



**Real proven solutions** to enable active demand and distributed generation flexible integration, through a fully controllable **LOW Voltage** and medium voltage distribution grid

*DISCERN 3<sup>rd</sup> Workshop, The role of KPIs in evaluating Smart Grid Projects  
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# Index



1

Partners and key figures

5

UPGRID KPI methodology

2

Expected technical impact

6

UPGRID KPI definition

3

The UPGRID project

7

UPGRID KPI experience

4

EEGI contribution

8

Next steps

# 1. Partners and Key figures



Call/Topic : LCE 7–2014: Distribution grid and retail market

Duration: 01/01/2015 – 31/12/2017 (36 months)

Total PM: 1.639

Budget: 15,7 M€ (11,9 M€ EU grant)

Project coordinator: Iberdrola Distribución Eléctrica, SAU

Partners: 19 from 7 EU countries (ES, PT, PL, SE, UK, FR, NO)



## 2. Expected Technical Impact



### Observability and control of LV grid

- Achieve sound LV network representation
- Functional specification of LV dispatch
- Deployment of tools to support LV operation of field crews
- Improvement in Operations and Maintenance of LV grid
- Improvement of QoS to customers

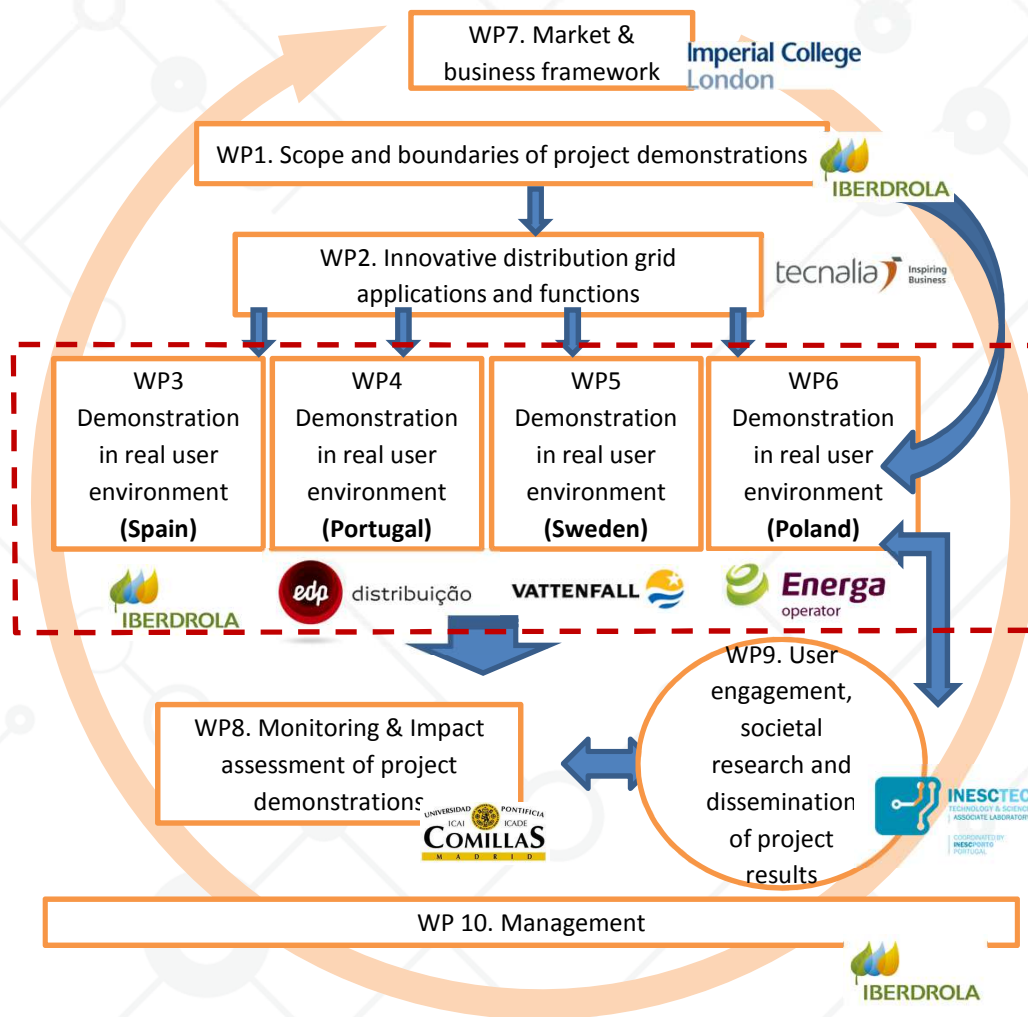
### Extensive use of AMI infrastructure

- Integration and processing of meter events in the OMS
- Deployment of multiservice PRIME subnetwork
- Development of LV grid remote control operation over Smart Metering PRIME infrastructure

### Enhance the role of DSOs to facilitate an open market for services

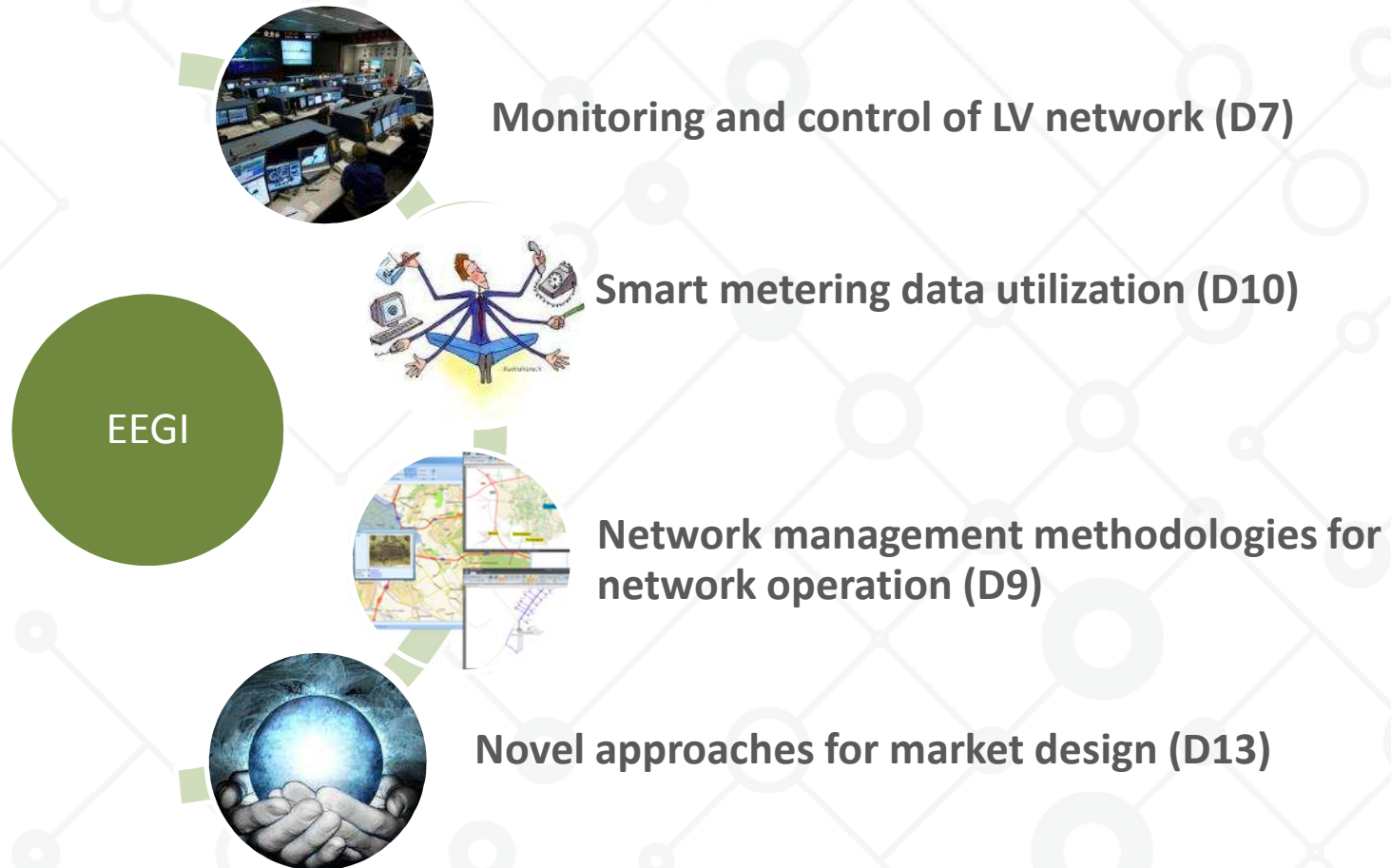
### Participation of customers, distributed generation and energy storage in network management

# 3. The UPGRID project



- Spain:** Bilbao area (North of Spain)
  - 1.075 Secondary Substations (SSs)
  - More than 3.500 LV lines supervised
  - More than 190.000 customers
  - Urban area
- Portugal:** Parque das Nações (Lisbon)
  - 2 Substations / 144 SSs
  - 13,450 Residential customers (LV)
  - 16 EV Charging Stations
  - LV network mostly underground
  - Urban area
- Sweden:** Åmål (Dalsland)
  - 2 MV lines
  - 51 Secondary Substations
  - 528 customers
  - LV lines mostly overhead
  - Rural area
- Poland:** Gdynia (Pomeranian Reg.)
  - 55 Secondary Substations
  - About 14.700 customers
  - 38 km MV lines / 107 km LV lines
  - Overhead and underground LV network

# 4. EEGI Contribution



A total of 38 different sub-functionalities aligned with EEGI have been defined in UPGRID to be tested in the project



# 5. UPGRID KPI methodology (I)



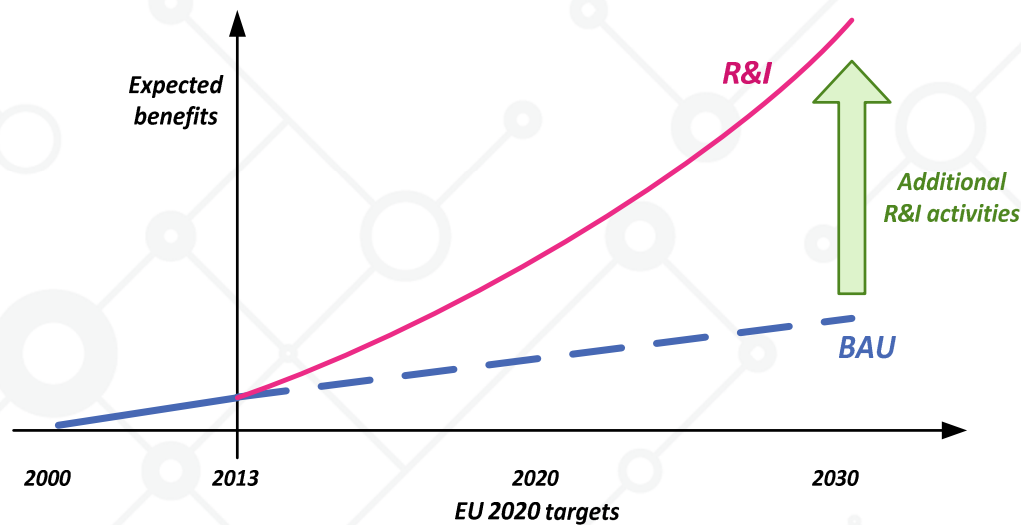
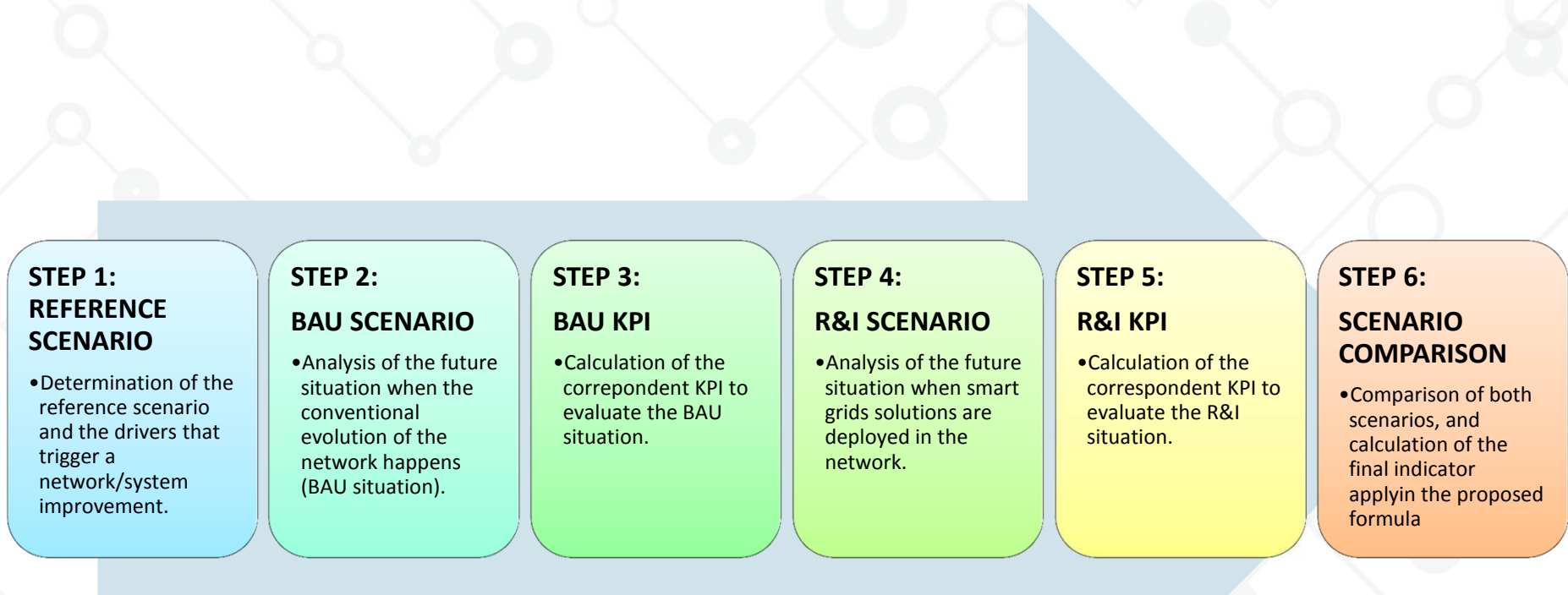
C1	Integration of smart customers	D1	Active Demand for increased network flexibility
		D2	Enabling maximum energy efficiency in new or refurbished urban using smart distribution grids
C2	Integration of DER and new uses	D3	Integration of DER at low voltage
		D4	Integration of DER at medium voltage / high voltage
		D5	Integration of storage in network management
		D6	Integration of infrastructure to host Electrical Vehicles
C3	Network operations	D7	Monitoring and control of LV networks
		D8	Automation and control of MV networks
		D9	Network management methodologies for network operation
		D10	Smart metering data utilization
C4	Network planning and asset management	D11	Novel planning approaches for distribution networks
		D12	Novel approaches to asset management
C5	Market design	D13	New approaches for market design



4 Demos

EEGI Cluster				
EEGi Function Objective (Di)	X		X	X
UPGRID sub-functionality	X		X	
UPGRID sub-functionality		X		
UPGRID sub-functionality				X

# 5. UPGRID KPI methodology (II)





# 5. UPGRID KPI methodology (III)



- **GRID+** (*Supporting the Development of the European Electricity Grids Initiative (EEGI), 2011-2014*)

- Deliverable D3.4: **Define EEGI Project and Programme KPIs** (15/04/2013)



- **GRID4EU** (*Large-Scale Demonstration of Advanced Smart GRID Solutions with wide Replication and Scalability Potential for EUROPE, 2011-2016*)

- Deliverable D2.2: **Project KPIs definition and measurement methods** (05/10/2012)



- **iGREENGRID** (*Integrating Renewables in the EuropeAN Electricity Grid, 2013-2015*)

- Deliverable D4.1: **Report listing selected KPIs and precise recommendations to EEGI Team for improvement of list of EEGI KPIs** (08/08/2014)



- **DISCERN** (*Distributed intelligence for Cost-Effective and Reliable Distribution Network Operation, 2013-2016*)

- Deliverable D1.2: **Intermediate demonstration projects KPI fulfilment report. Definition and calculation methodology of DISCERN KPIs** (29/01/2015)



- **ADVANCED** (*Active Demand Value And Consumers Experience Discovery, 2012-2014*)

- Deliverable D1.2: **Report on the validated KPIs** (30/01/2014)

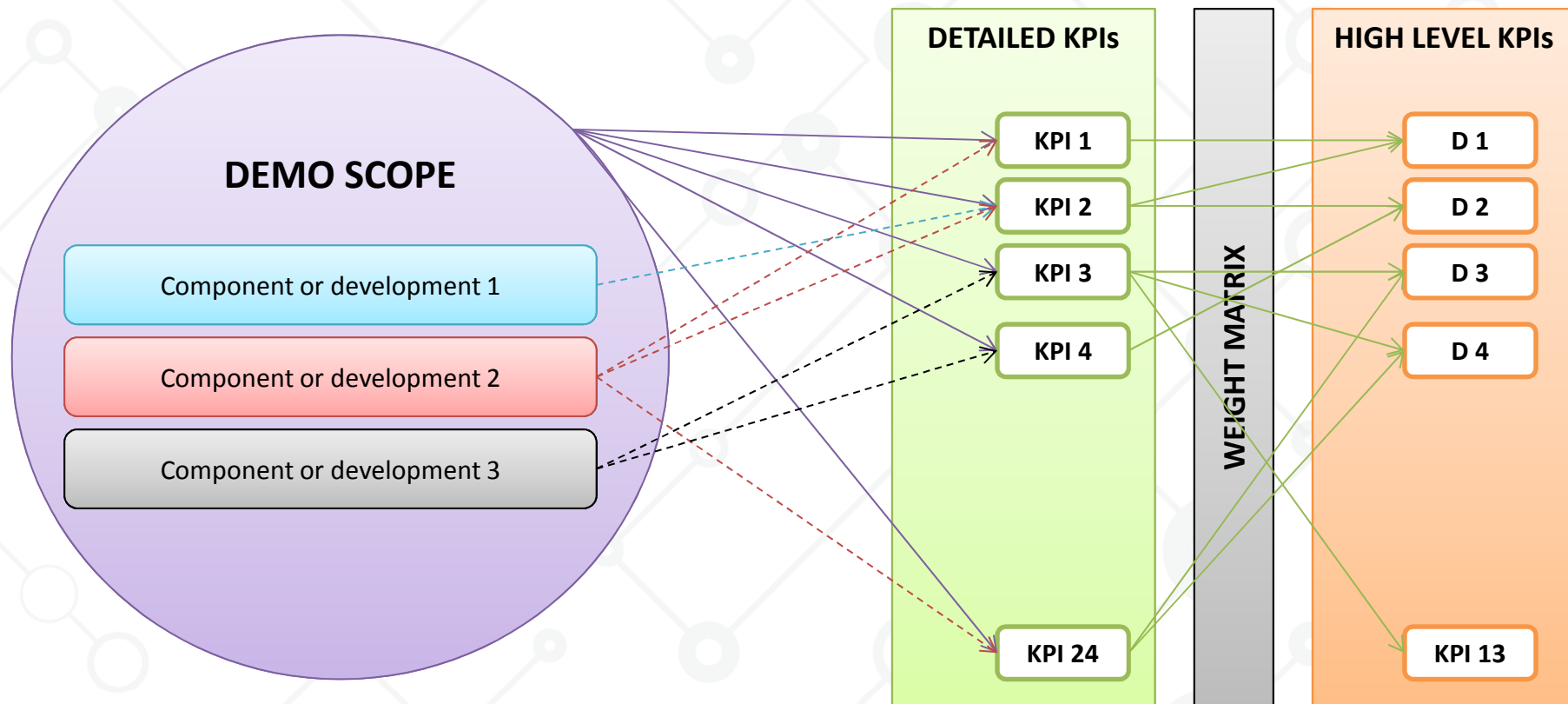


- **IDEAL** (*Ideal grid for all, 2013-2016*)

- Deliverable D7.1: **KPI Definition** (02/12/2014)



# 5. UPGRID KPI methodology (IV)



- **Detailed KPIs** will be applied to the whole Demo.
- The results of **one or more Demo developments** may impact on **one or more detailed KPI**.
- So, **detailed KPIs will be only calculated once per Demo**.
- Each **high level KPI** may be built by at least one **detailed KPI**.

# 5. UPGRID KPI methodology (V)

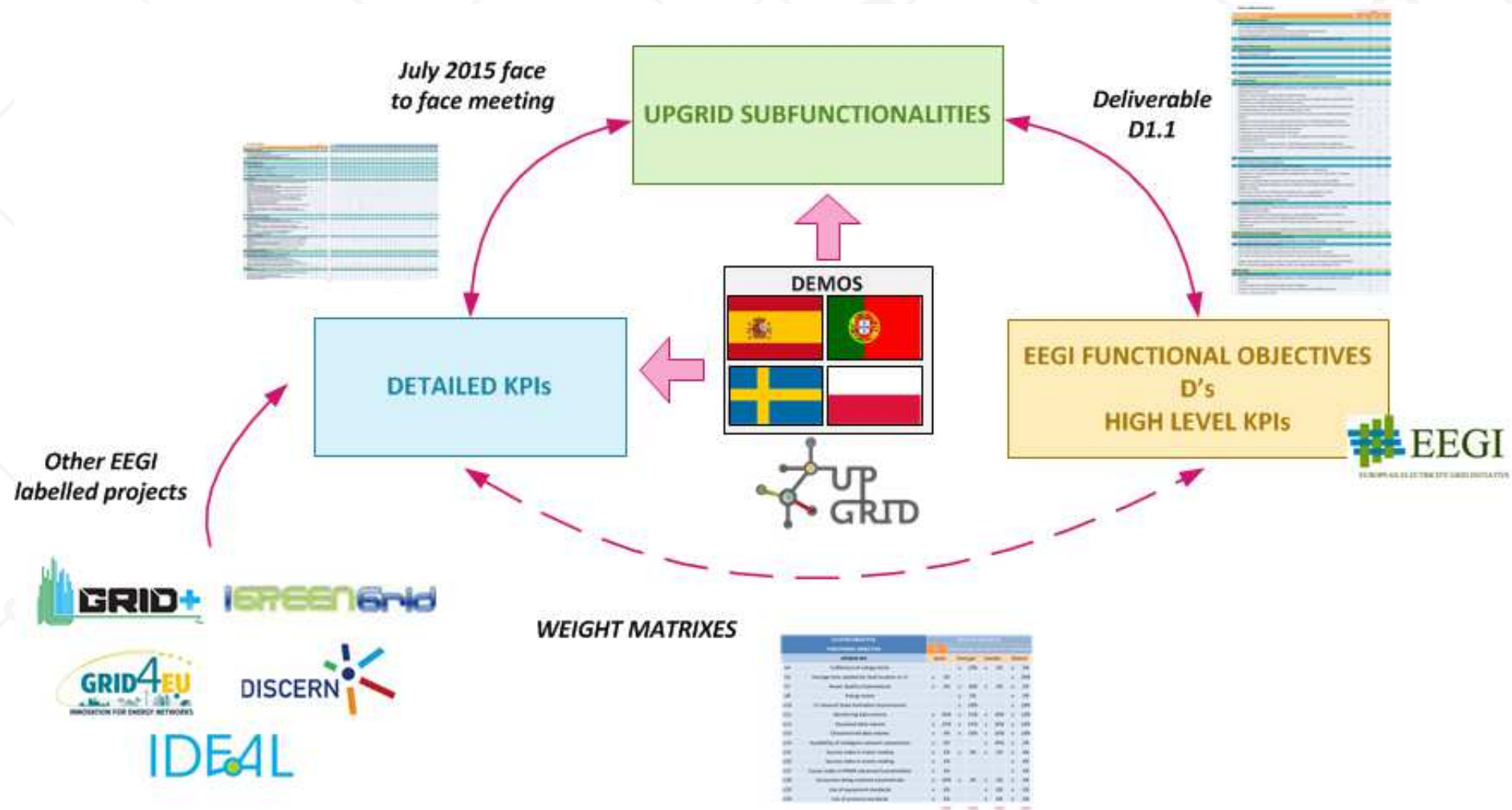


- **Example:** Component to be deployed in one of the UPGRID demos: *A storage system to be installed in secondary substations with a BMS (battery management system) able to receive orders from the DSO to inject or consume energy from the grid.*
- This component will impact positively in some **UPGRID detailed KPIs**:
  - $P_{DSM}$ : Demand flexibility
  - $P_{DER}$ : Generation flexibility
  - VL: Fulfilment of voltage limits
  - $\Delta E$ : Energy losses
  - AV: Availability of intelligent network components
- $P_{DSM}$ : **Demand flexibility**, will be combined with some of the other KPIs on the list to calculate, with a weighted sum, the following **high level KPIs**:
  - D1: Active demand for increased network flexibility.
  - D5: Integration of storage in network management.
  - D13: Novel approaches for market design.

	<b>Detailed KPI</b>	<b>Detailed KPI value</b>	<b>Weight</b>	<b>Contribution to high level KPI</b>
$P_{DSM}$	Demand flexibility	80 %	35 %	$0,80 \times 0,35 = 0,28$
$P_{DER}$	Generation flexibility	75 %	35 %	$0,75 \times 0,35 = 0,26$
VL	Fulfilment of voltage limits	15 %	15 %	$0,15 \times 0,15 = 0,02$
$\Delta E$	Energy losses	20 %	15 %	$0,20 \times 0,15 = 0,03$

<b>D5</b>	<b>Integration of storage in network management</b>	<b>59,50 %</b>
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# 5. UPGRID KPI methodology (VI)



# 6. UPGRID KPI definition (I)



#	UPGRID KPI		EEGI LABELLED PROJECTS	DEFINED FOR UPGRID PROJECT
1	P <sub>DSM</sub>	Demand flexibility	x	
2	P <sub>DER</sub>	Generation flexibility	x	
3	HC <sub>EV</sub>	Hosting Capacity of Electric Vehicles	x	
4	VL	Fulfilment of voltage limits	x	
5	ΔT <sub>LV</sub>	Average time for LV faults	x	
6	ΔT <sub>MV</sub>	Average time needed for fault location in MV	x	
7	QS <sub>LV</sub>	Quality of Supply Improvement in LV	x	
8	QS <sub>MV</sub>	Quality of Supply Improvement in MV	x	
9	ΔE	Energy losses	x	
10	MDV	Monitoring information categories	x	
11	ADV	Available information categories		x
12	CDV	Characterized information categories		x
13	AV	Availability of intelligent network components	x	
14	SIMR	Success index in meter reading	x	
15	SIER	Success index in event reading		x
16	SIAF	Success index in advanced functionalities		x
17	SIMC	Success index in meters connectivity		x
18	Quota	Consumers being metered automatically	x	
19	ILT	Improved Life-time of transformers		x
20	R	Participant recruitment	x	
21	A	Active participation	x	
22	VF	Load curve valley filling		x
23	UES	Use of equipment standards	x	
24	UPS	Use of protocol standards	x	
25	GHG	Reduction in greenhouse gas emissions	x	

A total of **25 detail KPIs**, from which...

...**18 KPIs** have been taken as reference **from other EU projects**

...**7 KPIs** has been proposed **specifically for UPGRID**

We have taken **advantage from other EU projects** and previous experiences.



# 6. UPGRID KPI definition (II)



In terms of Function Objectives...

	High Level KPIs (EEGI Functional Objectives)	Number of associated Detailed KPIs
D1	Active Demand for increased network flexibility	7
D2	Enabling maximum energy efficiency in new or refurbished urban using smart distribution grids	0
D3	Integration of DER at low voltage	4
D4	Integration of DER at medium voltage / high voltage	0
D5	Integration of storage in network management	0
D6	Integration of infrastructure to host Electrical Vehicles	4
D7	Monitoring and control of LV networks	13
D8	Automation and control of MV networks	4
D9	Network management methodologies for network operation	7
D10	Smart metering data utilization	8
D11	Novel planning approaches for distribution networks	1
D12	Novel approaches to asset management	8
D13	New approaches for market design	9

It can be seen that the function objective that has more KPIs associated is D7 which is one of the most important topic of the project.



# 7. UPGRID KPI experience (I)



- Have the opportunity to **work in parallel with demonstrators** from their starting stages **facilitate the definition of KPIs**. Then, it is more feasible to **reach a balance**. That is, adapt KPIs to demos and demos to KPIs.
- The first aim given to KPIs in UPGRID is the **impact evaluation** of those solutions tested **within each demonstrator**, before **(BaU)** and after **(R&I)** of the implementations, **instead of comparing demonstrators** that are different to each other and most probably differ from their initial starting point. For this reason, **demonstrators should frame their approach to calculate KPI** based on its **own conditions** and **expected data availability**. This **reduces the reluctance** to define and work with KPIs.

## 7. UPGRID KPI experience (II)



- UPGRID aspires to make KPI seems as **alive task** along the project (to **facilitate the integration of further demonstrator contributions** up to the moment they are calculated) but also take **commitment from demonstrators to keep** the compromise of calculating **the already selected and defined KPIs**.
- Have a **clear methodology** to work with KPIs **from the beginning** of a project and being **assimilated by all** the involved partners is important **to be successful** in all the other steps.
- It is true that demonstrators have some **worries on defining KPI** in advanced **before having a completed and detailed definition of their implementations**. This barrier is reduced taken into account the previous four points.

## 7. UPGRID KPI experience (III)



- Thanks to **knowing in advance the KPI definitions and the set of data required** for the calculations, **demonstrators have already their constant attention** to them while the demos are developed. Then, they can collect the information as soon as it is identified.
- The **contextual information** behind each demonstrator KPI **is critical** to ensure a **correct interpretation of results** and to allow taking **advantage from other demos implementations**. This **need to be stated clearly** from the moment the **methodology** is established.
- To ensure a **correct management and coordination** of issues derived from working with KPIs in projects that involve different demonstrators, it is important to designate a **central partner in charge of this task** with a profile aligned with the KPIs field. It should exist a **tight interaction between this partner and demonstrators**.

## 7. UPGRID KPI experience (IV)



- The **KPIs should not be imposed** to demonstrators but they should be the **result of a collaborative effort** of all the involved parties. This **reduces the reluctance** to define and work with KPIs as well.
- It is considered that a **KPI is useful** only if it **evaluates the impact** that a demonstrator is **aimed at** with their solutions and the indicator is **computable with a reasonable effort**.
- It is clear that the **experience accumulated from previous projects** by all the partners **has facilitated the KPI work so far in the UPGRID**. We have taken advantage of it (e.g. EEGI methodology and KPI identified in other projects). It is important that **each new project does its bit**.
- **KPIs based on cost** are complicated to calculate (mainly due to availability of data) and they have been avoided in the project.

## 8. Next steps



- Demonstrators will **continue developing their sub-functionalities and collecting data for KPIs**. The tight interaction between the KPI task responsible and the demos will continue.
- Deliverable **D1.4 (public) is available**.
- **Other KPIs will be added** as the project moves forward (e.g. business models and customer relation)
- UPGRID will **continue collecting experiences** regarding KPI.



***Thanks for your attention***



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