</i>	<i>UC7 (X)</i> <i>UC8 (X)</i>
Calculation							
<b>Formula or Calculation procedure</b>	$NGE = \sum GE_n$						
	Where: <i>NGE: Total number of grid events [-]</i> <i>GE<sub>n</sub>: Grid event number n [-]</i>						
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b>		<b>Business as usual (BaU)</b>		<b>FLEXIGRID (R&amp;D)</b>		
	<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>		
<b>Units</b>	[-]						
<b>Other KPIs related</b>	--						
Calculation Methodology							
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>	
NGE_01	Obtain event registers from DB, SCADA, SoE					UCS	
Data sources / types							
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible
Registered event	NGE_01	IED extraction	IEDs / Others	DSO SCADA DB	monthly	one year	DSC
Baseline							
<b>Source of baseline condition</b>			<b>Literature</b>	<b>Historical data</b>	<b>Measured at start</b>		
			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
			<b>Simulation</b>	<b>Laboratory</b>	<b>Field</b>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>Details of baseline</b>							
<b>Responsible</b>		UCS / DSC					
Comments							
DSC = Demo-Sites coordinator UCS = Use Case supervisor optionally can be separated by zone and type of event							

## FLEXIGRID KPI DATASHEET

Basic Information										
<b>Name:</b>	Oversight variables available			<b>KPI ID:</b>	OVV					
<b>Description:</b>	Oversight level of secondary substation for maintenance purposes. Number of signals to determine predictive and corrective maintenance actions.									
Location										
<b>Demo site (Use Case)</b>	<b>Spain</b>			<b>Greece</b>			<b>Croatia</b>			<b>Italy</b>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	<i>UC1 (X)</i>	<i>UC2 (X)</i>	<i>UC3 (X)</i>	<i>UC4 (X)</i>	<i>UC5 (X)</i>	<i>UC6 (X)</i>	<i>UC7 (X)</i>	<i>UC8 (X)</i>		
Calculation										
<b>Formula or Calculation procedure</b>	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="font-size: 2em; font-weight: bold;">OVV</div> <div style="font-size: 1.5em;"> <math display="block">OVV_{avg} = \frac{\sum S_n}{n} (*)</math> </div> </div> <p><i>Where:</i>            OVV: Total number of signals [-]            S<sub>n</sub>: Total number of signals in substation "n" [-]            OVV<sub>avg</sub>: Average number of signals [-]            n: Total number of substations (to be monitored) [-]            (*) alternative KPI</p>									
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b>		<b>Business as usual (BaU)</b>		<b>FLEXIGRID (R&amp;D)</b>					
	<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>					
<b>Units</b>	[-]									
<b>Other KPIs related</b>	Successful meter reading index (SMRI) Successful event reading index (SERI)									
Calculation Methodology										
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>			
OVV_1	Define substation signals to be monitored / available (TS <sub>n</sub> )						DSC			
OVV_2	Define signals that can be used to make a maintenance plan from TS <sub>n</sub> and determine S <sub>n</sub>						UCS			
OVV_3	Perform calculation of OVV in a baseline and a FLEXIGRID scenario						UCS			
Data sources / types										
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible			
Signals to be monitored	TS <sub>n</sub>	Determine the number of signals to transmit / receive	--	DSO DB / Register	once	--	DSC			
Baseline										
<b>Source of baseline condition</b>			<b>Literature</b>	<b>Historical data</b>	<b>Measured at start</b>					
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					
			<b>Simulation</b>	<b>Laboratory</b>	<b>Field</b>					
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>					
<b>Details of baseline</b>										
<b>Responsible</b>	UCS / DSC									
Comments										
DSC = Demo-Sites coordinator UCS = Use Case supervisor										

## FLEXIGRID KPI DATASHEET

Basic Information								
<b>Name:</b>	Peak Load Reduction				<b>KPI ID:</b>	PLRed		
<b>Description:</b>	This KPI shows the reduction in the maximum electricity demand. The KPI is actually the difference between the two peaks, the power peak with respect to the baseline and the power peak with respect to the Demand Response event with the FLEXIDRIG solutions.							
Location								
<b>Demo site (Use Case)</b>	<i>Spain</i> <input type="checkbox"/> <i>UC1 (X) UC2 (X)</i>	<i>Greece</i> <input type="checkbox"/> <i>UC3 (X) UC4 (X)</i>	<i>Croatia</i> <input type="checkbox"/> <i>UC5 (X) UC6 (X)</i>	<i>Italy</i> <input type="checkbox"/> <i>UC7 (X) UC8 (X)</i>				
Calculation								
<b>Formula or Calculation procedure</b>	$PLRed = 100 \cdot \left(1 - \frac{PP_{R\&D}}{PP_{BL}}\right)$							
	<i>Where:</i> PP_BL: Peak load, evaluated during a Baseline scenario in a period [W] PP_R&D: Peak load, evaluated using the FLEXIGRID solutions in a period [W]							
<b>Scenarios to be measured / calculated</b>	<i>Baseline</i> <input checked="" type="checkbox"/>		<i>Business as usual (BaU)</i> <input type="checkbox"/>		<i>FLEXIGRID (R&amp;D)</i> <input checked="" type="checkbox"/>			
<b>Units</b>	%							
<b>Other KPIs related</b>	-							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>		
PLRed_01	Define the electrical boundary of the demo site					DSC		
PLRed_02	Obtain historical data of active power within the zone defined previously					DSC		
PLRed_03	Obtain new data of active power within the zone defined previously after using the FLEXIGRID solution					DSC		
PLRed_04	Perform calculation of PLRed					UCS		
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Active power	P	meters units lecture	IEDs / Others	DSO power registers	daily	one year	DSC	
Baseline								
<b>Source of baseline condition</b>			<i>Literature</i> <input type="checkbox"/>	<i>Historical data</i> <input checked="" type="checkbox"/>	<i>Measured at start</i> <input type="checkbox"/>			
			<i>Simulation</i> <input checked="" type="checkbox"/>	<i>Laboratory</i> <input type="checkbox"/>	<i>Field</i> <input checked="" type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Protections tripping time improvement			<b>KPI ID:</b>	PTT			
<b>Description:</b>	Effective reduction of tripping time by implementation of new algorithms							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)    UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)    UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)    UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)    UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$PTT = M_{NTT} - M_{TT}$ <p>Where:            PTT: Reduction of tripping time [ms]            M_NTT: Median of tripping time with FLEXIGRID algorithms [ms]            M_TT: Median of tripping time in a baseline scenario [ms]</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[ms]							
<b>Other KPIs related</b>	--							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
PTT_01	Obtain configurations settings from protection units (CONF)						DSC	
PTT_02	Obtain tripping time in baseline conditions (Simulation, Operation registers, Secondary injection testing, Hardware in the loop technics)						DSC	
PTT_03	Obtain tripping time using the new algorithms provided by FLEXIGRID						UCS	
PTT_04	Perform calculation to determine the median tripping time for each protection and location monitored						UCS	
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
IED configuration files	CONF	File	IEDs / Catalogs	IED Register, Catalogs, standard	DWP6	DWP6	DSC	
Protection Operation time	OT	Tripping time from IED	IEDs / Simulations	IED Register, Secondary injection unit	DWP6	DWP6	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input checked="" type="checkbox"/>	<b>Historical data</b> <input type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input checked="" type="checkbox"/>	<b>Field</b> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Reactive Energy Consumption				<b>KPI ID:</b>	RE		
<b>Description:</b>	Total reactive energy consumed in a period of time							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)    UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)    UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)    UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)    UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$RE = \sum Eq_n$ <p>Where:            RE: Total Reactive Energy [MVARh]            Eqn: Reactive energy consumed in period n [MVARh]</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[MVARh]							
<b>Other KPIs related</b>	Energy Consumption (EC)							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>		
RE_01	Obtain reactive energy consumption in all nodes involved					DSC		
RE_02	Perform calculation of total reactive energy according to the minimum monitoring period					UCS		
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Reactive energy	Eq	Power meters units lecture	IEDs / Others	DSO power registers	monthly	one year	UCS	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input checked="" type="checkbox"/>		<b>Historical data</b> <input type="checkbox"/>		<b>Measured at start</b> <input type="checkbox"/>	
			<b>Simulation</b> <input checked="" type="checkbox"/>		<b>Laboratory</b> <input type="checkbox"/>		<b>Field</b> <input type="checkbox"/>	
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

## FLEXIGRID KPI DATASHEET

Basic Information								
<b>Name:</b>	Increased RES Hosting capacity				<b>KPI ID:</b>	RESHC		
<b>Description:</b>	The RES hosting capacity is the total installed capacity of RES that can be connected without endangering system stability and reducing system reliability							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> <i>UC1 (X)      UC2 (X)</i>	<b>Greece</b> <input type="checkbox"/> <i>UC3 (X)      UC4 (X)</i>	<b>Croatia</b> <input type="checkbox"/> <i>UC5 (X)      UC6 (X)</i>	<b>Italy</b> <input type="checkbox"/> <i>UC7 (X)      UC8 (X)</i>				
Calculation								
<b>Formula or Calculation procedure</b>	$RESHC = 100 \cdot \left( \frac{HC_{FG} - HC_{BL}}{HC_{BL}} \right)$ <p>Where:  <i>RESHC: Is the enhanced hosting capacity of RES when FLEXIGRID solutions are applied [%]</i>  <i>HC<sub>FG</sub>: Is the additional hosting capacity of RES when FLEXIGRID solutions are applied with respect to currently connected generation [MW]</i>  <i>HC<sub>BL</sub>: Is the hosting capacity of RES in baseline scenario with respect to currently connected generation [MW]</i></p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	%							
<b>Other KPIs related</b>	Increased EV Hosting capacity (EVHC)							
Calculation Methodology								
Nº	Step description					Responsible		
RESHC_01	Get all demo site asset characteristics					DSC		
RESHC_02	Model the power grid to perform OPF simulations					UCS		
RESHC_03	Perform an OPF for a baseline scenario to obtain the capacity of the grid					UCS		
RESHC_04	Perform an OPF for a FLEXIGRID scenario to obtain the capacity of the grid					UCS		
RESHC_05	Perform calculation of RESHC					UCS		
Data sources / types								
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible	
Demo assets characteristics	RESHC_01	Nominal values / specifications	Datasheets / Registers	DSO DB	ones	--	DSC	
Hosting capacity	HC <sub>FG</sub> / HC <sub>BL</sub>	OPF Simulation	OPF Simulator	DB	--	--	UCS	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								



FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	System Average interruption Duration Index			<b>KPI ID:</b>	SAIDI			
<b>Description:</b>	Is the average duration of all interruptions per utility customer during the period of analysis. Here, the total customer minutes of interruption are added together and divided by the total number of customers in the system.							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)      UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)      UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)      UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)      UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$SAIDI = \frac{\sum r_i N_i}{N_T} \quad r_i = SI_{st} - SI_{en}$ <p>Where:  <math>r_i</math> : Restoration time for each interruption event [minutes]  <math>N_T</math> : Total number of customers served for the area [integer]  <math>N_i</math> : Number of interrupted customers for each sustained interruption event during the reporting period [integer]</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[minutes]							
<b>Other KPIs related</b>	CAIDI, SAIFI							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
SAIDI_01	Detect number and duration of interruptions						DSC	
SAIDI_02	Detect or estimate the number of affected customers						DSC	
SAIDI_03	Calculate SAIDI in FLEXIGRID scenario						UCS	
SAIDI_04	Compare to baseline scenario						UCS	
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Service interruption event timestamp	SI_st	Sequence of events logging	Various	DSO, SCADA DB or SoE	once at the end of the monitoring period	one year	DSC	
Restoration command timestamp	SI_en	Sequence of events logging	Various	DSO, SCADA DB or SoE	once at the end of the monitoring period	one year	DSC	
Number of interrupted customers	Ni	Adding the number of customers in the affected areas	Various	DSO, Costumers DB	once at the end of the monitoring period	one year	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input checked="" type="checkbox"/>			
<b>Details of baseline</b>	Previous SAIDI values in the same area.							
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET							
Basic Information							
<b>Name:</b>	Self-Consumption Rate (SCRt)				<b>KPI ID:</b>	SCRt	
<b>Description:</b>	Is the ratio of consumed renewable energy over the sum of all renewable electricity generated on site.						
Location							
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)    UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)    UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)    UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)    UC8 (X)
Calculation							
<b>Formula or Calculation procedure</b>	$\text{SCRt} = \frac{E_{C\_RE}}{E_{G\_RE\_tot}}$ $E_{C\_RE} = E_{G\_RE} ; E_{C\_tot} \geq E_{G\_RE}$ $E_{C\_RE} = E_{C\_tot} ; E_{C\_tot} < E_{G\_RE}$ <p>Where:  <i>E<sub>c_re</sub></i>: Is the on-site renewable electricity consumption [kWh]  <i>E<sub>g_re_tot</sub></i>: Total energy produced by RES locally  <i>E<sub>c_tot</sub></i>: Total electricity consumption locally [kWh]</p>						
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>		
<b>Units</b>	[-]						
<b>Other KPIs related</b>	Self-sufficiency Ratio (SSRt)						
Calculation Methodology							
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>	
SCRt_01	Define the electrical boundary of the demo site to perform the energy flow					DSC	
SCRt_02	Obtain amount of generated energy locally (within the bounds)					DSC	
SCRt_03	Obtain amount of consumed energy locally (within the bounds)					DSC	
SCRt_04	Perform calculation of E <sub>c_re</sub>					UCS	
SCRt_05	Perform calculation of SCRt					UCS	
Data sources / types							
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>
Total energy generated by RES	E <sub>res</sub>	meters units lecture	IEDs / Others	DSO registers	hourly	one year	DSC
Total energy consumed	E <sub>con</sub>	meters units lecture	IEDs / Others	DSO registers	hourly	one year	DSC
Baseline							
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>		<b>Historical data</b> <input type="checkbox"/>		<b>Measured at start</b> <input checked="" type="checkbox"/>
			<b>Simulation</b> <input checked="" type="checkbox"/>		<b>Laboratory</b> <input type="checkbox"/>		<b>Field</b> <input checked="" type="checkbox"/>
<b>Details of baseline</b>							
<b>Responsible</b>	UCS / DSC						
Comments							
DSC = Demo-Sites coordinator UCS = Use Case supervisor can be verified by simulation or field data							

FLEXIGRID KPI DATASHEET								
<b>Basic Information</b>								
<b>Name:</b>	Successful event reading index			<b>KPI ID:</b>	SERI			
<b>Description:</b>	This KPI has been defined to analyze if all the meters or IED's are sending their registers							
<b>Location</b>								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)    UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)    UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)    UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)    UC8 (X)	
<b>Calculation</b>								
<b>Formula or Calculation procedure</b>	$SERI = 100 \cdot \left( \frac{SPr}{T_{PR}} \right)$ $SERI = 100 \cdot \left( \frac{T_{PR} - FPr}{T_{PR}} \right)^{(*)}$ <p>Where:            SERI: Successful event reading index [%]            SPr: Successful number of polling request [-]            FPr: Failure number of polling request [-]            T_PR: Total number of pollings request [-]            (*) alternative method</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[%]							
<b>Other KPIs related</b>	--							
<b>Calculation Methodology</b>								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
SERI_01	Obtain numbers of polling request to IED's						DSC	
SERI_02	Obtain numbers of success polling request to IED's						DSC	
SERI_03	(alternative) Obtain number of polling request failure to IED's						DSC	
SERI_04	Perform calculation of SERI						UCS	
<b>Data sources / types</b>								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Polling success indicator	PS	Watchdogs / polling request timeout	IEDs / Others	DSO DB	monthly	one year	DSC	
<b>Baseline</b>								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input type="checkbox"/>	<b>Measured at start</b> <input checked="" type="checkbox"/>			
			<b>Simulation</b> <input type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input checked="" type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
<b>Comments</b>								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

## FLEXIGRID KPI DATASHEET

Basic Information							
<b>Name:</b>	Successful meter reading index			<b>KPI ID:</b>	SMRI		
<b>Description:</b>	Is a indicator to evaluate the performance of the metering infrastructure, covering all kind of queries to request meter data						
Location							
<b>Demo site (Use Case)</b>	<b>Spain</b>	<b>Greece</b>		<b>Croatia</b>		<b>Italy</b>	
	<input type="checkbox"/> <i>UC1 (X) UC2 (X)</i>	<input type="checkbox"/> <i>UC3 (X) UC4 (X)</i>	<input type="checkbox"/> <i>UC5 (X) UC6 (X)</i>	<input type="checkbox"/> <i>UC7 (X) UC8 (X)</i>			
Calculation							
<b>Formula or Calculation procedure</b>	$SMRI = 100 \cdot \left( \frac{SPr}{T_{PR}} \right)$ $SMRI = 100 \cdot \left( \frac{T_{PR} - FPr}{T_{PR}} \right)^{(*)}$ <p>Where:  <i>SERI: Successful meter reading index [%]</i>  <i>SPr: Successful number of polling request [-]</i>  <i>FPr: Failure number of polling request [-]</i>  <i>T<sub>TP</sub>: Total number of pollings request [-]</i>            (*) alternative method</p>						
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b>		<b>Business as usual (BaU)</b>		<b>FLEXIGRID (R&amp;D)</b>		
	<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>		
<b>Units</b>	[%]						
<b>Other KPIs related</b>	--						
Calculation Methodology							
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>
SMRI_01	Obtain numbers of polling request to IED's						DSC
SMRI_02	Obtain numbers of success polling request to IED's						DSC
SMRI_03	(alternative) Obtain number of polling request failure to IED's						DSC
SMRI_04	Perform calculation of SERI						UCS
Data sources / types							
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>
Polling success indicator	PS	Watchdogs / polling request timeout	IEDs / Others	DSO DB	monthly	one year	DSC
Baseline							
<b>Source of baseline condition</b>			<b>Literature</b>	<b>Historical data</b>		<b>Measured at start</b>	
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
			<b>Simulation</b>	<b>Laboratory</b>		<b>Field</b>	
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>Details of baseline</b>							
<b>Responsible</b>	UCS / DSC						
Comments							
DSC = Demo-Sites coordinator UCS = Use Case supervisor							

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Switching success ratio to islanded mode			<b>KPI ID:</b>	SSR			
<b>Description:</b>	Number of successful switching operations to islanded mode divided by the total number of switching attempts to islanded mode in a year							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X) <input type="checkbox"/> UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X) <input type="checkbox"/> UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X) <input type="checkbox"/> UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X) <input type="checkbox"/> UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$SSR = 100 \cdot \left( \frac{\sum SS_n}{\sum S_m} \right)$ <p>Where:  SSR: Successful switch to islanded mode ratio [%]  SS_n: Successful reconnection to the grid n [-]  S_m: Total attempts to switch to the grid m [-]</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	%							
<b>Other KPIs related</b>	--							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>		
SSR_01	Get all attempts to reconnect to the grid from islanded mode					DSC		
SSR_02	Get all successful reconnection to the grid events					DSC		
SSR_03	Perform calculation of SSR					UCS		
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Number of attempts to switch to islanded mode	S_m	DSO register/ SoE	SCADA DB DSC	DSO database	monthly	one year	DSC	
Number of successful switch to islanded mode	SS_n	DSO register/ SoE	SCADA DB DSC	DSO database	monthly	one year	DSC	
<b>Source of baseline condition</b>			<b>Literature</b> <input checked="" type="checkbox"/>	<b>Historical data</b> <input type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

## FLEXIGRID KPI DATASHEET

Basic Information								
<b>Name:</b>	Self-sufficiency Ratio				<b>KPI ID:</b>	SSRt		
<b>Description:</b>	It's the ratio of total power provided by RES consumed locally and total power required by local demand in a period							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> <i>UC1 (X) UC2 (X)</i>	<b>Greece</b> <input type="checkbox"/> <i>UC3 (X) UC4 (X)</i>	<b>Croatia</b> <input type="checkbox"/> <i>UC5 (X) UC6 (X)</i>	<b>Italy</b> <input type="checkbox"/> <i>UC7 (X) UC8 (X)</i>				
Calculation								
<b>Formula or Calculation procedure</b>	$SSRt = \frac{E_{C\_RE}}{E_{C\_tot}}$ $E_{C\_RE} = E_{G\_RE} ; E_{C\_tot} \geq E_{G\_RE}$ $E_{C\_RE} = E_{C\_tot} ; E_{C\_tot} < E_{G\_RE}$ <p>Where:  <i>Ec_re</i>: Is the on-site renewable electricity consumption [kWh]  <i>Ec_tot</i>: Total electricity consumption [kWh]  <i>Eg_RE</i>: Energy produced by RES</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[-]							
<b>Other KPIs related</b>	Self-Consumption Rate (SCRt)							
Calculation Methodology								
Nº	Step description					Responsible		
SSRt_01	Define the electrical boundary of the demo site to perform the energy flow					DSC		
SSRt_02	Obtain amount of generated energy locally (within the bounds)					DSC		
SSRt_03	Obtain amount of consumed energy locally (within the bounds)					DSC		
SSRt_04	Perform calculation of Ec_re					UCS		
SSRt_05	Perform calculation of SSRt					UCS		
Data sources / types								
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible	
Total energy generated by RES	E_res	meters units lecture	IEDs / Others	DSO registers	hourly	one year	DSC	
Total energy consumed	E_con	meters units lecture	IEDs / Others	DSO registers	hourly	one year	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input type="checkbox"/>	<b>Measured at start</b> <input checked="" type="checkbox"/>			
			<b>Simulation</b> <input type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input checked="" type="checkbox"/>			
<b>Details of baseline</b>	-							
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

## FLEXIGRID KPI DATASHEET

Basic Information							
<b>Name:</b>	Thermal discomfort factor				<b>KPI ID:</b>	TDF	
<b>Description:</b>	Assessing the people's satisfaction with the thermal environment						
Location							
<b>Demo site (Use Case)</b>	<b>Spain</b>	<b>Greece</b>	<b>Croatia</b>	<b>Italy</b>			
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<small>UC1 (X)</small>	<small>UC2 (X)</small>	<small>UC3 (X)</small>	<small>UC4 (X)</small>	<small>UC5 (X)</small>	<small>UC6 (X)</small>	<small>UC7 (X)</small>
Calculation							
<b>Formula or Calculation procedure</b>	Questionnaires with 1 to 5 scale, analysis from psychometric scale						
<b>Scenarios to be measured / calculated</b>			<b>Baseline</b>	<b>Business as usual (BaU)</b>	<b>FLEXIGRID (R&amp;D)</b>		
			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>Units</b>	Likert scale (1 to 5)						
<b>Other KPIs related</b>	--						
Calculation Methodology							
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>	
TDF_01	Create a questionnaire model for each demo (questions)					DSC	
TDF_02	Define deploy system (online, mail, etc) for each #Cu					DSC	
TDF_03	Gather all feedbacks					DSC	
TDF_04	Perform calculation of results #TDF					UCS	
Data sources / types							
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible
Customers to deliver the questionnaire	#Cu	Diffusion targeting	DSO DB	DSO	once	DWP6	DSC
Thermal discomfort factor	#TDA	analysis from psychometric scale	TDF_04	DWP6	DWP6	DWP6	DSC
Baseline							
<b>Source of baseline condition</b>			<b>Literature</b>	<b>Historical data</b>	<b>Measured at start</b>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
			<b>Simulation</b>	<b>Laboratory</b>	<b>Field</b>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>Details of baseline</b>							
<b>Responsible</b>	UCS / DSC						
Comments							
DSC = Demo-Sites coordinator UCS = Use Case supervisor							

## FLEXIGRID KPI DATASHEET

Basic Information							
<b>Name:</b>	Number of Voltage Limits Violations			<b>KPI ID:</b>	VLV		
<b>Description:</b>	Number of times than voltage in a node exceeds (under or over) the tolerance limit (usually 5%) for more than 2 seconds in a period of time.						
Location							
<b>Demo site (Use Case)</b>	<b>Spain</b>	<b>Greece</b>	<b>Croatia</b>	<b>Italy</b>			
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<i>UC1 (X)</i>	<i>UC2 (X)</i>	<i>UC3 (X)</i>	<i>UC4 (X)</i>	<i>UC5 (X)</i>	<i>UC6 (X)</i>	<i>UC7 (X)</i> <i>UC8 (X)</i>
Calculation							
<b>Formula or Calculation procedure</b>	$VLV = \sum e_{vlv}$ <p>Where:            VLV: Total number of voltage limits violations in a period [-]            e_vlv: event of voltage limit violation [-]</p>						
<b>Scenarios to be measured / calculated</b>	<i>Baseline</i>	<i>Business as usual (BaU)</i>			<i>FLEXIGRID (R&amp;D)</i>		
	<input checked="" type="checkbox"/>	<input type="checkbox"/>			<input checked="" type="checkbox"/>		
<b>Units</b>	[integer]/[time]						
<b>Other KPIs related</b>	--						
Calculation Methodology							
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>
VLV_01	Obtain all voltage limits violations from the baseline scenario						DSC
VLV_02	Calculate VLV to the baseline scenario						UCS
VLV_03	Obtain all voltage limits violations from the FLEXIGRID (R&D) scenario						DSC
VLV_04	Calculate VLV for the FLEXIGRID scenario (simulated or field data)						UCS
VLV_05	Compare to baseline scenario						UCS
Data sources / types							
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>
Voltage limit violation event	VLVe	Power meters units lecture	IEDs / Others	DSO SoE register	daily	one year	DSC
Baseline							
<b>Source of baseline condition</b>			<i>Literature</i>	<i>Historical data</i>	<i>Measured at start</i>		
			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
			<i>Simulation</i>	<i>Laboratory</i>	<i>Field</i>		
			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>Details of baseline</b>							
<b>Responsible</b>	UCS / DSC						
Comments							
DSC = Demo-Sites coordinator UCS = Use Case supervisor							



FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	CO2 tonnes saved			<b>KPI ID:</b>	CO2Sv			
<b>Description:</b>	Amount of CO2 reduction due to substitution of fossil power generation by additional RES units inside the distribution network under analysis (Using FLEXIGRID solution)							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)      UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)      UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)      UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)      UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$CO2Sv = 100 \cdot \left( \frac{CO2_{FG} - CO2_{BL}}{CO2_{BL}} \right)$ <p>Where:            CO2Sv: Reduction in CO2 emissions [%]            CO2_FG: Total CO2 emissions under FLEXIGRID scenario[kg]*            CO2_BL: Total CO2 emissions under Baseline scenario[kg]            *Calculate emissions according to available data in each demo site using (A),(B), (C) or (D)</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	%							
<b>Other KPIs related</b>	Reduction of energy losses (REL)							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
CO2Sv_01	Result from demand shifting (A)						DSC	
CO2Sv_02	Equivalent coefficient of CO2 emissions (B)						DSC	
CO2Sv_03	Result from the reduction of technical losses (C)						DSC	
CO2Sv_04	Result from the incorporation of RES due increase of hosting capacity (D)						DSC	
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Reduction of CO2 from demand shifting	CO2Sv_01	Calculation demand shifting	KPI calculation (REL)	DWP6	DWP6	DWP6	DSC	
Equivalent coefficient of CO2 emissions	CO2Sv_02	Public Values	Public Values	Public Values	DWP6	DWP6	DSC	
Reduction of CO2 from reduction of losses	CO2Sv_03	Calculation of reduction of losses	KPI calculation (REL)	DWP6	DWP6	DWP6	DSC	
Reduction of CO2 from an increase of RES	CO2Sv_04	Calculation of increase in HC	KPI calculation (RESHC)	DWP6	DWP6	DWP6	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input checked="" type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input type="checkbox"/>			
<b>Details of baseline</b>	Adaptation must be required for each demo site and solutions							
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Demand Available Flexibility				<b>KPI ID:</b>	DAF		
<b>Description:</b>	The amount of load that can be shifted temporally. Needs specification dependent on the method used to provide an incentive (RTP, remote operation of customer assets or other options)							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)      UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)      UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)      UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)      UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$DAF = \sum Df_n$ <p>Where: DAF: Demand Available for Flexibility [MW] Df_n: Amount of load that can be shifted in node n [MW]</p>							
<b>Scenarios to be measured / calculated</b>			<b>Baseline</b> <input checked="" type="checkbox"/>	<b>Business as usual (BaU)</b> <input type="checkbox"/>	<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[MW]							
<b>Other KPIs related</b>	Generation Available Flexibility (GAF)							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>		
GAF_01	Power grid assets characteristics (lines, transformers, generatos, etc.) #GD					DSC		
GAF_02	Modeling power grid for LPF using #GD					DSC		
GAF_03	Determine load available to be shifted in a baseline scenario in node (Gf_n)					UCS		
GAF_04	Determine load available to be shifted in a FLEXIGRID scenario in node (Gf_n)					UCS		
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Grid data	#GD	Power grid parameters for modeling	DSO registers /DB	DSO registers /DB	once	-	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input checked="" type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Energy Consumption				<b>KPI ID:</b>	EC		
<b>Description:</b>	Total energy consumed in a period of time							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)    UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)    UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)    UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)    UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$EC = \sum E p_n$ <p>Where:            EC: Total Energy [MWh]            Eqn: Energy consumed in period n [MWh]</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[MVARh]							
<b>Other KPIs related</b>	Reactive Energy Consumption (RE)							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>		
EC_01	Obtain energy consumption in all nodes involved					DSC		
EC_02	Perform calculation of total energy according to the minimum monitoring period					UCS		
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Energy	Ep	Power meters units lecture	IEDs / Others	DSO power registers	monthly	one year	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input checked="" type="checkbox"/>		<b>Historical data</b> <input type="checkbox"/>		<b>Measured at start</b> <input type="checkbox"/>	
			<b>Simulation</b> <input checked="" type="checkbox"/>		<b>Laboratory</b> <input type="checkbox"/>		<b>Field</b> <input type="checkbox"/>	
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Energy not supplied			<b>KPI ID:</b>	ENS			
<b>Description:</b>	The amount of energy that normally would be delivered, but now is not because of an outage							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b>		<b>Greece</b>		<b>Croatia</b>		<b>Italy</b>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	UC1 (X)	UC2 (X)	UC3 (X)	UC4 (X)	UC5 (X)	UC6 (X)	UC7 (X)	UC8 (X)
Calculation								
<b>Formula or Calculation procedure</b>	$ENS = \sum (P_i \times D_i)$							
	<p>Where:</p> <p>Pi: Power interrupted for interruption "i" [MW]</p> <p>Di: Duration of interruption "i" [H]</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b>		<b>Business as usual (BaU)</b>		<b>FLEXIGRID (R&amp;D)</b>			
	<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>			
<b>Units</b>	[MWh]							
<b>Other KPIs related</b>	SAIDI, CAIDI, SAIFI							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
ENS_01	Detect number and duration of interruptions						DSC	
ENS_02	Determine or estimate the number of MW interrupted						DSC	
ENS_03	Perform calculation of ENS						UCS	
ENS_04	Compare to baseline scenario						UCS	
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Service interruption event timestamp	SI_st	Sequence of events logging	Various	DSO, SCADA DB or SoE	monthly	one year	DSC	
Restoration command timestamp	SI_en	Sequence of events logging	Various	DSO, SCADA DB or SoE	monthly	one year	DSC	
Power interrupted	Pi	Define power bloc disconnected	GIS / IED / Meters	DSO, SCADA DB or SoE	monthly	one year	DSC	
Baseline								
<b>Source of baseline condition</b>	<b>Literature</b>		<b>Historical data</b>		<b>Measured at start</b>			
	<input type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>			
	<b>Simulation</b>		<b>Laboratory</b>		<b>Field</b>			
	<input type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
<p>DSC = Demo-Sites coordinator</p> <p>UCS = Use Case supervisor</p>								

FLEXIGRID KPI DATASHEET							
<b>Basic Information</b>							
<b>Name:</b>	Increased EV Hosting capacity			<b>KPI ID:</b>	EVHC		
<b>Description:</b>	The additional EV capacity that can be accommodated on the distribution network after the deployment of the FLEXIGRID solution, compared to the EV capacity that can be accommodated on the distribution network without it.						
<b>Location</b>							
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> <i>UC1 (X) UC2 (X)</i>	<b>Greece</b> <input type="checkbox"/> <i>UC3 (X) UC4 (X)</i>	<b>Croatia</b> <input type="checkbox"/> <i>UC5 (X) UC6 (X)</i>	<b>Italy</b> <input type="checkbox"/> <i>UC7 (X) UC8 (X)</i>			
<b>Calculation</b>							
<b>Formula or Calculation procedure</b>	$EVHC = 100 \cdot \left( \frac{HC_{FG} - HC_{BL}}{HC_{BL}} \right)$ <p>Where:  RESHC: Is the enhanced hosting capacity of EV when FLEXIGRID solutions are applied [%]  HC_FG: Is the additional hosting capacity of EV when FLEXIGRID solutions are applied with respect to currently connected generation [MW]  HC_BL: Is the hosting capacity of EV in baseline scenario with respect to currently connected generation [MW]</p>						
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>	<b>Business as usual (BaU)</b> <input type="checkbox"/>	<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>				
<b>Units</b>	%						
<b>Other KPIs related</b>	Increased RES Hosting capacity (RESHC)						
<b>Calculation Methodology</b>							
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>
EVHC_01	Get all demo site asset characteristics						DSC
EVHC_02	Model the power grid to perform OPF simulations						UCS
EVHC_03	Perform an OPF for a baseline scenario to obtain the capacity of the grid						UCS
EVHC_04	Perform an OPF for a FLEXIGRID scenario to obtain the capacity of the grid						UCS
EVHC_05	Perform calculation of EVHC						UCS
<b>Data sources / types</b>							
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>
Demo assets characteristics	EVHC_01	Nominal values / specifications	Datasheets / Registers	DSO DB	ones	--	DSC
Hosting capacity	HC_FG/ HC_BL	OPF Simulation	OPF Simulator	DB	--	--	UCS
<b>Baseline</b>							
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>		
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input type="checkbox"/>		
<b>Details of baseline</b>							
<b>Responsible</b>	UCS / DSC						
<b>Comments</b>							
DSC = Demo-Sites coordinator UCS = Use Case supervisor							

## FLEXIGRID KPI DATASHEET

Basic Information							
<b>Name:</b>	Flexibility actions taken			<b>KPI ID:</b>	FAT		
<b>Description:</b>	Number of flexibility actions taken to reduce demand, load control, network configuration, etc. in a period						
Location							
<b>Demo site (Use Case)</b>	<b>Spain</b>	<b>Greece</b>	<b>Croatia</b>	<b>Italy</b>			
	<input type="checkbox"/> <i>UC1 (X)      UC2 (X)</i>	<input type="checkbox"/> <i>UC3 (X)      UC4 (X)</i>	<input type="checkbox"/> <i>UC5 (X)      UC6 (X)</i>	<input type="checkbox"/> <i>UC7 (X)      UC8 (X)</i>			
Calculation							
<b>Formula or Calculation procedure</b>	$FAT = \sum FA_n$ <p>Where:            FAT: Number of flexibility actions taken [-]            FA<sub>n</sub>: An event in the grid that involves a change in generation or demand behavior [-]</p>						
<b>Scenarios to be measured / calculated</b>	<i>Baseline</i>		<i>Business as usual (BaU)</i>		<i>FLEXIGRID (R&amp;D)</i>		
	<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>		
<b>Units</b>	%						
<b>Other KPIs related</b>	--						
Calculation Methodology							
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>
FAT_01	Determine characteristics of a flexibility action						UCS
FAT_02	Obtain all flexibility actions taken in the grid						DSC
FAT_03	Perform data calculation of total flexibility actions taken						UCS
Data sources / types							
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible
flexibility actions taken	FAT_02	determine number of flexibility actions	IEDs / Simulations	DSO power registers / Simulation	hourly	one month	UCS
Baseline							
<b>Source of baseline condition</b>			<i>Literature</i>	<i>Historical data</i>	<i>Measured at start</i>		
			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
			<i>Simulation</i>	<i>Laboratory</i>	<i>Field</i>		
			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>Details of baseline</b>							
<b>Responsible</b>	UCS / DSC						
Comments							
DSC = Demo-Sites coordinator UCS = Use Case supervisor Can also be calculated by separating each type of event							

## FLEXIGRID KPI DATASHEET

Basic Information								
<b>Name:</b>	Number of frequency out of range events			<b>KPI ID:</b>	FOR			
<b>Description:</b>	Calculates times that the average value of the fundamental frequency measured over periods of 10 s goes out of the stated ranges (FCE).							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b>		<b>Greece</b>		<b>Croatia</b>		<b>Italy</b>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<i>UC1 (X)</i>	<i>UC2 (X)</i>	<i>UC3 (X)</i>	<i>UC4 (X)</i>	<i>UC5 (X)</i>	<i>UC6 (X)</i>	<i>UC7 (X)</i>	<i>UC8 (X)</i>
Calculation								
<b>Formula or Calculation procedure</b>	$FOR = \sum e_{for}$							
	<p><i>Where:</i>  <i>FOR: Total number of frequency out of range events in a period [-]</i>  <i>e_for: event of voltage limit violation [-]</i></p>							
<b>Scenarios to be measured / calculated</b>			<b>Baseline</b>	<b>Business as usual (BaU)</b>	<b>FLEXIGRID (R&amp;D)</b>			
			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
<b>Units</b>	[integer]/[time]							
<b>Other KPIs related</b>	--							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
FOR_01	Obtain all frequency out of range event from the baseline scenario						DSC	
FOR_02	Calculate FOR to the baseline scenario						UCS	
FOR_03	Obtain all frequency out of range event from the FLEXIFRID (R&D) scenario						DSC	
FOR_04	Calculate FOR for the FLEXIGRID scenario						UCS	
FOR_05	Compare to baseline scenario						UCS	
Data sources / types								
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible	
Frequency out range event	e_for	Power meters units lecture	IEDs / Others	DSO SoE register	daily	one year	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b>	<b>Historical data</b>	<b>Measured at start</b>			
			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
			<b>Simulation</b>	<b>Laboratory</b>	<b>Field</b>			
			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>			UCS / DSC					
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor  optionally can be discriminated by over and under frequency events								

## FLEXIGRID KPI DATASHEET

Basic Information								
<b>Name:</b>	Generation Available Flexibility				<b>KPI ID:</b>	GAF		
<b>Description:</b>	The amount of generation that can be shifted temporally							
Location								
<b>Demo site (Use Case)</b>	<i>Spain</i> <input type="checkbox"/> <small>UC1 (X)      UC2 (X)</small>	<i>Greece</i> <input type="checkbox"/> <small>UC3 (X)      UC4 (X)</small>	<i>Croatia</i> <input type="checkbox"/> <small>UC5 (X)      UC6 (X)</small>	<i>Italy</i> <input type="checkbox"/> <small>UC7 (X)      UC8 (X)</small>				
Calculation								
<b>Formula or Calculation procedure</b>	$GAF = \sum Gf_n$ <p><i>Where:</i> GAF: [MW] Gf_n: Amount of generation that can be shifted in node n [MW]</p>							
<b>Scenarios to be measured / calculated</b>	<i>Baseline</i> <input checked="" type="checkbox"/>	<i>Business as usual (BaU)</i> <input type="checkbox"/>	<i>FLEXIGRID (R&amp;D)</i> <input checked="" type="checkbox"/>					
<b>Units</b>	[MW]							
<b>Other KPIs related</b>	Demand Available Flexibility (DAF)							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>		
GAF_01	Power grid assets characteristics (lines, transformers, generatos, etc.) #GD					DSC		
GAF_02	Modeling power grid for LPF using #GD					DSC		
GAF_03	Determine generation available to be shifted in a baseline scenario in node (Gf_n)					USC		
GAF_04	Determine generation available to be shifted in a FLEXIGRID scenario in node (Gf_n)					USC		
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Grid data	#GD	Power grid parameters for modeling	DSO registers /DB	DSO registers /DB	once	-	DSC	
Baseline								
<b>Source of baseline condition</b>			<i>Literature</i> <input checked="" type="checkbox"/>	<i>Historical data</i> <input checked="" type="checkbox"/>	<i>Measured at start</i> <input type="checkbox"/>			
			<i>Simulation</i> <input checked="" type="checkbox"/>	<i>Laboratory</i> <input type="checkbox"/>	<i>Field</i> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								



FLEXIGRID KPI DATASHEET								
<b>Basic Information</b>								
<b>Name:</b>	Grid investment deferral				<b>KPI ID:</b>	GID		
<b>Description:</b>	Savings (avoided costs) by employing new proposed solutions vs traditional (e.g. line reinforcement)							
<b>Location</b>								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)    UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)    UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)    UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)    UC8 (X)	
<b>Calculation</b>								
<b>Formula or Calculation procedure</b>	$GID = \sum Sc_n$ <p>Where:            GID: Total grid investment deferral [€]            Sc_n: Amount of investment deferral by node/cathgory/element "n" in the grid [€]</p>							
<b>Scenarios to be measured / calculated</b>			<b>Baseline</b> <input type="checkbox"/>	<b>Business as usual (BaU)</b> <input checked="" type="checkbox"/>	<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	€							
<b>Other KPIs related</b>	Peak load reduction (PLRed) Load curve valley filling (VF) Line overload occurrence (LOO)							
<b>Calculation Methodology</b>								
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>		
GID_01	Get all demo site asset characteristics					DSC		
GID_02	Model the power grid to perform OPF simulations					UCS		
GID_03	Perform an OPF for a BaU scenario to identify possible reinforcements					UCS		
GID_04	Perform an OPF for a FLEXIGRID to discard reinforcements estimated in GID_03					UCS		
GID_05	Determine investments required by GID_04 and GID_03 to define SCn					UCS		
<b>Data sources / types</b>								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Demo assets characteristics	GID_01	Nominal values / specifications	Datasheets / Registers	DSO DB	once	--	DSO	
<b>Baseline</b>								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
<b>Comments</b>								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

## FLEXIGRID KPI DATASHEET

Basic Information								
<b>Name:</b>	Line overload occurrence				<b>KPI ID:</b>	LOO		
<b>Description:</b>	Number of line overloading events up to 15 minutes within a year							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> <i>UC1 (X) UC2 (X)</i>	<b>Greece</b> <input type="checkbox"/> <i>UC3 (X) UC4 (X)</i>	<b>Croatia</b> <input type="checkbox"/> <i>UC5 (X) UC6 (X)</i>	<b>Italy</b> <input type="checkbox"/> <i>UC7 (X) UC8 (X)</i>				
Calculation								
<b>Formula or Calculation procedure</b>	$LOO = \sum LOE_n$ <p>Where:            LOO: Total lines overload events in a period [-]            LOE<sub>n</sub>: event of line overload n [-]</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[integer]							
<b>Other KPIs related</b>	--							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
LOO_01	Define lines to be monitored						DSC	
LOO_02	Obtain lines characteristics (type of conductor, suport geometry, geographical coordinates, etc.)						DSC	
LOO_03	Perform calculation of thermal limits for each line to define nominal current						UCS	
LOO_04	Obtain currents values for each section of line to be monitored						UCS	
LOO_05	Determine number of overloads line events						UCS	
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Line	e_for	Power meters units lecture	IEDs / Others	DSO SoE register	daily	one year	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>		<b>Measured at start</b> <input type="checkbox"/>		
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>		<b>Field</b> <input checked="" type="checkbox"/>		
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
<b>Basic Information</b>								
<b>Name:</b>	Minimum frequency reached after a contingency event			<b>KPI ID:</b>	NADIR			
<b>Description:</b>	Minimum frequency reached after a contingency event (by node)							
<b>Location</b>								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)    UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)    UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)    UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)    UC8 (X)	
<b>Calculation</b>								
<b>Formula or Calculation procedure</b>	$NADIR = \min(f(t)_n)$							
	<i>Where:</i> NADIR: [Hz] f(t)_n: Frequency function in a event of inertial/load/generation variation in node n [Hz]							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[Hz]							
<b>Other KPIs related</b>	Rate of Change of Frequency (ROCOF)							
<b>Calculation Methodology</b>								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
NADIR_01	Modeling of power grid, including inertial components of generation and load						UCS	
NADIR_02	Define scenarios to evaluate (different inertia, load and generations schemes)						UCS	
NADIR_03	Perform calculation of NADIR for the baseline scenarios / nodes						UCS	
NADIR_04	Perform calculation of NADIR for the FLEXIGRID scenarios / nodes						UCS	
<b>Data sources / types</b>								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Network data	NADIR_01	Modeling power grid	DSO DB / Registers	DSO DB / Registers	once	-	DSC	
Frequency function	NADIR_03 / 04	Simulation	Simulated COMTRADE, Oscillographyc register	DSC	once	-	DSC	
<b>Baseline</b>								
<b>Source of baseline condition</b>			<b>Literature</b>		<b>Historical data</b>		<b>Measured at start</b>	
			<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
			<b>Simulation</b>		<b>Laboratory</b>		<b>Field</b>	
			<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
<b>Comments</b>								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
<b>Basic Information</b>								
<b>Name:</b>	Reduction in Energy Losses			<b>KPI ID:</b>	REL			
<b>Description:</b>	Amount of electrical energy lost on grid's conductors, transformers, etc.							
<b>Location</b>								
<b>Demo site (Use Case)</b>	<b>Spain</b>		<b>Greece</b>		<b>Croatia</b>		<b>Italy</b>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<i>UC1 (X)</i>	<i>UC2 (X)</i>	<i>UC3 (X)</i>	<i>UC4 (X)</i>	<i>UC5 (X)</i>	<i>UC6 (X)</i>	<i>UC7 (X)</i>	<i>UC8 (X)</i>
<b>Calculation</b>								
<b>Formula or Calculation procedure</b>	$REL = 100 \cdot \left( \frac{\sum EL_{BL} - \sum EL_{FG}}{\sum EL_{BL}} \right)$							
	<i>Where:</i> REL: Total reduction in energy losses [%] EL_FG: Total energy losses under FLEXIGRID scenario[MW] EL_BL: Total energy losses under BaU scenario[MW]							
<b>Scenarios to be measured / calculated</b>	<i>Baseline</i>		<i>Business as usual (BaU)</i>		<i>FLEXIGRID (R&amp;D)</i>			
	<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>			
<b>Units</b>	%							
<b>Other KPIs related</b>	--							
<b>Calculation Methodology</b>								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
REL_01	Demo site network data #ND (lines characteristics, datasheets, nameplates, databases, etc.)						DSC	
REL_02	Modeling demo site network with data supplied in REL_01						DSC	
REL_03	Perform calculation of LPF to estimate energy losses in a baseline and a FLEXIGRID scenarios to obtain REL						UCS	
<b>Data sources / types</b>								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Network data for modeling	#ND	characteristics of devices for modeling	datashhets, DB, nameplates	DSO registers	once	-	DSC	
<b>Baseline</b>								
<b>Source of baseline condition</b>			<b>Literature</b>		<b>Historical data</b>		<b>Measured at start</b>	
			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
			<b>Simulation</b>		<b>Laboratory</b>		<b>Field</b>	
			<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
<b>Comments</b>								
DSC = Demo-Sites coordinator UCS = Use Case supervisor Can be divided by type (lines, transformers)								

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Rate of Change of Frequency			<b>KPI ID:</b>	ROCOF			
<b>Description:</b>	Corresponds with the frequency gradient after an active power imbalance.							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)    UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)    UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)    UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)    UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$ROCOF(t) = \left( \frac{df(t)}{dt} \right)$							
	Where: ROCOF: Gradient of frequency [Hz/s] f(t): Frequency function in a event of inertial/load/generation variation [Hz]							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	[Hz/s]							
<b>Other KPIs related</b>	Minimum frequency reached after a contingency event (NADIR)							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
ROCOF_01	Modeling of power grid, including inertial components of generation and load						USC	
ROCOF_02	Define scenarios to evaluate (different inertia, load and generations schemes)						USC	
ROCOF_03	Perform calculation of ROCOF for the baseline scenarios / nodes						USC	
ROCOF_04	Perform calculation of ROCOF for the FLEXIGRID scenarios / nodes						USC	
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Network data	ROCOF_01	Modeling power grid	DSO DB / Registers	DSO DB / Registers	once	-	DSC	
Frequency function	ROCOF_03 / 04	Simulation	Simulated COMTRADE, Oscillography register	DSC	once	-	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input checked="" type="checkbox"/>	<b>Historical data</b> <input type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
Basic Information								
<b>Name:</b>	Reverse Power Flow			<b>KPI ID:</b>	RPF			
<b>Description:</b>	Power/energy flow from distribution feeder/system upward due to excess of RES power generation							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> UC1 (X)    UC2 (X)		<b>Greece</b> <input type="checkbox"/> UC3 (X)    UC4 (X)		<b>Croatia</b> <input type="checkbox"/> UC5 (X)    UC6 (X)		<b>Italy</b> <input type="checkbox"/> UC7 (X)    UC8 (X)	
Calculation								
<b>Formula or Calculation procedure</b>	$RPF = \frac{\sum R_{POW}}{year}$ <p>Where:            RPF: Total reverse power flow [kWh/year]            R_pow: reverse power energy [kWh]</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	%							
<b>Other KPIs related</b>	--							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
RPF_01	Modeling of power grid, including inertial components of generation and load using data from PG_dat						UCS	
RPF_02	Define scenarios to evaluate (different load and generations schemes)						DSC	
RPF_03	Perform calculation of Load flow for the baseline scenarios / nodes						UCS	
RPF_04	Determine R_pow for the baseline scenarios / nodes						UCS	
RPF_05	Perform calculation of Load flow for the FLEXIGRID scenarios / nodes						UCS	
RPF_06	Determine R_pow for the FLEXIGRID scenarios / nodes						UCS	
Data sources / types								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Power grid data	PG_dat	data collection	DSO DB / registers	DSO DB / registers	once	--	DSC	
Reverse power flow in a substation feeder	R_pow	Simulated value	LPF simulator	LPF software	once	--	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>	<b>Measured at start</b> <input type="checkbox"/>			
			<b>Simulation</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>	<b>Field</b> <input type="checkbox"/>			
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
<b>Basic Information</b>								
<b>Name:</b>	System Average Interruption Frequency Index			<b>KPI ID:</b>	SAIFI			
<b>Description:</b>	The System Average Interruption Frequency Index (SAIFI) indicates how often the average customer experiences a sustained interruption over a predefined period of time.							
<b>Location</b>								
<b>Demo site (Use Case)</b>	<i>Spain</i> <input type="checkbox"/> UC1 (X)      UC2 (X)		<i>Greece</i> <input type="checkbox"/> UC3 (X)      UC4 (X)		<i>Croatia</i> <input type="checkbox"/> UC5 (X)      UC6 (X)		<i>Italy</i> <input type="checkbox"/> UC7 (X)      UC8 (X)	
<b>Calculation</b>								
<b>Formula or Calculation procedure</b>	$SAIFI = \frac{\sum N_i}{\sum N_T}$ <p>Where:  <i>N<sub>i</sub></i>: Number of interrupted customers for each sustained interruption event during the reporting period [integer]  <i>N<sub>T</sub></i>: Total number of customers served for the area [integer]</p>							
<b>Scenarios to be measured / calculated</b>	<i>Baseline</i> <input checked="" type="checkbox"/>		<i>Business as usual (BaU)</i> <input type="checkbox"/>		<i>FLEXIGRID (R&amp;D)</i> <input checked="" type="checkbox"/>			
<b>Units</b>	%							
<b>Other KPIs related</b>	CAIDI, SAIDI							
<b>Calculation Methodology</b>								
<b>Nº</b>	<i>Step description</i>						<i>Responsible</i>	
SAIFI_01	Detect or estimate the number of affected customers						DSC	
SAIFI_02	Calculate SAIFI in FLEXIGRID scenario						UCS	
SAIFI_03	Compare to baseline scenario						UCS	
<b>Data sources / types</b>								
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible	
Service interruption event timestamp	SI_st	Sequence of events logging	Various	DSO, SCADA DB or SoE	once at the end of the monitoring period	one year	DSO	
Restoration command timestamp	SI_en	Sequence of events logging	Various	DSO, SCADA DB or SoE	once at the end of the monitoring period	one year	DSO	
Number of interrupted customers	Ni	Adding the number of customers in the affected areas	Various	DSO, Costumers DB	once at the end of the monitoring period	one year	DSO	
<b>Baseline</b>								
<b>Source of baseline condition</b>			<i>Literature</i> <input type="checkbox"/>		<i>Historical data</i> <input checked="" type="checkbox"/>		<i>Measured at start</i> <input type="checkbox"/>	
			<i>Simulation</i> <input type="checkbox"/>		<i>Laboratory</i> <input type="checkbox"/>		<i>Field</i> <input checked="" type="checkbox"/>	
<b>Details of baseline</b>	Previous CAIDI values in the same area.							
<b>Responsible</b>	UCS / DSC							
<b>Comments</b>								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								

FLEXIGRID KPI DATASHEET								
<b>Basic Information</b>								
<b>Name:</b>	Rate of successful switching operations to reconnect to grid			<b>KPI ID:</b>	SSG			
<b>Description:</b>	Number of successful reconnections to grid divided by number of all attempts to reconnect to grid in a year							
<b>Location</b>								
<b>Demo site (Use Case)</b>	<b>Spain</b>		<b>Greece</b>		<b>Croatia</b>		<b>Italy</b>	
	UC1 (X) <input type="checkbox"/>	UC2 (X) <input type="checkbox"/>	UC3 (X) <input type="checkbox"/>	UC4 (X) <input type="checkbox"/>	UC5 (X) <input type="checkbox"/>	UC6 (X) <input type="checkbox"/>	UC7 (X) <input type="checkbox"/>	UC8 (X) <input type="checkbox"/>
<b>Calculation</b>								
<b>Formula or Calculation procedure</b>	$SSG = 100 \cdot \left( \frac{\sum SS_n}{\sum S_m} \right)$							
	<p>Where:</p> <p>SSG: Successful switching to grid ratio [%]</p> <p>SS<sub>n</sub>: Successful reconnection to the grid n [-]</p> <p>S<sub>m</sub>: Total attempts to switch to the grid m [-]</p>							
<b>Scenarios to be measured / calculated</b>		<b>Baseline</b>		<b>Business as usual (BaU)</b>		<b>FLEXIGRID (R&amp;D)</b>		
		<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>		
<b>Units</b>	[%]							
<b>Other KPIs related</b>	Island mode reliability rate (IMRR) Switching success ratio to islanded mode(SSR)							
<b>Calculation Methodology</b>								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
SSG_01	Get all attempts to reconnect to the grid from islanded mode						DSC	
SSG_02	Get all successful reconnection to the grid events						DSC	
SSG_03	Perform calculation of SSG						UCS	
<b>Data sources / types</b>								
<b>Data</b>	<b>TAG</b>	<b>Methodology</b>	<b>Source/ Tools/ Instruments</b>	<b>Location of data collection</b>	<b>Frequency of data collection</b>	<b>Min. Monitoring period</b>	<b>Responsible</b>	
Number of attempts to reconnect to the grid	S <sub>m</sub>	DSO register/ SoE	SCADA DB DSC	DSO database	monthly	one year	DSC	
Number of successful reconnections to the grid	SS <sub>n</sub>	DSO register/ SoE	SCADA DB DSC	DSO database	monthly	one year	DSC	
<b>Baseline</b>								
<b>Source of baseline condition</b>			<b>Literature</b>		<b>Historical data</b>		<b>Measured at start</b>	
			<input type="checkbox"/>		<input checked="" type="checkbox"/>		<input type="checkbox"/>	
			<b>Simulation</b>		<b>Laboratory</b>		<b>Field</b>	
			<input type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
<b>Comments</b>								
DSC = Demo-Sites coordinator UCS = Use Case supervisor								



## FLEXIGRID KPI DATASHEET

Basic Information								
<b>Name:</b>	Load curve valley filling				<b>KPI ID:</b>	VF		
<b>Description:</b>	It is defined as the ability to shift load to valley hours, by means of the direct control of assets or by tariff strategy.							
Location								
<b>Demo site (Use Case)</b>	<b>Spain</b> <input type="checkbox"/> <small>UC1 (X)      UC2 (X)</small>	<b>Greece</b> <input type="checkbox"/> <small>UC3 (X)      UC4 (X)</small>	<b>Croatia</b> <input type="checkbox"/> <small>UC5 (X)      UC6 (X)</small>	<b>Italy</b> <input type="checkbox"/> <small>UC7 (X)      UC8 (X)</small>				
Calculation								
<b>Formula or Calculation procedure</b>	$VF = 100 \cdot \left  \frac{V_{BL} - V_{FG}}{V_{BL}} \right $ <p><i>Where:</i>            VF: Load valley filling [%]            V_BL: Total demand in valley with baseline scenario [MW]            V_FG: Total demand in valley with FLEXIGRID scenario [MW]</p>							
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b> <input checked="" type="checkbox"/>		<b>Business as usual (BaU)</b> <input type="checkbox"/>		<b>FLEXIGRID (R&amp;D)</b> <input checked="" type="checkbox"/>			
<b>Units</b>	%							
<b>Other KPIs related</b>	--							
Calculation Methodology								
<b>Nº</b>	<b>Step description</b>						<b>Responsible</b>	
VF_01*	Obtain load curve from demo site #LC (by node) for baseline a FLEXIGRID scenarios						DSC	
VF_02	Perform calculation of minimum of demand (valley) for baseline a FLEXIGRID scenarios V_BS and V_FG						UCS	
VF_03	Perform calculation of VF						UCS	
Data sources / types								
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible	
Demand	#LC	Power meters units lecture	IEDs / Others	DSO power registers	DWP6	DWP6	DSC	
Baseline								
<b>Source of baseline condition</b>			<b>Literature</b> <input type="checkbox"/>	<b>Historical data</b> <input checked="" type="checkbox"/>		<b>Measured at start</b> <input checked="" type="checkbox"/>		
			<b>Simulation*</b> <input checked="" type="checkbox"/>	<b>Laboratory</b> <input type="checkbox"/>		<b>Field</b> <input checked="" type="checkbox"/>		
<b>Details of baseline</b>								
<b>Responsible</b>	UCS / DSC							
Comments								
DSC = Demo-Sites coordinator UCS = Use Case supervisor *Alternatively can be calculated using simulations								

## FLEXIGRID KPI DATASHEET

Basic Information							
<b>Name:</b>	Voltage Unbalance Factor				<b>KPI ID:</b>	VUF	
<b>Description:</b>	Voltage unbalance is defined as the ratio of the negative sequence voltage component to the positive sequence voltage component						
Location							
<b>Demo site (Use Case)</b>	<b>Spain</b>	<b>Greece</b>	<b>Croatia</b>	<b>Italy</b>			
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<small>UC1 (X)</small>	<small>UC2 (X)</small>	<small>UC3 (X)</small>	<small>UC4 (X)</small>	<small>UC5 (X)</small>	<small>UC6 (X)</small>	<small>UC7 (X)</small> <small>UC8 (X)</small>
Calculation							
<b>Formula or Calculation procedure</b>	$VUF = 100 \cdot \left( \frac{V_{Neg}}{V_{Pos}} \right)$ <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 45%;"> <p><i>Where:</i>  VUF: voltage unbalance factor in sample k  V_neg: Negative sequence voltage component [V]  V_pos: Positive sequence voltage component [V]  Vab, Vbc, Vca: Line to line voltage magnitude [V]</p> </div> <div style="width: 45%;"> <math display="block">V_{Neg} = \frac{V_{ab} + a^2 V_{bc} + a V_{ca}}{3}</math> <math display="block">V_{Pos} = \frac{V_{ab} + a V_{bc} + a^2 V_{ca}}{3}</math> <math display="block">a = 1(120^\circ)</math> </div> </div>						
<b>Scenarios to be measured / calculated</b>	<b>Baseline</b>		<b>Business as usual (BaU)</b>		<b>FLEXIGRID (R&amp;D)</b>		
	<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>		
<b>Units</b>	%						
<b>Other KPIs related</b>	--						
Calculation Methodology							
<b>Nº</b>	<b>Step description</b>					<b>Responsible</b>	
VUF_01	Obtain voltage samples in nodes to be monitored					DSC	
VUF_02	Calculate positive and negative component for each node / sample					DSC	
VUF_03	Calculate VUF for each node / sample					UCS	
VUF_04	Calculate average VUF for voltage node in min. monitoring period					UCS	
Data sources / types							
<b>Data</b>	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitoring period	Responsible
Voltage fasor	Vabc	Power meters units lecture	IEDs / Others	DSO power registers	WDP6	one month	DSC
Baseline							
<b>Source of baseline condition</b>			<b>Literature</b>	<b>Historical data</b>	<b>Measured at start</b>		
			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
			<b>Simulation</b>	<b>Laboratory</b>	<b>Field</b>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>Details of baseline</b>							
<b>Responsible</b>	UCS / DSC						
Comments							
DSC = Demo-Sites coordinator UCS = Use Case supervisor							