

# **TIGON KPIs Panel**

### Deliverable 2.4 (v01) WP2. Boundary conditions and baseline for TIGON development

#### **Responsible Partner**

CIRCE

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## **Technical references**

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### **Executive Summary**

This document sets out the guidance for the use of KPIs by the TIGON project during the deployment and testing phases. During the execution of this task, a general list of KPIs was defined together with the leaders of the demos and the technology providers. Additionally, to provide more flexibility during the deployment stage, this list was divided into two large categories, corresponding to the main KPIs and the auxiliary KPIs. The first list covers the requirements indicated by the demo leaders, the second works as a complementary list that can be used on demand during later stages. To complement this, a contingency and monitoring plan is included, the former will allow KPIs to be modified or adjusted if necessary, and the latter provides general guidance on how to evaluate and coordinate efforts during the deployment phase.

The TIGON project has two defined demonstration sites (in Spain and France), initially, both will share the same KPIs but it is possible to adapt the final list to better fit the specific requirements defined later during WP6 and WP5 (Spanish and French deployment stages respectively). The complete list is shown in Table 1.

Cat	KPI	ID
	Self-Consumption Rate	SCRt
	Energy Consumption	EC
	Peak load reduction	PLRed
	Average estimation of savings per stakeholder	AeS
	Generation Available Flexibility	GAF
	Reverse Power Flow	RPF
Main	CAIDI	CAIDI
Ž	CO2 tonnes saved	CO2Sv
	Number of Grid Events	NGE
	SAIDI	SAIDI
	Line overload occurrence	LOO
	Grid investment deferral	GID
	Load curve valley filling	VF
	Voltage Unbalance Factor	VUF
	Demand Flexibility Potential	DFP
	DR Delivery Deviation	DRDD
	Energy not supplied	END
	SAIFI	SAIFI
	Demand Available Flexibility	DAF
	Increased EV Hosting capacity	EVHC
Aux	Number of Voltage Limits Violations	VLV
	Reduction in Energy Losses	REL
	Number of frequency out of range events	FOR
	RoCoF	RoCoF
	Flexibility actions taken	FAT
	NADIR	NADIR
	Reactive Energy Consumption	RE

#### Table 0.1. KPI general list





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# List of acronyms, figures and tables

### Abreviations and acronyms

А	Current in Ampere
BaU	Business as Usual
DER	Distributed Energy Resources
EV	Electric Vehicles
KPI	Key Performance Indicator
Μ	Month
PV	Photovoltaic system
R&D	Research and Development
RES	Renewable Energy Sources
RMS	Root Mean Squared
TP	Technical Partner
UCS	Use Case supervisor
V	Voltage in Volts
WP	Work Package

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## 1. Objective of TIGON KPIs Panel

The main goal of TIGON is to enable a smooth deployment and integration of intelligent DC-based grid architectures within the current energy system, while providing ancillary services to the main network. To do so, TIGON proposes a four-level approach aiming at improving reliability, resilience performance, and cost efficiency of hybrid grids through the development of an innovative portfolio of power electronic solutions and software systems and tools focused on the efficient monitoring, control and management of DC grids. These solutions will be demonstrated in two main Demo-Sites located in France and Spain, while additional use cases will act as niche markets for analysing and further solidifying the replication of TIGON developments after the project's end.

This concept has been designed to assure the operation of DC grids in different modes (e.g. connected to the main grid or in isolated mode even in emergency situations) as well as the accommodation of high shares of renewable energy, while minimizing investments in infrastructures. This will enable a smooth integration of DC grids within the existing electricity grid based mainly on AC, thus boosting their deployment across the whole European electricity system.

The novelty of this approach relies on the integration of TIGON main physical and software developments, which are the key enablers for the smart and cost-effective operation of the whole DC-based hybrid grid. The starting point is the Solid-State Transformer (SST), which constitutes the link of the hybrid grid with the main AC grid. Compared to conventional transformers, the SST is a power electronics based apparatus that includes features such as voltage regulation, power flow management, load disturbance rejection or fault current limitation. Therefore, the optimization of the power flows will be performed already at the AC/DC interface, influencing as well the power flow from other conventional transformers and avoiding congestion issues, which implies a high degree of digitalization and improved smartness in the network.

The objective of this deliverable is to provide a comprehensive set of KPIs defined with the help of all partners involved (demo site leaders and developers), this list will be complemented by the use of a common template form containing all the information to perform the calculation, as well as the definition of the data source, the frequency of collection and the responsible parties.

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





# 2. KPI Definition

#### 2.1. Selection methodology

The first set of KPIs was launched at the beginning of WP2, based on earlier projects that focused on deployment and integration of intelligent DC-based grid architectures within the current energy system (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 considered 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 below.

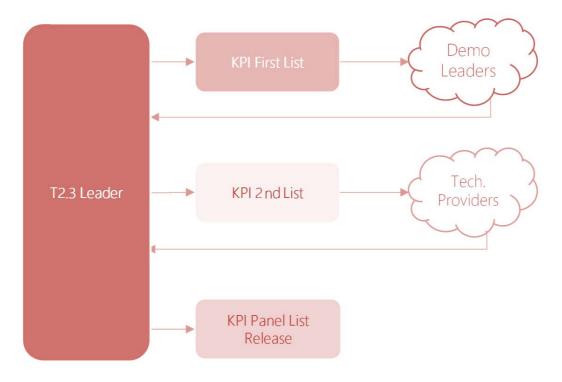


Figure 2.1. KPI Definition workflow





#### 2.2. Categories and implementation

The TIGON project has two demonstration with several technologies to be tested, as 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 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 the next figure.

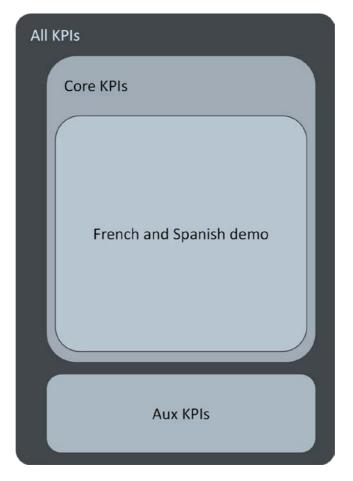


Figure 2.2. KPI Classification





# 3. 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 Table 4.1. KPI panel List.

#### Table 4.1. KPI panel List

ID	KPI	Description	Unit
SCRt	Self-Consumption Rate	Amount of energy supplied by local RES and consumed on site/locally	percent
EC	Energy Consumption	Sum of electrical energy [kWh], measured over a given time period	[kWh]
PLRed	Peak load reduction	Reduction of the value of the maximum load on a given period (day, month, year).	%
AeS	Average estimation of savings per stakeholder	Total savings from avoided energy consumption or purchase (depending on stakeholder concerned) over the sum of that avoided energy	€/kWh
GAF	Generation Available Flexibility	The amount of generation that can be shifted temporally	[MW]
RPF	Reverse Power Flow	power/energy flown from distribution feeder/system upward due to excess of RES power generation	kWh/y
CAIDI	CAIDI	sum(duration all customer interruptions) / number of customer interruptions	min
CO2Sv	CO2 tonnes saved	Tonnes of carbon dioxide saved	%
NGE	Number of Grid Events	e.g. Tripping event, recloser operation. include a location ID and timestamp	integer
SAIDI	SAIDI	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.	min
LOO	Line overload occurrence	Number of line overloading events up to 15 minutes (OL_E [-]) within a year	Integer / [year]
GID	Grid investment deferral	Savings (avoided costs) by employing new proposed solutions vs traditional (e.g. line reinforcement)	[€]





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ID	КРІ	Description	Unit
VF	Load curve valley filling	Can be a result of improvements in Tariffs & Demand Response and Network Balance with Steering	[MVV]
VUF	Voltage Unbalance Factor	Difference in the voltage of the three phases	percent
DFP	Demand Flexibility Potential	The amount of potential Demand Flexibility reflects the amount of energy consumption reduction participating Customers (i.e. End Users) could potentially accept and apply	kWh
DRDD	DR Delivery Deviation	The difference between the DR the Customer has committed to deliver and the DR that the Customer actually delivered	kWh
ENS	Energy not supplied	The amount of energy that normally would be delivered, but now is not because of a power outage in [MWh]	[MWh]
SAIFI	SAIFI	System average interruption frequency index during the period of analysis.	interruptions/customer.year
DAF	Demand Available Flexibility	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)	[MW]
EVHC	Increased EV Hosting capacity	The additional EV capacity that can be accommodated on the distribution network after the deployment of the project solution, compared to the EV capacity that can be accommodated on the distribution network without it.	[MW]
VLV	Number of Voltage Limits Violations	Number of times that voltage in a node exceeds (under or over) the tolerance limit (e.g. voltage dips/swells).	Integer / [time]
REL	Reduction in Energy Losses	Amount of electrical energy lost on grid's conductors, transformers, etc.	[kWh]
FOR	Number of frequency out of range events	calculates times that the average value of the fundamental frequency measured over periods of 10 s goes out of the stated ranges (FCE).	Integer / [time]
RoCoF	RoCoF	Rate of Change of Frequency	Hz/s
FAT	Flexibility actions taken	Number of flexibility actions taken to reduce demand, load control, network configuration, etc. (NaT [-]) in a period	integer/[time]
NADIR	nadir	minimum frequency reached after a contingency event	Hz
RE	Reactive Energy Consumption	Total reactive power in a period	[kVAr]/[time]





# 4. KPI DATASHEET

### 4.1. 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.

	TIGON KPI DATASHEET								
$\wedge \geq$	-			Basic Infor	rmation				
$A \mid \mid$	Name:					KP	ID:		
									1 7
	Description:								
	Units								
B	-			Locati	ion				4
	Demo site								
	(Use Case)								
				Calcula					1
	1	1		Calcula	ition				1
	Formula								
	or								
	Calculation								
	procedure								
				Baseline		Business as usua	,	TIGON	
	Scenarios to be	measured	calculated	Busenne		business us usuu	′	ndon	
	Scenarios to be	measureu /	calculateu						
				Calculation M		ý			4
	Nº	<u> </u>		Step descr	ription			Responsible	-
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									1
									1
	Data sources / types							1	
				Coursed					1
	Data	TAG	Methodology	Tools/	ocation of d collection		Min. Monit period		
				Instruments	conection	uata collection	period	·	
			Ba	seline definition /	BaU meth	odology			4
				Literature	,	Historical data		Aeasured at start	
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	Details	I		Other KPIs	related				
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				General co	mments				1
G —				General co	mments				
G				General co	mments				
G				General co	mments				
G –				General co	mments				







#### 4.2. 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 TIGON 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.
- I. Validation: indicates the environment in which data will be obtained to calculate/compare versus base values.

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



## 5. 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 WP5 and WP6. At least once KPIs will be measured at the beginning and end of the demonstration phase by the use cases supervisors and demo-sites coordinators to assess the impacts achieved using TIGON technologies and services at the two demonstration sites.

The proposed monitoring plan consists of the following steps:

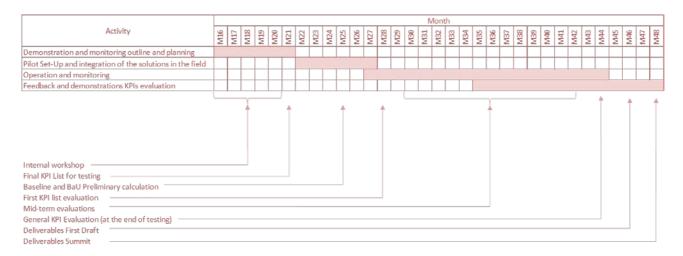
- Internal workshop to discuss and define the common plan for demonstration and monitoring common protocols for demonstration activities, including reporting and data collection procedures. The key performance indicators defined in Task 2.4 (contained in this document) will be measured at the beginning and end of the demonstration phase by use case monitors and demonstration site coordinators to assess the effects achieved through the use of TIGON technologies and services at the two demonstration sites.
- Calculation of the baseline and/or BaU: This will allow to define the status of the demos before the implementation of the solutions proposed in the TIGON 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 below 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 WP5 and WP6 workshops.
- 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 T5.4 and T6.4 to compare the progress made after the implementation of the TIGON 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 D5.4 and D6.4.

An outline of the proposed monitoring plan is shown in the diagram below (Figure 5.1), with all steps and milestones considered as references that could be modified during the main workshop held at the beginning of WP5 and WP6.





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# 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 WP5 and WP6 leaders, 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 or FR is used according to the country concerned. For example, the modification of a datasheet with original version 0.2 for the Spanish demo gives as new version the 0.3ES, 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 she/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 or 4 depending on the type of KPI, the application should be requested before these packages are finalized (see monitoring plan in section 6), the general process for solving KPI calculation problems is shown in the next figure.





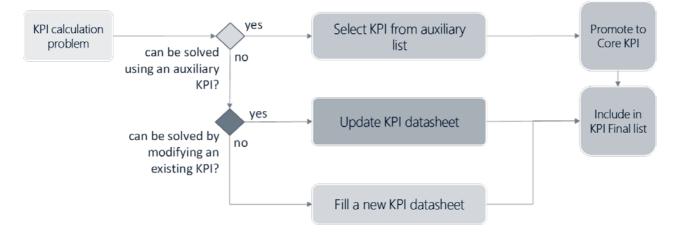


Figure 6.1. KPI troubleshooting procedure.





# 7. REFERENCES

BEST PATHS - BEyond State-of-the-art Technologies for rePowering Ac corridors and multi-terminal Hvdc Systems - D13.5 KPI (Levels 1&2) assessment and conclusion.

IDE4L - IDEAL GRID FOR ALL - Deliverable D7.1: KPI Definition

Dionysios Pramangioulis et al. - A Methodology for Determination and Definition of Key Performance Indicators for Smart Grids Development in Island Energy Systems - Energies 2019

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.

John Van Gorp - Using Key Performance Indicators (KPIs) to Manage Power System Reliability - Schneider Electric



# Annex I: KPI Datasheet template





										V	/0.1
			TIGON KPI	DATASI	HEE	Т					
				formation							
Name:						KP	ID:	- [			
Description:											
Units											
			Loc	ation							
Demo site											
(Use Case)											
	-		Calcu	ulation							
Formula											
or											
Calculation											
procedure											
			Baseliı	ne	E	Business as usua	1		7	TIGON	
Scenarios to be	measured	/ calculated		7	_		-		-		
		,									
	1		Calculation		gy						
Nº			Step de	scription					F	Responsible	
			Data cou	coc / turo							
	1		Source/	rces / types	)			Min.			
Data	TAG	Methodology	Tools/	Location of		Frequency of		nitorir	νσ	Responsibl	
Data	IAG	Wethodology	Instruments	collectio	on	data collection		period	ıв	Responsible	e
		Rad	eline definition	/ Ball met	hodo	logy	1				
		Das									
			Literatı	ıre		Historical data		Μ	leasu	red at start	
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Responsible			,	\ /	- (	, 24	. /	- (	,	(	
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Responsible											
Details	<u> </u>										
			Other KI	Pls related							
				Je Felated							
			General	comments							

# Annex II: KPI Datasheets (filled)





			TIGON KPI	DATAS	IEE.	Τ			VC
				ormation					
Name:		Solf Conc	umption Rate (S			KD	ID:		SCRt
Name:	-	3011-00115		CRIJ		NP I	טוי.		SCRI
Description:	Is the ra	atio of consumed	l renewable ene	rgy over the	e sun	of all renewable	e electr	icity gener	rated on site.
Units				[·	·]				
			Loc	ation					
Demo site (Use Case)				TBD in WP	5 and	WP6			
			Calcu	llation					
Formula or Calculation procedure	Where:	$t = \frac{E_{C\_RE}}{E_{G\_RE\_tot}}$		E	C_RE	$F = E_{G\_RE}$ ; $F = E_{C\_tot}$ ;			
	Eg_re_tot	he on-site renew : Total energy pro tal electricity cor	oduced by RES lo	ocally / [kWh]		/h] Business as usua	,	Т	'IGON
Scenarios to be	e measured	measured / calculated							
			Calculation		gy				
N⁰			Step des					R	Responsible
SCRt_01		e electrical bound							TBD
SCRt_02		Obtain amount of generated energy locally (within the bounds) TBD							
SCRt_03		ount of consum		(within the	e bou	nds)			TBD
SCRt_04	Perform ca	alculation of Ec_	re						TBD
SCRt_05	Perform ca	alculation of SCR	t						TBD
			Data sour	ces / types					
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio		Frequency of data collection		Aonitoring eriod	Responsible
Total energy	E_res	meters units	IEDs / Others	DSO regis		hourly	on	e year	TBD
Total energy	E_con	meters units	IEDs / Others	DSO regis		hourly	on	e year	TBD
	Source	Bas	Eline definition Literatu BL()		hodo BL (	Historical data	U()	Measu BL()	red at start
Responsible	-								
Details			Valia	lation					
Er	nvironment		Simulati			Laboratory		Data Field	
Responsible			L				I		
Details									
				Pls related					

									V 0.1
			TIGON KPI	DATAS	HEE1				
	T			formation					
Name:		Ener	gy Consumption			KP	ID:		EC
Description:			Total ener	gy consum	ed in a	a period of time			
Units				[M)	Nh]				
			Loc	ation	-				
Demo site (Use Case)				TBD in WP	5 and	WP6			
			Calcu	lation					
Formula or Calculation procedure		Energy [MWh] gy consumed in p		$C = \sum E$	$Ep_n$				
	29.11 2.1101	gy eeneunieu nip			_			_	
			Baselir	ne	E	Business as usua		7	IGON
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				_					
	T		Calculation		gy				
N⁰				scription				R	esponsible
EC_01		ergy consumptio							TBD
EC_02	Perform ca	alculation of tota				im monitoring p	eriod		TBD
	1			ces / types					
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collection		Frequency of data collection		Aonitoring eriod	Responsible
Energy	Ep	Power meters	IEDs / Others	DSO pov		monthly	on	e year	TBD
		Bas	seline definition	/ BaU met	hodo	logy			
	Source		Literatu BL()	i <b>re</b> ] BaU( )	BL (	Historical data	U()	Measu [ BL()	red at start  BaU()
Responsible	<b> </b>								
Details			Malte	dation					
			Valio	auon					
			Simulat	ion		Laboratory		Da	ta Field
Env	vironment			]				[	
Responsible									
Details									
			Other K	Pls related					
			General	comments					

									V 0.1
			TIGON KPI	DATAS	HEE	Т			
			Basic In	formation					
Name:		Peak	Load Reduction	1		КР	I ID:		PLRed
Description:		PI shows the red the two peaks, t	uction in the ma he power peak	aximum ele with respec	t to t	ty demand. The	KPI is act the powe	•	
Units				[9	6]				
			Loc	ation	<u></u>				
Demo site (Use Case)				TBD in WP	5 and	I WP6			
	1		Calcu	ulation					
Formula or Calculation procedure		ak load, evaluate Peak load, evaluat	-	line scenar	io in a	a period [W]			
			Baseliı	10		Business as usua	J	7	TIGON
Scenarios to be	be measured / calculated								
	measurea	, calculated							
			Calculation		ogy				
Nº Di Di Di O (				scription				ŀ	Responsible
PLRed_01		e electrical bound							TBD
PLRed_02		storical data of a						_	TBD
PLRed_03 PLRed_04		w data of active alculation of PLR		le zone den	neu p	previously after t	using the		TBD TBD
PLReu_04	Periorinic			rces / types					
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collection	data	Frequency of data collection	Min. Moi peri	•	Responsible
Active power	Р	meters units	IEDs / Others	DSO pov	ver	daily	one y	/ear	TBD
		Bas	eline definition	/ BaU met	hodo	ology			
	Source		Literatu BL()	<b>ire</b> ] BaU()	BL (	Historical data	U() BI	<b>Measu</b> _ ( )	BaU( )
Responsible Details									
Details			Vali	dation					
	Environment Simulation Laboratory Data Field							ta Field	
Responsible									
Details			Other KI	Pls related					
				comments					

				DATAC	JEE	τ			V
			TIGON KPI		166	l			
Nama		vorago octimatio		formation	or	KDI	10.		<b>A</b> o S
Name:	A	verage estimatio	on of savings pe	rstakenoid	er	KPI	ID:		AeS
Description:	Total sa	vings from avoid			-	chase (dependin Dided energy.	g on st	akeholder	concerned
Units	-			[ŧ	5]				
Onits				ation	-]				
Demo site (Use Case)				TBD in WP	5 and	WP6			
			Calc	ulation					
Formula or Calculation procedure	S_n: Savin n: Total nu AeS_fg: Av AeS_Bau:	$AeS = \frac{\sum S_n}{n}$ %AeS = 100 $\frac{AeS_fg}{AeS_BaU}$ (*) re: Average estimation of savings [€] Savings in cathegory n [€] tal number of categories for savings [-] fg: Average estimations savings in TIGON scenario [€] Bau: Average estimations savings in BaU scenario [€] pmplementary formula						fg aU (*)	
Scenarios to be measured / calculated			Baseline     Business as usual     TIG       Calculation Methodology     Calculation Methodology     Calculation Methodology						
N₽	1						esponsible		
AeS_01	Determine	e all categories t							TBD
AeS_01		aU scenario for		-					TBD
AeS_02		IGON scenario f			1				TBD
AeS_04		alculation for Ba				;)			TBD
AeS_05		IGON scenario f			-				TBD
			÷	rces / types					
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio	data	Frequency of data collection		lonitoring eriod	Responsibl
		Dee	eline definitior		bode	logy			
		Das							
Source			Literature Historical data			J( )	Measured at start		
Responsible									
Details				dation					
			valı	uation					
Environment			Simulation		Laboratory			Data Field	

Responsible	
Details	
	Other KPIs related
	General comments

									V 0.1	
			TIGON KPI	DATASI	HEE	Т				
			Basic In	formation						
Name:		Generatio	n Available Flex	ibility		KP	I ID:		GAF	
								·		
Description:		Т	he amount of ge	eneration th	iat ca	n be shifted tem	nporally	/		
Units				[M	W]					
	1		Loc	ation						
Demo site				TBD in WP	5 and	WP6				
(Use Case)										
				• -•						
	1		Calcu	ulation						
				GAF =	$\sum c$	G.f.,				
Formula					` ل	- <i>J</i> 11				
or										
Calculation										
procedure										
	Where:									
	GAF: [M	-				<b>Fa</b> (1) (1)				
	Gf_n: An	nount of generat	ion that can be s	shifted in n	ode n	[IVIW]				
		Baseline Business as usual TIGON								
Scenarios to be	measured	measured / calculated								
			Calculation	Methodolo	σν					
N₽				scription	61			6	Responsible	
GAF_01	Power grid	d assets characte		-	gene	ratos, etc.) #GD		-	TBD	
GAF_02	_	power grid for L			80.00				TBD	
GAF_03	-	e generation ava		ed in a bas	eline	scenario in node	e (Gfn)	)	TBD	
 GAF_04		e generation ava						,	TBD	
		-		rces / types			<u> </u>			
			Source/							
Data	TAG	Methodology	Tools/	Location of collection		Frequency of data collection		1onitoring eriod	Responsible	
			Instruments	conectio	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		μ.	enou		
Grid data	#GD	Power grid	DSO registers	DSO regis	ters	once		-	TBD	
		Bas	eline definition	/ BaU met	hodo	logy				
			Literatı	ire		Historical data	T	Μραςι	red at start	
	Source			-				measu		
	1		BL()	BaU()	BL (	) Ba	U( )	BL()	BaU()	
Responsible										
Details										
			Valie	dation						
			Simulat	ion		Laboratory		Da	ta Field	
Env	vironment			-		·				
					L					
Responsible										
Details										
			Other KI	Pls related						
			Conoral	comments						
			General	comments						

			<b>FIGON KPI</b>	DATAS	HEE	T			
				formation					
Name:	1	Reve	rse Power Flow			KPI	ID:		RPF
Description:	Power/	energy flow fron	n distribution fe	eder/syste	m up	oward due to exc	cess of R	RES powe	er generation
Units				[kWh	/vear	]			
			Loc	ation		<u>,</u>			
Demo site (Use Case)				TBD in WP	5 anc	I WP6			
			Calcu	ulation					
Formula or Calculation procedure		$RPF = \frac{\sum R_{POW}}{year}$ <i>Where:</i> RPF: Total reverse power flow [kWh/year] R_pow: reverse power energy [kWh]							
	R_pow: r	everse power er	nergy [kWh]						
Scenarios to be	measured	/ calculated	Baselin	ne ]	E	Business as usua	1	ד	IGON
			Calaulation						
N₽			Calculation	scription	pgy				esponsible
	Modeling	of power grid, ir			nts of	generation and	load	^	TBD
	_	enarios to evalua	_	-		-	1044		TBD
		alculation of Loa		-					TBD
		e R_pow for the				,		_	TBD
 RPF_05	-	alculation of Loa				/ nodes			TBD
RPF_06	Determin	e R_pow for the	TIGON scenario	os / nodes					TBD
			Data sour	rces / types	5				
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio		Frequency of data collection		onitoring riod	Responsible
Power grid data	PG_dat	data collection	DSO DB /	DSO DE	3 /	once	-		TBD
Reverse power	R_pow	Simulated	LPF simulator	LPF softw	/are	once	-		TBD
		Bas	eline definition	/ BaU met	hodo	ology			
Source			Literature				Measu	red at start	
Responsible			BL()	BaU()	BL (		U() B	( /	DaU(
Details									
			Valie	dation					
			Simulat	ion		Laboratory		Da	ta Field
Env	vironment		l —	1					

LI	vironment		
Responsible			
Details			
		Other KPIs related	
		General comments	

				DATACI		-			V 0.1
			TIGON KPI		166				
Newser				formation		KD			CAIDI
Name:		ustomer Average	e interruption Di	uration inde	ex	KP	ID:		CAIDI
Description:	The Custo	mer Average Int	erruption Durati	on Index (C serv	-	represents the a	average t	ime req	uired to restore
Units				[min	utes]				
	•		Loc	ation					
Demo site (Use Case)		TBD in WP5 and WP6							
			Calcu	lation					
Formula or Calculation procedure		CAIDI =	-	event [minu		$r_i = SI_{st}$	-		orting period
	[integer]								
Scenarios to be	measured / calculated								
	T		Calculation		gy				
Nº ○				scription					Responsible
CAIDI_01			t number and du						TBD
CAIDI_02			estimate the nur					_	TBD
CAIDI_03		(	Calculate CAIDI i			0		_	TBD
CAIDI_04			Compare to ba						TBD
	1		1	ces / types					
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio	n	Frequency of data collection	Min. Mo per	-	Responsible
Service interruption		Sequence of	Various	DSO, SCA		once at the	one	-	TBD
Restoration	SI_en	Sequence of	Various	DSO, SCA	DA	once at the	one		TBD
Number of	Ni	Adding the	Various	DSO,		once at the	one	year	TBD
	Source	Bas	BL()		BL (	Historical data	U() В	<b>Меазı</b> L ( )	ured at start
Responsible									
Details				lation					
Env	Validation           Validation         Laboratory         Data Fiel           vironment						nta Field		
Responsible									
Details									
			Other Ki	Pls related					
			General	comments					

Name: Description: Units Demo site (Use Case)	Amount o	CO2	2 tonnes saved n due to substit istribution netw	formation ution of fos vork under	ssil po	KPI	•	onal RI	CO2Sv		
Description: Units Demo site	Amount o	of CO2 reduction	2 tonnes saved n due to substit istribution netw	ution of fos vork under	•	wer generation	by additi	onal RI			
Description: Units Demo site	Amount o	of CO2 reduction	n due to substit istribution netw	vork under	•	wer generation	by additi	onal RI			
Description: Units Demo site	Amount o		istribution netw	vork under	•	-	•	onal RI			
Demo site			loc	50	Amount of CO2 reduction due to substitution of fossil power generation by additional RES units inside the distribution network under analysis (Using TIGON solution)						
Demo site			loc	19	6]						
				ation	<u></u>						
	TBD in WP5 and WP6										
			Calcu	ulation							
	CO2_FG: CO2_BL: T	$CO2Sv = 100 \cdot \left(\frac{CO2_{FG} - CO2_{BL}}{CO2_{BL}}\right)$ /here: CO2Sv: Reduction in CO2 emissions [%] CO2_FG: Total CO2 emissions under TIGON scenario[kg]* CO2_BL: Total CO2 emissions under Baseline scenario[kg] CO2_BL: Total CO2 emissions under Baseline scenario[kg]									
Scenarios to be m	neasured ,	/ calculated	Baselir	ne ]	В	usiness as usua	1	т [	IGON		
			Calculation	Methodolo	ogy						
N⁰			Step des	scription				R	esponsible		
CO2Sv_01 F	Result fror	n demand shifti	ing (A)						TBD		
CO2Sv 02 E	Equivalent	coefficient of C	O2 emissions (E	3)					TBD		
_	· ·		of technical los						TBD		
	Result fror	n the incorpora	tion of RES due	increase of	f host	ing capacity (D)			TBD		
		· · ·		rces / types		<u> </u>					
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio	<sup>:</sup> data	Frequency of data collection	Min. Mon peric	-	Responsible		
Reduction of CO2	CO2Sv_01	Calculation	KPI calculation			TBD	TBD	)	TBD		
Equivalent (	CO2Sv_02	Public Values	Public Values	Public Va	lues	TBD	TBD	)	TBD		
Reduction of CO2	CO2Sv_03	Calculation of	KPI calculation			TBD	TBD	)	TBD		
Reduction of CO2	CO2Sv_04	Calculation of	KPI calculation			TBD	TBD	)	TBD		
		Bas	eline definition	/ BaU met	hodo	logy					
Source						[	red at start				
Responsible											
Details											
			Valio	dation							
			Simulat	ion		Laboratory		Da	ta Field		

LI	vironment		
Responsible			
Details			
		Other KPIs related	
		General comments	

									V 0.1
			TIGON KPI	DATAS	HEET	Т			
				formation					
Name:		Numh	per of grid event			KD	I ID:		NGE
indiric.				5					NGL
Description:	Number	of events that ch	nange the netwo	rk, as lines opera	-		protec	tion in subs	stations, OLTC
Units				[·	-1				
			Loc	ation	_				
Demo site (Use Case)				TBD in WP	5 and	WP6			
			Calcu	ulation					
Formula or Calculation procedure		al number of gric id event number	l events [-]	$GE = \sum_{i=1}^{n}$	GEn	1			
	02_/// 0//	a crent namber							
			Baselir	пе	E	Business as usua	l	Т	'IGON
Scenarios to be	/ calculated		1				Γ		
				4				L	
			Calculation	Methodolo	gv				
N₽				scription	01			R	Responsible
NGE_01	Obtain eve	ent registers fron							TBD
	0.000			- rces / types					
			Source/	1			<u> </u>		
Data	TAG	Methodology	Tools/ Instruments	Location of collection		Frequency of data collection		Monitoring period	Responsible
<b>Registered event</b>	NGE_01	IED extraction	IEDs / Others	DSO SCAD	A DB	monthly	or	ne year	TBD
		Bas	seline definition	/ BaU met	hodo	logy			
	Source		Literature		BL (	Historical data		Measured at start	
Responsible									
Details				dation					
			valio	ation					
			Simulat	ion		Laboratory		Da	ta Field
Env	/ironment			-				-	
								[	
Responsible									
Details									
			Other Ki	Pls related					
			General	comments					

			TIGON KPI	ΠΔΤΔ	IEE	Г			V 0.:
Newser				formation		KD		-	CAIDI
Name:		System Average	Interruption Du	ration index	(	КР	ID:		SAIDI
Description:		rage duration of minutes of inter			and			-	
Units				[m	in]				
			Loc	ation					
Demo site (Use Case)				TBD in WP	5 and	WP6			
			Calcı	lation					
Formula or Calculation procedure	NT : Total	SAIDI ation time for ea number of custo er of interrupted	mers served for	the area [in	ntege				orting period
	[[integer]]		Baselir			Business as usua			TIGON
Scenarios to be measured / calculated				]	Ľ				
	-		Calculation	Methodolo	gy				
N⁰			-	scription				ŀ	Responsible
SAIDI_01		Detect number and duration of interruptions TBD						TBD	
SAIDI_02		Detect or estimate the number of affected customers TBD							
SAIDI_03			Calculate SAIDI i	n TIGON sc	enario	C			TBD
SAIDI_04			Compare to ba	seline scen	ario				TBD
		1	Data sour	ces / types					
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio		Frequency of data collection		onitoring riod	Responsible
ervice interruption		Sequence of	Various	DSO, SCA		once at the		year	TBD
Restoration	SI_en	Sequence of	Various	DSO, SCA	DA	once at the		year	TBD
Number of	Ni	Adding the	Various	DSO,		once at the	one	year	TBD
	Source	Bas	seline definition Literatu		hodo	logy Historical data		Measu	red at start
			BL()	BaU()	BL (	)	U() E	SL()	BaU(
Responsible				540()	טב (	, Dd	~\	- ( )	DaU
Details									
			Valio	dation					
En	vironment		Simulat	ion ]		Laboratory		Data Field	
Responsible	-								
Details			Other K	Pls related					
			General	comments					

									V 0.1
			TIGON KPI	DATAS	HEE	Т			
			Basic In	formation					
Name:		Line ov	verload occuren	ce		KPI	ID:		LOO
Description:		Numbe	er of line overlo	ading even	ts up	to 15 minutes v	vithin a	a year	
Units				[inte	eger]				
			Loc	ation	<u> </u>				
Demo site (Use Case)				TBD in WP	5 anc	1 WP6			
			Calc	ulation					
Formula or Calculation procedure	Where: LOO: Tot	tal lines overload		$D = \sum L$	0E <sub>n</sub>				
	LOE_n: e	event of line over	load n [-]						
Scenarios to be	e measured	Baseline			Business as usual		TIGON		
			Calculation	Methodolo	ogy				
Nº			Step description Re					esponsible	
LOO_01	Define lin	es to be monito	red						TBD
LOO_02	Obtain lin	es characteristic	cs (type of conductor, suport geometry, geographical						TBD
LOO_03	Perform o	alculation of the	ermal limits for	mal limits for each line to define nominal current T					TBD
LOO_04	Obtain cu	rrents values for	r each section o	f line to be	moni	itored			TBD
LOO_05	Determin	e number of ove	rloads line ever	nts					TBD
			Data sou	rces / types	5				
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio	on	Frequency of data collection		lonitoring eriod	Responsible
Line	e_for	Power meters	IEDs / Others	DSO So		daily	one	e year	TBD
		Bas	eline definitior	n / BaU met	hodo	ology			
Responsible	Source		Literati	ure ] BaU()	BL (	Historical data	U()	Measur [ BL()	red at start
Details									
			Vali	dation					
En	vironment		Simulation		Laboratory			Data Field	

Responsible							
Details							
	Other KPIs related						
	General comments						

Name: Description: Units Demo site (Use Case)	Saving	Grid in s (avoided costs)	vestment deferr by employing n Loc	-	[]			;. line reir	GID nforcement)
Description: Units Demo site	Saving		by employing n	ew propose [ <del>{</del> ation TBD in WP	[]	utions vs traditic		, line reir	
Units Demo site	Saving	s (avoided costs)	Loc	[€ Tation TBD in WP	[]		onal (e.g	, line reir	forcement)
Demo site				TBD in WP	-	WP6			
Demo site				TBD in WP	-	WP6			
			Calcu		5 and	WP6			
			Calcu	ulation					
	$GID = \sum Sc_n$ Where: GID: Total grid investment deferral [€] Sc_n: Amount of investment deferral by node/cathegory/element "n" in the grid [€]								
	<u>30_11. Ani</u>	ount of investing							
Scenarios to be m	Scenarios to be measured / calculated			Baseline Business as usual					
			Calculation	Methodolo	gv				
Nº				scription	07			R	esponsible
	Get all der	no site asset cha		<b>-</b>					TBD
	Model the	power grid to pe	erform OPF sim	ulations					TBD
_		n OPF for a BaU s			e reinf	orcements			TBD
		n OPF for a TIGO					;		TBD
_	Determine	e investments rec	quired by GID 0	4 and GID	03 to	 define SCn			TBD
			Data sou	rces / types					
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio		Frequency of data collection		onitoring riod	Responsibl
Demo assets characteristics	GID_01	Nominal values / specifications	Datasheets / Registers	DSO D	В	once			TBD
		Bas	eline definition	/ BaU met	hodo	logy			
			Literatı	ure		Historical data		Measu	red at start
	ource		BL() BaU() BL		BL (	) Bal	U() E	3L()	 BaU(
Responsible Details									
Details			Valio	dation					
			Simulat			Laboratory		Da	ta Field
Envir	ronment			1					

Responsible	•	•	
Details			
	Other KPIs related		
	General comments		

			TIGON KPI	DATASI	IEET				
			Basic In	formation					
Name:		Load o	curve valley fillin	ng		KPI ID:		VF	
Description:	It is de	fined as the abili	ty to shift load	to valley ho tariff st	-	of the direc	t control	of assets or by	
Units	_			[%	6]				
Demo site (Use Case)				TBD in WP	5 and WP6				
			Calc	ulation					
Formula or Calculation procedure	V_BL: To	valley filling [% vtal demand in va tal demand in va	] alley with basel	ine scenaric					
	V_FG: 10	tal demand in va	liey with figur	scenario [	VIVVJ				
Scenarios to b	e measured	/ calculated	Baseline Business as usual TIGON				TIGON		
			Calculation	Methodolo	gy				
N⁰			Step de	scription				Responsible	
VF_01*		ad curve from de		-				TBD	
VF_02	Perform o V_BS and	alculation of min	nimun of demai	nd (valley) 1	for baseline a	TIGON scen	arios	TBD	
VF_03	Perform o	alculation of VF						TBD	
				rces / types					
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio		-	Monitorir period	Responsible	
Demand	#LC	Power meters	IEDs / Others	DSO pow	ver TB	D	TBD	TBD	
		Bas	eline definition	n / BaU met	hodology				
Source		Literature		Historica BL ( )	a <b>l data</b>  BaU( )	Mea BL()	Measured at start		
Responsible									
Details									
			Vali	dation			1		
	Environment			Simulation		Laboratory		Data Field	

Responsible		
Details		
	Other KPIs related	
	General comments	

			TIGON KPI	DATASH	IEE.	т			V 0.
				formation					
Name:	1	Voltage	Unbalance Fac			KP	ID:	1	VUF
Humen		1010050							101
Description:	Voltage	unbalance is de		o of the neg uence volta			ge compo	nent to	o the positive
Units				[%	.1				
Onits				ation	0]				
	1		LOC	ation					
Demo site (Use Case)				TBD in WP5	5 and	I WP6			
			Calci	ulation					
Formula or		VUF	$= 100 \cdot \left(\frac{V_{Ne}}{V_{Po}}\right)$	$\left(\frac{g}{s}\right)$			$eg = \frac{V_{ab}}{V_{ab}}$		
Calculation procedure	V_neg: No V_pos: Po	Where: $a = 1(12)$ VUF: voltage unbalance factor in sample k $V_neg$ : Negative sequence voltage component [V]         V_pos: Positive sequence voltage component [V] $V_pos$ : Positive sequence voltage component [V]         Vab,Vbc,Vca: Line to line voltage magnitude [V] $V_p$						= 1(120°)	
			Baseliı	ne	F	Business as usua	1	7	IGON
Scenarios to be	Scenarios to be measured / calculated				-			,	
Scenarios to be	measureu								
				-					
			Calculation	Methodolo	gy				
N⁰			Step de	scription				F	Responsible
VUF_01	Obtain vo	Dbtain voltage samples in nodes to be monitored TBD						TBD	
 VUF_02		positive and neg			ode /	/ sample		1	TBD
VUF_03						· ·			TBD
VUF_04	Calculate	average VUF for	voltage node in	min. monite	oring	period			TBD
_	•	Ŭ		rces / types		•			
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio		Frequency of data collection	Min. Mon perio	-	Responsible
Voltage fasor	Vabc	Power meters	IEDs / Others	DSO pow	/er	TBD	one mo	onth	TBD
		Bas	eline definition	/ BaU met	hodo	ology			
	Source		Literatu BL()	BaU()	Historical data				red at start BaU( )
Responsible									
Details									
			Vali	dation					
En	vironment		Simulat	ion 1		Laboratory		Da	ta Field
				J					
Responsible			<u> </u>				<b>I</b>		
Details									
			Other Ki	Pls related					
			General	comments					

			TIGON KPI	DATAS	IFF.	г			V 0.2
				formation		•			
News	1	Demend							
Name:	-	Demand	Flexibility Poter	ntial		KP	ID:		DFP
Description:	The an	The amount of potential Demand Flexibility reflects the amount of energy consumption reduction participating Customers (i.e. End Users) could potentially accept and apply							
Units				[M]	W1				
			Loc	ation	-				
Demo site (Use Case)				TBD in WP	5 and	WP6			
			Calcu	ulation					
Formula or Calculation procedure		and available fo	or flexibility [MV	-					
	All			i ili noue il [	ivivvj				
		Baseliı	ne	В	Susiness as usua	11	Τ	IGON	
Scenarios to be	measured		٦ T				г		
								L	
			Calculation	Mathadala	<u>a</u>				
N₽	1			scription	'5 <b>'</b>			D	esponsible
	Power ari	accete charact			000	eratos etc.) #C		- <sup></sup>	TBD
GAF_02	Power grid assets characteristics (lines, transformers, generatos, etc.) #GD Modeling power grid for LPF using #GD						TBD		
GAF_03	•	e potencial load		chiftad in a	baco	lina connaria in	nodo		TBD
GAF_05	Determine			rces / types			noue		ТБО
	1			lites / types	)	[		I	
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectic		Frequency of data collection		onitoring riod	Responsible
Grid data	#GD	Power grid	DSO registers	DSO regis	ters	once		-	TBD
		Bas	eline definition	/ BaU met	hodo	logy			
			Literatı	ure		Historical data		Measu	red at start
	Source							г	
				]	_	, LLI			
			BL()	BaU()	BL (	) Ba	U() E	BL()	BaU()
Responsible									
Details				dation					
			valle						
			Simulat	ion		Laboratory		Da	ta Field
En	vironment			<b>,</b>				F	
Responsible									
Details									
			Other Ki	Pls related					
			Consul	0000000000					
			General	comments					

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         Customer actually delivered           Units         [kWh]           Demo site (Use Case)         TBD in WP5 and WP6           Demo site (Use Case)         TBD in WP5 and WP6           Calculation         Calculation           DFC; Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t         DFC; Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t           DFC; Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t         DFC; Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t           The following times series are assumed to be available for the calculation (per asset / customer premise):         P; The forecasted maximum power (orange line) that can be applied for providing downwards flexibility (increase load)           Or         Calculation prior         The requested flexibility should be between the limits of the promised flexibility. None, all or part of it should be available for delivery due and a detivation is approach should be followed for requests to provide guawards flexibility (i.e. request provide downwards flexibility a still 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		,	TIGON KPI DATASI	IEET	
Description:         The difference between the DR requested to be delivered by the Customer and the DR that the Customer actually delivered           Units         [kWh]           Units         [kWh]           Demo site (Use Case)         TBD in WP5 and WP6           Demo site (Use Case)         Calculation           Demo site (Use Case)         TBD in WP5 and WP6           Calculation         DRDD i = ADFD i - DFR i           Where:         ADFD; Actual Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t           DFR;         Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t           DFR;         Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t           The calculation of ADFD; and DFR, can be carried out using the following process:         The forecasted baseline power (blue line), which is the forecast of the load given no activation is requested P, <sup>min</sup> ; the forecasted maximum power (orange line) that can be applied for providing downwards flexibility (increase load)           P, <sup>min</sup> ;         The forecasted maximum power (vellow line) that can be applied for providing understafter stick 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 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 flexibilit			<b>Basic Information</b>		
Description:         Customer actually delivered           Units         [kWh]           Location         Image: Customer actually delivered           Demo site (Use Case)         TBD in WP5 and WP6           Calculation         TBD in WP5 and WP6           Calculation         DRDD[i = ADFDi - DFRi           Where:         ADFD; Actual Demand Flexibility Belivered by the Customer [kWh] in demand flexibility event at time t           DFR; Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t           The calculation of ADFD; and DFR; can be carried out using the following process:           The following times series are assumed to be available for the calculation (per asset / customer premise):           P; The forecasted baseline power (blue line), which is the forecast of the load given no activation is requested           P; "": The forecasted maximum power (vange line) that can be applied for providing downwards flexibility (increase load)           P; "": The forecasted maximum power (vellow line) that can be applied for providing upwards flexibility (increase load)           P; "": The forecasted flexibility was actually delivered by Customers.           The requested flexibility should be between the limits of the promised flexibility. None, all or part of it should be available for delivery (wher requested).           Let's assume that a_=[0,1] is the signal that represents the requested flexibility. None, all or part of it should be conviated flexibility. A similar approach should be	Name:	DR D	elivery Deviation	KPI ID:	DRDD
Location           Demo site (Use Case)         TBD in WP5 and WP6           Calculation           © DRDD $i_i = ADFD_i - DFR_i$ Where:           ADFD; Actual Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t           DFR;:         Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t           DFR;:         Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t           The calculation of ADFD, and DFR, can be carried out using the following process:         The forecasted baseline power (blue line), which is the forecast of the load given no activation is requested $P_i^{min}$ : The forecasted maximum power (orange line) that can be applied for providing downwards flexibility (reduced load)           P_mestimation 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. or Calculation period they are the reference power which the actual measured power must be compared against, in order to allowing (i.e. requested flexibility should be between the limits of the promised flexibility. None, all or part of it should be available for delivery (when requested).           Let's assume that $a_i=[0,1]$ 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 requestst provide upwards flexibility	Description:	The difference betwe	•	•	r and the DR that the
Demo site (Use case)         TBD in WPS and WP6           **DRDDit = ADFDi - DFRi           **DRDDit = ADFDi - DFRi           Where:           ADFD; Actual Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t           DFR; Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t           The calculation of ADFD, and DFR, can be carried out using the following process:           The following times series are assumed to be available for the calculation (per asset / customer premise):           P; The forecasted baseline power (bule line), which is the forecast of the lead given no activation is requested           P; The forecasted maximum power (orange line) that can be applied for providing downwards flexibility (increase load)           P; "The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)           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.           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).           Let's assume that a_=(0,1] 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 consum	Units		· · ·	/h]	
IBD in WPS and WPS         Calculation         Calculation         IDRDD i = ADFD i - DFR i         Where:         ADFD; Actual Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t         DFR; Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t         The calculation of ADFD, and DFR, can be carried out using the following process:         The following times series are assumed to be available for the calculation (per asset / customer premise):         P; The forecasted maximum power (orange line) that can be applied for providing downwards flexibility (increase load)         P, <sup>me</sup> : The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)         P, <sup>me</sup> : The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)         P, <sup>me</sup> : The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)         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 as actually delivered by Customers.         The requested flexibility should be between the limits of the promised flexibility. Anne, all or part of it should be available for delivery (when requested).         Let's assume that		-	Location		
BORDD i = ADFD i - DFR i Where: ADFD; Actual Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t DFR;: Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t The calculation of ADFD; and DFR; can be carried out using the following process: The following times series are assumed to be available for the calculation (per asset / customer premise): P; The forecasted baseline power (blue line), which is the forecast of the load given no activation is requested P; <sup>min</sup> : The forecasted maximum power (orange line) that can be applied for providing downwards flexibility (reduced load) P; <sup>min</sup> : The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)Formula or Calculation procedureThe requested flexibility should be between the limits of the 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. 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). Let's assume that a;=[0,1] is the signal that represents the requested flexibility. None, all or part of it should be available for delivery (when requested communito). The requested flexibility (i.e. increase consumption). The requested doar reduction (downwards flexibility). A similar approach should be followed for requests t provide upwards flexibility (i.e. the DFR) is: P; (downeed=a; (P, -P, ^min)) Hi the reduction (downwards flexibility) (i.e. the DFR) is: P; (downeed=a; (P, -P, ^min)) Hi the requested downwards flexibility at time t (i.e. the ADFD) is: P; (downeed=a; (P, -P, ^min)) Hi the			TBD in WP	5 and WP6	
Where:       ADFD <sub>1</sub> : Actual Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t         DFR <sub>2</sub> : Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t         DFR <sub>2</sub> : Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t         The calculation of ADFD <sub>1</sub> and DFR <sub>1</sub> can be carried out using the following process:         The following times series are assumed to be available for the calculation (per asset / customer premise):         P <sub>1</sub> : The forecasted baseline power (blue line), which is the forecast of the load given no activation is requested         P <sub>1</sub> <sup>mn</sup> : The forecasted maximum power (orange line) that can be applied for providing downwards flexibility (ircease load)         P <sub>1</sub> <sup>mn</sup> : The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)         P <sub>1</sub> <sup>mn</sup> : The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)         P <sub>1</sub> <sup>mn</sup> : The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)         The requested flexibility should be between the limits of the 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 should be between the limits of the promised flexibility. None, all or part of it should be available for delivery (when requested).         Let's assume that a <sub>i</sub> =[0,1] is the signal that represents the requested flexibility.			Calculation		
Where:       ADFDr: Actual Demand Flexibility Delivered by the Customer [kWh] in demand flexibility event at time t         DFR: Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t         DFR: Demand Flexibility Requested to be delivered by the Customer [kWh] in demand flexibility event at time t         The calculation of ADFDr, and DFR, can be carried out using the following process:         The following times series are assumed to be available for the calculation (per asset / customer premise):         Pr: The forecasted baseline power (blue line), which is the forecast of the load given no activation is requested         Pr: The forecasted minimum power (orange line) that can be applied for providing downwards flexibility (ircluced load)         Pr: The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)         Pr: The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)         Pr: The forecasted maximum power (yellow line) that can be applied for providing upwards flexibility (increase load)         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.         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).         Let's assume that a_=[0,1] is th		$\mathbb{P}DRDD_i = ADFD_i$	$-DFR_i$		
Formula       (reduced load)         or       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.         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).         Let's assume that a <sub>t</sub> =[0,1] 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 the provide upwards flexibility (i.e. increased consumption).         The requested low reduction (downwards flexibility) (i.e. the DFR <sub>t</sub> ) is:       Pt (down.ed)=at (Pt - Pt (T, T, T)).         While the delivered downwards flexibility at time t (i.e. the ADFD <sub>t</sub> ) is:       Pt (down.ed)=at (Pt - T, T)).         From the above equalitions, it is evident that:       If Pt >Pt (T, T, T).         If Pt =Pt min, the promised but not delivered flexibility at time t is equal to at (Pt - Pt min).         If Pt =Pt min, the flexibility requested is equal to the one delivered at time t         If Pt =Pt min, the flexibility delivered is greater than the one requested at time t. The additional flexibility delivered is		ADFD <sub>t</sub> : Actual Demand Flexib DFR <sub>t</sub> : Demand Flexibility Rec The calculation of ADFD <sub>t</sub> and The following times series ar P <sub>t</sub> : The forecasted baseline p	quested to be delivered by the I DFR <sub>t</sub> can be carried out using re assumed to be available for rower (blue line), which is the	Customer [kWh] in demand the following process: the calculation (per asset / cu forecast of the load given no	flexibility event at time t ustomer premise): activation is requested
Calculation procedureThe requested flexibility should be between the limits of the promised flexibility. None, all or part of it should be available for delivery (when requested).Let's assume that $a_t=[0,1]$ 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 DFRt) is: $P_t^{(down,req)} = a_t (P_t - P_t^{min})$ , while the delivered downwards flexibility at time t (i.e. the ADFDt) is: $P_t^{(down,del)} = a_t (P_t - max(P_t, P_t^{min}))$ From the above equations, it is evident that: If $P_t > P_t^{min}$ , the promised but not delivered flexibility at time t is equal to $a_t (P_t - P_t^{min})$ If $P_t = P_t^{min}$ , the flexibility requested is equal to the one delivered at time t If $P_t < P_t^{min}$ , the flexibility delivered is greater than the one requested at time t. The additional flexibility delivered is 		(reduced load) Pt <sup>max</sup> : The forecasted maximuload) Ioad) These time series represent the evaluation period they are the	um power (yellow line) that ca the flexibility which was "pron ne reference power which the	n be applied for providing up nised" for a specific time peri actual measured power mus	owards flexibility (increased od and afterwards in the
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 DFRt) is: $P_t^{(down,req)} = a_t (P_t - P_t^{min})$ , while the delivered downwards flexibility at time t (i.e. the ADFDt) is: $P_t^{(down,del)} = a_t (P_t - max(P_t, P_t^{min}))$ From the above equations, it is evident that: If $P_t > P_t^{min}$ , the promised but not delivered flexibility at time t is equal to $a_t (P_t - P_t^{min})$ If $P_t = P_t^{min}$ , the flexibility requested is equal to the one delivered at time t. The additional flexibility delivered is	Calculation			e promised flexibility. None,	all or part of it should be
		activation to 1 indicating full consumption (i.e. request to provide upwards flexibility (i The requested load reduction $P_t^{(down,req)}=a_t \cdot (P_t - P_t^{min})$ , while the delivered downwar $P_t^{(down,del)}=a_t \cdot (P_t - max(P_t, P_t^{min}))$ From the above equations, it If $P_t > P_t^{min}$ , the promised but If $P_t = P_t^{min}$ , the flexibility required If $P_t < P_t^{min}$ , the flexibility delive	activation). In what follows, w provide downwards flexibility .e. increased consumption). n (downwards flexibility) (i.e. rds flexibility at time t (i.e. the in)) t is evident that: not delivered flexibility at time ested is equal to the one deliv	we consider the case that the ). A similar approach should the DFR <sub>t</sub> ) is: ADFD <sub>t</sub> ) is: e t is equal to $a_t \cdot (P_t - P_t^{min})$ ered at time t	signal refers to decreased be followed for requests to
			Baseline	Business as usual	TIGON
Baseline Business as usual TIGON	Scenarios to h	e measured / calculated			

	measurea			J					
			Calculation	Methodolo	οgy				
N₽	1			scription	<u>/51</u>			R	Responsible
DRDD_01	Calculate	the Demand Res			fferer	nce between the	2		TBD
DRDD_02		the actual delive							TBD
 DRDD_03		ence between D			-				TBD
_	Data sources / types								
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio		Frequency of data collection	Min. Monit period	-	Responsible
Forecasted	#FBP	Historical data	Local meter	Custom	er	Every minute	Day		TBD
Forecasted	#FMIP	Thermal	Sensors	Participa	ting	Every minute	Day		TBD
Forecasted	#FMAP	Thermal	Sensors	Participa	ting	Every minute	Day		TBD
Actual power	#APC	Measurement	Local meter	Custom	er	Every minute	Day		TBD
		Bas	eline definition	/ BaU met	hodo	logy			
	Source     Literature     Historical data     Measured at start       BL()     BaU()     BL()     BaU()     BL()							red at start	
Responsible							<u>`´</u>		
Details									
	-		Valio	dation					
En	vironment		Simulat	ion ]		Laboratory		Da	ta Field
Responsible									
Details									
	Other KPIs related								
			General	comments					

			TIGON KPI	DATASI	HEE.	Г			V 0.1
				formation					
Name:	[	Ener	gy not supplied	ormation		КЫ	ID:		ENS
Name.		LITEI	gy not supplied			KF I	10.		LING
Description:	The	e amount of ener	gy that normally	/ would be	delive	ered, but now is	not beca	ause of a	an outage
Units				[M\	Nh1				
			Loc	ation					
Demo site (Use Case)				TBD in WP	5 and	WP6			
	1		Calcu	lation					
Formula or Calculation procedure		interrupted for ir on of interruptior	nterruption "i" [i	$S = \sum_{i=1}^{N} (i$	$P_i \times$	D <sub>i</sub> )			
	DI: Duratio	on of interruptior							
Scenarios to be	measured	neasured / calculated Baseline Business as usual TIGON							
			Calculation	Methodolo	gy				
N⁰				scription					Responsible
ENS_01	Detect nu	mber and duration	on of interruptio	ns					TBD
ENS_02	Determine	Determine or estimate the number of MW interrupted TBD							
ENS_03	Perform c	alculation of ENS	•						TBD
ENS_04	Compare	to baseline scena	nrio						TBD
	-		Data sour	ces / types			-		
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio	n	Frequency of data collection	Monit	in. toring riod	Responsible
Service	SI_st	Sequence of	Various	DSO, SCA		monthly		year	TBD
Restoration	SI_en	Sequence of	Various	DSO, SCA		monthly		year	TBD
Power interrupted	Pi	Define power	GIS / IED /	DSO, SCA		monthly	one	year	TBD
		Bas	seline definition	/ BaU met	hodo	logy			
	Source		Literatu BL()	i <b>re</b> ] BaU()	BL (	Historical data	U() E	Measi	ured at start BaU()
Responsible Details									
	l		Valie	dation					
Env	vironment		Simulat			Laboratory		De	ata Field
Responsible							1		
Details									
				Pls related					
			General	comments					

			FIGON KPI	DATASHI	ET			
			Basic In	formation				
Name:	S	ystem Average I	nterruption Free	quency Index	KP	ID:		SAIFI
Description:	The Sys	-			AIFI) indicates how over a predefined p			age customer
Units				[%]				
Onits	L		Loc	ation				
Demo site (Use Case)				TBD in WP5 a	and WP6			
			Calcu	ulation				
	[integer]	per of interrupted	l customers for	r the area [int	ed interruption eve			porting peric
Scenarios to be	measured	/ calculated		]				
				Methodology	1		1	
<b>№</b>		<b>D</b>		scription				Responsible
SAIFI_01 SAIFI_02			stimate the nur alculate SAIFI o					TBD TBD
SAIFI_02		C	Compare to ba					TBD
5/11/_00			· ·	rces / types			_	100
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of data collectio		Min Monito peric	ring	Responsib
Service interruption event timestamp	SI_st	Sequence of events logging	Various	DSO, SCADA DB or SoE		one y	ear	TBD
Restoration command timestamp	SI_en	Sequence of events logging	Various	DSO, SCAD/ DB or SoE		one y	ear	TBD
		Adding the number of			once at the			

		areas			pe	nou			
		Bas	eline definition	/ BaU meth	odology				
	Source		Literature BL() BaU() E		Historical data			<b>Measu</b> BL()	red at start
Responsible									
Details									
Validation									
Env	rironment		Simulat	ion ]	Labo	ratory		Da	ta Field
Responsible									
Details									
			Other Ki	Pls related					
			General	comments					

			TIGON KPI	DA <u>TAS</u>	IEET				V 0.
				ormation					
Name:	1	Demand	Available Flexib			КР	I ID:		GAF
Description:	The amou		an be shifted ter centive (RTP, rer						
Units				[M]	\\/1				
Onits			Loc	ation	••]				
Demo site (Use Case)				TBD in WP	5 and V	WP6			
			Calcu	Ilation					
Formula or Calculation procedure			or Flexibility [M\ t can be shifted			$f_n$			
		, , , , , ,	Baselin	e	В	usiness as usud	al 🛛		TIGON
Scenarios to be	measured	/ calculated							
	-		Calculation		gy				
N⁰			Step des						Responsible
GAF_01	Power grid	d assets characte	eristics (lines, tra	nsformers,	genera	atos, etc.) #GD			TBD
GAF_02	Modeling	Modeling power grid for LPF using #GDTBD							TBD
GAF_03	Determine	Determine load available to be shifted in a baseline scenario in node (Gf_n) TBD						TBD	
GAF_04	Determine	e load available t	o be shifted in a	TIGON scer	nario ir	n node (Gfn)			TBD
_				ces / types		( _ /			
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collectio	data	Frequency of data collection	Мо	Min. nitoring period	Responsible
Grid data	#GD	Power grid	DSO registers	DSO regis		once		-	TBD
	Source	Dd:	Seline definition Literatu BL()			Historical data	iU( )	Meas	sured at start
Responsible				-	-				•
Details									
			Valio	lation					
			Simulati	ion		Laboratory		D	ata Field
En	vironment		<u> </u>						
Responsible			<u> </u>						
Details									
			Other KF	Pls related					
			General	comments					

			TIGON KPI	ΠΑΤΔ	FFT				V
				formation					
Name:	1	Increased	EV Hosting cap			KPI		1	EVHC
Description:		additional EV ca nent of the TIGC	apacity that can N solution, con	be accommo	e EV capacit	ne distrik y that ca	oution net		after the
Units				[%]					
Demo site (Use Case)				ation TBD in WP5 :	and WP6				
			Calcu	ulation					
Formula or Calculation procedure	HC_FG: Is currently c	the enhanced ho the additional h connected gener the hosting cap	osting capacity o nosting capacity ration [MW]	of EV when T	IGON solutio TIGON solut	, ons are a ions are	applied w	vith re	
Scenarios to be	measured	/ calculated	Baselir	ne ]	Business	as usual	1	1	
Scenarios to be	measured	/ calculated		ne ] Methodolog		as usual		7	
Scenarios to be	measured	/ calculated	Calculation	]		as usual			TIGON
		/ calculated	Calculation Step des	Methodolog		as usual			
Nº	Get all der		Calculation Step des aracteristics	Methodolog		as usual			Responsible
<b>№</b> EVHC_01 EVHC_02 EVHC_03	Get all der Model the Perform a	no site asset cha power grid to p n OPF for a base	Calculation Step des aracteristics perform OPF sime line scenario to	Methodolog scription nulations obtain the c	<b>y</b>	he grid			Responsible TBD TBD TBD TBD
№           EVHC_01           EVHC_02           EVHC_03           EVHC_04	Get all der Model the Perform a Perform a	no site asset cha power grid to p n OPF for a base n OPF for a TIGC	Calculation Step des aracteristics perform OPF sim line scenario to ON scenario to o	Methodolog scription nulations obtain the c	<b>y</b>	he grid			Responsible TBD TBD
<b>№</b> EVHC_01 EVHC_02 EVHC_03	Get all der Model the Perform a Perform a	no site asset cha power grid to p n OPF for a base	Calculation Step des aracteristics perform OPF sim line scenario to ON scenario to o HC	Methodolog scription nulations obtain the cap	<b>y</b>	he grid			Responsible TBD TBD TBD TBD
№           EVHC_01           EVHC_02           EVHC_03           EVHC_04	Get all der Model the Perform a Perform a	no site asset cha power grid to p n OPF for a base n OPF for a TIGC	Calculation Step des aracteristics perform OPF sim line scenario to ON scenario to o HC	Methodolog scription nulations obtain the c	y apacity of the pacity of the f Freque	he grid e grid	Min. Monitor perio	ing	Responsible TBD TBD TBD TBD TBD TBD TBD
№         EVHC_01         EVHC_02         EVHC_03         EVHC_04         EVHC_05	Get all der Model the Perform a Perform ca	mo site asset cha power grid to p n OPF for a base n OPF for a TIGC alculation of EVI	Calculation Step des aracteristics perform OPF sim eline scenario to o ON scenario to o HC Data sour Source/ Tools/	Methodolog scription nulations obtain the cap btain the cap cces / types Location of	y apacity of the pacity of the f Freque	he grid e grid ncy of llection	Min.	ing	Responsible TBD TBD TBD TBD TBD TBD TBD
№         EVHC_01         EVHC_02         EVHC_03         EVHC_04         EVHC_05	Get all der Model the Perform a Perform ca TAG	mo site asset cha power grid to p n OPF for a base n OPF for a TIGC alculation of EVI Methodology Nominal values	Calculation Step des aracteristics perform OPF sime eline scenario to o DN scenario to o HC Data sour Source/ Tools/ Instruments Datasheets /	Methodolog scription nulations obtain the c btain the cap ces / types Location of data collectio	y apacity of the pacity of the f Freque on data co	he grid e grid ncy of llection	Min.	ing	Responsible TBD TBD TBD TBD TBD TBD Responsib
№         EVHC_01         EVHC_02         EVHC_03         EVHC_04         EVHC_05	Get all der Model the Perform a Perform ca TAG EVHC_01 HC_FG/	mo site asset cha e power grid to p n OPF for a base n OPF for a TIGC alculation of EVI Methodology Nominal values / specifications	Calculation Step des aracteristics perform OPF simeline scenario to o DN scenario to o HC Data sour Source/ Tools/ Instruments Datasheets / Registers	Methodolog scription nulations obtain the c btain the cap ces / types Location of data collection DSO DB DB	y apacity of the bacity of the f Freque on data co on	he grid e grid ncy of llection	Min.	ing	Responsible TBD TBD TBD TBD TBD TBD Responsib
Nº         EVHC_01         EVHC_02         EVHC_03         EVHC_04         EVHC_05	Get all der Model the Perform a Perform ca TAG EVHC_01 HC_FG/	mo site asset cha e power grid to p n OPF for a base n OPF for a TIGC alculation of EVI Methodology Nominal values / specifications	Calculation Step des aracteristics perform OPF sime eline scenario to o ON scenario to o HC Data sour Source/ Tools/ Instruments Datasheets / Registers OPF Simulator	Methodolog scription nulations obtain the cap totain the cap ces / types Location of data collection DSO DB DB DB	y apacity of the capacity of t	he grid e grid incy of llection es - al data	Min. Monitor perior 	ing d	Responsible TBD TBD TBD TBD TBD TBD TBD TBD TBD TBD
Nº         EVHC_01         EVHC_02         EVHC_03         EVHC_04         EVHC_05	Get all der Model the Perform a Perform ca TAG EVHC_01 HC_FG/ HC_BL	mo site asset cha e power grid to p n OPF for a base n OPF for a TIGC alculation of EVI Methodology Nominal values / specifications	Calculation Step des aracteristics perform OPF sim eline scenario to o N scenario to o HC Data sour Source/ Tools/ Instruments Datasheets / Registers OPF Simulator celine definition	Methodolog scription nulations obtain the cap totain the cap ces / types Location of data collection DSO DB DB DB	y apacity of the bacity of the on data co on odology	he grid e grid incy of llection es - al data	Min. Monitor perior	ing d	Responsible TBD TBD TBD TBD TBD TBD TBD TBD TBD TBD

Env	vironment	Simulation	Laboratory	Data Field
Responsible				
Details				
		Other KPIs related		
		General comments		

			FIGON KPI	DATASHI	ET			
			Basic Inf	formation				
Name:	_	Number of V	oltage Limits Vi	olations	КРІ	ID:		VLV
Description:	Numbe	r of times than v	-		der or over) the to n a period of time.	lerance lin	nit (us	sually 5%) for
Units				[intogor]/[	timel			
Units			Loc	[integer]/[ ation	linej			
Demo site (Use Case)				TBD in WP5 a	and WP6			
			Calcu	lation				
Formula or Calculation procedure	Where:	al number of voli		$V = \sum e_v$				
		ent of voltage lir	-	lions in a per	iou [-]			
Scenarios to be			Baselir	ne 	Business as usua	I	7	
			Calculation	Methodology	1			
N⁰			Step des				F	Responsible
VLV_01	Obtain all	voltage limits vi	olations from th	ie baseline sc	enario			TBD
VLV_02	Calculate	VLV to the basel	ine scenario					TBD
VLV_03	Obtain all	voltage limits vi	olations from th	e FLEXIFRID (	R&D) scenario			TBD
 VLV_04	-	VLV for the TIGC						TBD
_					adday			
VLV_05	Compare	to baseline scen						TBD
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of data collection		Min. Monitor period	-	Responsibl
Voltage limit violation event	VLVe	Power meters units lecture	IEDs / Others	DSO SoE register	daily	one ye	ar	TBD
		Bas	eline definition	/ BaU metho	odology			
	Source		Literatu		Historical data	Λ U() BL(		ured at start
Responsible			( )				. /	240
Responsible								

Env	vironment	Simulation	Laboratory	Data Field
Responsible				
Details				
		Other KPIs related		
		General comments		

			FIGON KPI	DATASHEE	Т			
			Basic Inf	ormation				
Name:		Reductio	on in Energy Los	ses	KPI	ID:		REL
Description:		Amount o	f electrical ener	gy lost on grid's	conductors, tra	nsformers	, etc.	
Units	+			[%]				
onits			Loc	ation				
Demo site (Use Case)				TBD in WP5 and	I WP6			
	1		Calcu	lation				
Formula or Calculation procedure		al reduction in er otal energy losse	nergy losses [%]	X	$\frac{L_{BL} - \sum EL_{FG}}{\sum EL_{BL}} \bigg)$			
	_	otal energy losses						
Scenarios to be	measured	/ calculated	Baselir	ne E	Business as usua	I	ד 	IGON
			Calculation	Methodology				
N⁰			Step des				R	esponsible
REL_01	Demo site databases	e network data # s, etc.)	ND (lines charad	cteristics, datash	eets, nameplate	es,		TBD
REL_02	Modeling	demo site netwo	ork with data su	pplied in REL_0	1			TBD
		alculation of LPF to obtain REL	to estimate en	ergy losses in a l	baseline and aTI	GON		TBD
REL_03	scenarios			-				
KEL_U3	Iscentarios		Data sour	ces / types	-			
Data	TAG	Methodology	Data sour Source/ Tools/ Instruments	Location of data collection	Frequency of data collection	Min. Monitor perio	ing	Responsib
_		Methodology characteristics of devices for modeling	Source/ Tools/	Location of		Monitor	ing	Responsibl TBD
<b>Data</b> Network data for	TAG	characteristics of devices for modeling	Source/ Tools/ Instruments datashhets, DB, nameplates	Location of data collection	data collection	Monitor perio	ing	
<b>Data</b> Network data for	TAG	characteristics of devices for modeling	Source/ Tools/ Instruments datashhets, DB, nameplates eline definition <i>Literatu</i>	Location of data collection DSO registers / BaU methodo	data collection once blogy Historical data	Monitor perior	ing d Measu	TBD
<b>Data</b> Network data for	TAG #ND	characteristics of devices for modeling	Source/ Tools/ Instruments datashhets, DB, nameplates eline definition	Location of data collection DSO registers / BaU methodo	data collection once blogy Historical data	Monitor perior -	ing d Measu	

Env	vironment	Simulation	Laboratory	Data Field
Responsible				
Details				
		Other KPIs related		
		General comments		

					155	<b>-</b>			V 0.1	
			TIGON KPI	DATASE formation	iEE	1				
Name:		Number of freq				КРІ	ID:		FOR	
Description:	Calculat	Calculates times that the average value of the fundamental frequency measured over periods of 10 s goes out of the stated ranges (FCE).								
Units		[integer]								
		Location								
Demo site (Use Case)		TBD in WP5 and WP6								
			Calcu	lation						
Formula or Calculation procedure	$FOR = \sum e_{for}$ Where: FOR: Total number of frequency out of range events in a period [-]									
		ent of voltage li								
Scenarios to be	measured	/ calculated	Baselir	ie	E	Business as usua	"		TIGON	
	measurea	y calculated								
			Calastatian							
Calculation Methodology										
<u>№</u>	Obtoin all	Step descriptionResponsibleObtain all frequency out of range event from the baseline scenarioTBD								
FOR_01			-	om the bas	seiine	escenario			TBD	
FOR_02		FOR to the base							TBD	
FOR_03	Obtain all	frequency out o	of range event fr	om the FLE	XIFR	ID (R&D) scenar	io		TBD	
FOR_04	Calculate	FOR for the TIG	ON scenario						TBD	
 FOR_05	Compare	to baseline scen	ario						TBD	
				ces / types				_		
	1	1					Min		1	
Data	TAG	Methodology	Source/ Tools/ Instruments	Location data collec		Frequency of data collection	Monito	ring	Responsible	
Frequency out range event	e_for	Power meters units lecture	IEDs / Others	DSO Sol registe		daily	one y	ear	TBD	
		Bas	eline definition	/ BaU met	hodo	ology				
			Literatu	ıre		Historical data		Measi	ured at start	
	Source		BL()	BaU()	BL (	) Bal	U() BL	()	BaU()	
Responsible										
Details				lation						
			valio	dation						
			Simulat	ion		Laboratory		Da	ata Field	
En	vironment		·			- -				
Responsible										
Details										
			Other KF	Pls related						
			General	comments						

			TIGON KPI	DATASI	HEE	T				
			Basic Inf	formation						
Name:	_	Rate of C	Change of Freque	ency		KPI	ID:		ROCOF	
Description:		Correspon	ds with the freq	uency grad	ient a	fter an active po	ower imb	alance	2.	
Units				[Hz	2/s]					
			Loc	ation						
Demo site (Use Case)		TBD in WP5 and WP6								
			Calcu	lation						
Formula or Calculation procedure		Gradient of freq				Frequency [Hz]	urbation sta	ROCO Time [s	······	
	f(t): Frequ	ency function i	n a event of iner	rtial/load/g	enera	ation variation [I	Hz]			
Scoparios to b	moscurod	Baseline E		B	Business as usual			TIGON		
	e measureu	Scenarios to be measured / calculated								
			Calculation	Methodolo	gy					
N⁰			Calculation Step des		рgy				Responsible	
<b>№</b> ROCOF_01	Modeling	of power grid, i		scription		generation and	load	-	<b>Responsible</b> TBD	
			Step des	componen	its of	-				
ROCOF_01	Define sce	narios to evalua	Step des ncluding inertial	componen ertia, load a	nts of and g	enerations schei			TBD	
ROCOF_01 ROCOF_02	Define sce Perform c	narios to evalua alculation of RO	Step des ncluding inertial ate (different ine	componen componen ertia, load a eline scena	nts of and go rios /	enerations schei nodes			TBD TBD	
ROCOF_01 ROCOF_02 ROCOF_03	Define sce Perform c	narios to evalua alculation of RO	Step des ncluding inertial ate (different ine COF for the base COF for the TIG	componen componen ertia, load a eline scena	nts of and go rios / os / n	enerations schei nodes			TBD TBD TBD	
ROCOF_01 ROCOF_02 ROCOF_03	Define sce Perform c	narios to evalua alculation of RO	Step des ncluding inertial ate (different ine COF for the base COF for the TIG	componen componen ertia, load a eline scena ON scenario	nts of and go rios / os / n of	enerations schei nodes		ring	TBD TBD TBD TBD	
ROCOF_01 ROCOF_02 ROCOF_03 ROCOF_04 Data	Define sce Perform ca Perform ca	narios to evalua alculation of RO alculation of RO Methodology	Step des ncluding inertial ate (different ine DCOF for the base DCOF for the TIG Data sour Source/ Tools/	componen ertia, load a eline scena ON scenario ces / types	nts of and ge rios / os / n of ction /	enerations scher nodes odes Frequency of	mes) Min Monito	ring	TBD TBD TBD TBD	
ROCOF_01 ROCOF_02 ROCOF_03 ROCOF_04	Define sce Perform ca Perform ca TAG	marios to evalua alculation of RO alculation of RO Methodology Modeling power grid Simulation	Step des ncluding inertial ate (different ine COF for the base COF for the TIGO Data sour Source/ Tools/ Instruments DSO DB / Registers Simulated COMTRADE, Oscillography register	component component ertia, load a eline scena ON scenarie cces / types Location data collec DSO DB Registe DSC	nts of and ge rios / os / n os of ction / rs	enerations scher nodes odes Frequency of data collection once once	mes) Min Monito	ring	TBD TBD TBD TBD Responsibl	
ROCOF_01 ROCOF_02 ROCOF_03 ROCOF_04 Data Network data Frequency	Define sce Perform ca Perform ca TAG ROCOF_01 ROCOF_0	marios to evalua alculation of RO alculation of RO Methodology Modeling power grid Simulation	Step des ncluding inertial ate (different ine COF for the base COF for the TIGE Data sour Source/ Tools/ Instruments DSO DB / Registers Simulated COMTRADE, Oscillography	component component ertia, load a eline scena ON scenarie cces / types Location data collec DSO DB Registe DSC	nts of and ge rios / os / n os of ction / rs	enerations scher nodes odes Frequency of data collection once once	mes) Min Monito	ring	TBD TBD TBD TBD Responsibl TBD	
ROCOF_01 ROCOF_02 ROCOF_03 ROCOF_04 Data Network data Frequency	Define sce Perform co Perform co TAG ROCOF_01 ROCOF_0 3 / 04	marios to evalua alculation of RO alculation of RO Methodology Modeling power grid Simulation	Step des ncluding inertial ate (different ine COF for the base COF for the TIGO Data sour Source/ Tools/ Instruments DSO DB / Registers Simulated COMTRADE, Oscillography register	component component ertia, load a eline scena ON scenario ces / types Location data collec DSO DB Registe DSC / BaU met	nts of and ge rios / os / n of ction / rs	enerations scher nodes odes Frequency of data collection once once	mes) Min Monito perio	ring od	TBD TBD TBD TBD Responsibl TBD	
ROCOF_01 ROCOF_02 ROCOF_03 ROCOF_04 Data Network data Frequency	Define sce Perform ca Perform ca TAG ROCOF_01 ROCOF_0	marios to evalua alculation of RO alculation of RO Methodology Modeling power grid Simulation	Step des ncluding inertial ate (different ine COF for the base COF for the TIGO Data sour Source/ Tools/ Instruments DSO DB / Registers Simulated COMTRADE, Oscillography register seline definition	component component ertia, load a eline scena ON scenario ces / types Location data collec DSO DB Registe DSC / BaU met	nts of and ge rios / os / n of ction / rs	enerations scher nodes odes Frequency of data collection once once	mes) Min Monito perio	ring od	TBD TBD TBD TBD Responsibl TBD TBD	

Details											
	Validation										
Environment		Simulation	Laboratory	Data Field							
Responsible											
Details											
		Other KPIs related									
		General comments									

			TIGON KPI	DATAS	HEE'					
			Basic In	formation						
Name:		Flexib	ility actions take	n		KPI	ID:		FAT	
Description:	Number o	Number of flexibility actions taken to reduce demand, load control, network configuration, etc. in a period								
Units		[integer]								
			Loc	ation						
Demo site (Use Case)		TBD in WP5 and WP6								
			Calcu	ulation						
Formula or Calculation procedure		nber of flexibility n event in the gri	actions taken [-	-		ation or demand	l beha	vior [-]		
Scenarios to be measured / calculated			Baseline			Business as usual				
			Calculation	Methodolo	gy					
N⁰				scription					Responsible	
FAT_01	Determine	e characteristics	of a flexibility ac	tion					TBD	
FAT_02		flexibility actions	-						TBD	
FAT_03	Perform d	ata calculation o							TBD	
Data	TAG	Methodology	Source/ Tools/ Instruments	Location of collection	data	Frequency of data collection	Mon	Min. hitoring eriod	Responsible	
flexibility actions taken	FAT_02	determine number of flexibility actions	IEDs / Simulations	/ DSO power / registers / hourly one month				TBD		
		Bas	seline definition	i / BaU met	hodo	logy				
			Literatı	ure		Historical data		Measu	ured at start	
	Source		BL() BaU()		BL() BaU() B		BL() BaU(			
Responsible										
Details				dation						
			Simulat			Laboratory		Do	ata Field	
Env	vironment			1		· · ·				

Responsible								
Details								
Other KPIs related								
		General comments						

			TIGON KPI	ΠΔΤΔΟ	HEE	т			V	
				ormation						
Name:	Minim	um frequency r	eached after a c		v ever	nt KPI	ID:		NADIR	
Description:		Minim	num frequency r	eached aft	er a c	ontingency ever	nt (by nod	e)		
Units		[Hz]								
			Loca	ation						
Demo site (Use Case)		TBD in WP5 and WP6								
			Calcu	lation						
Formula or Calculation procedure	<i>Where:</i> NADIR: [ f(t)_n: Fr	Hz]	R = min(f(t))		d/ger	Perturl [Z] Hz Hzedneuck Hz Hzedneuck	n in node	1. 	NADIR	
Scenarios to be	measured	Baseline Business as usual			I	TIGON				
			Calculation		gy			1		
<b>№</b>	D 4 a d a lina a	- <b>f</b>	Step des	•		t	laad		Responsible	
NADIR_01			-			generation and			TBD	
NADIR_02					-	enerations sche	mes)		TBD	
NADIR_03	-		DIR for the base		-				TBD	
NADIR_04	Perform c	alculation of NA	DIR for the TIGO			odes			TBD	
	1		Source/	ces / types			Min.			
Data	TAG	Methodology	Tools/ Instruments	Location data collec		Frequency of data collection	Min. Monitoring period		Responsible	
Network data	NADIR_01	Modeling power grid	DSO DB / Registers	DSO DB Registe	-	once	-		TBD	
Frequency function	NADIR_03 / 04	Simulation	Simulated COMTRADE, Oscillographyc register	DSC		once	- TBD		TBD	
		Bas	seline definition	/ BaU met	hodo	ology				
	Source		Literatu BL()	n <b>re</b> BaU()	BL (	Historical data	л J() BL		ured at start	
Responsible					(		, 55	. /	240(	

Details										
Validation										
Environment		Simulation	Laboratory	Data Field						
Responsible										
Details										
		Other KPIs related								
		General comments								

									V 0.1		
			FIGON KPI	DATASH	<b>HEE</b>	T					
	-			formation				-			
Name:		Reactive	Energy Consum	otion		KPI	ID:		RE		
Description:			Total reactive o	energy cons	sume	d in a period of	time				
Units		[MVARh]									
		Location									
Demo site (Use Case)		TBD in WP5 and WP6									
			Calcu	ulation							
Formula or Calculation procedure	$RE = \sum Eq_n$ Where: RE: Total Reactive Energy [MVARh] Eqn: Reactive energy consumed in period n [MVARh]										
	,	57	Baselir			usiness as usua	,	-	TIGON		
Scenarios to be	measured	/ calculated	Busenn	le	D		<b>'</b>				
		,									
			Calculation	Mathadala	m						
	1			scription	<u>59</u>			F	Responsible		
DE 01	Ohtoin na				. I d						
RE_01	Obtain re	active energy co	nsumption in al	i nodes invo	olved				TBD		
RE_02	Perform of period	calculation of tot			_	the minimum m	onitoring		TBD		
	T			ces / types					-		
Data	TAG	Methodology	Source/ Tools/ Instruments	Location data collec		Frequency of data collection	Min. Monitor perio	ring	Responsible		
Reactive energy	Eq	Power meters units lecture	IEDs / Others	DSO pow register		monthly	one ye	one year TBD			
		Bas	eline definition	/ BaU met	hodo	logy			-		
	Source		Literature			Historical data		Measured at st			
			BL()	BaU()	BL (	) Bal	J() BL	()	BaU()		
Responsible											
Details			Vali	dation							
_	•		Simulat	ion		Laboratory		Da	ıta Field		
En	vironment										
				·					·		
Responsible											
Details			Other 10	Pis related							
			Other Ki	is related							
			General	comments							