JASPERS Networking Platform

Supporting investments in Smart Grids in 2014-2020

Smart Grids Project Assessment Tool

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SCOPE OF THE WORK

- Provide a framework for the JASPERS project team to **support national authorities** of beneficiary countries (i.e. new EU Member States) **identifying most relevant Smart Grids investments** for the EU funding period 2014-2020:
  - Methodology for **framing the scope and impact** of Smart Grids investments
  - Definition of **eligibility criteria** for Smart Grid investments
  - **Guidelines** for the application and implementation procedures
  - Analysis of **case studies** (Poland and Romania)

AGENDA

- **Characterization of Smart Grid investment**
- **Eligibility criteria and proposed assessment methodology**
- **Smart Grid assessment tool**

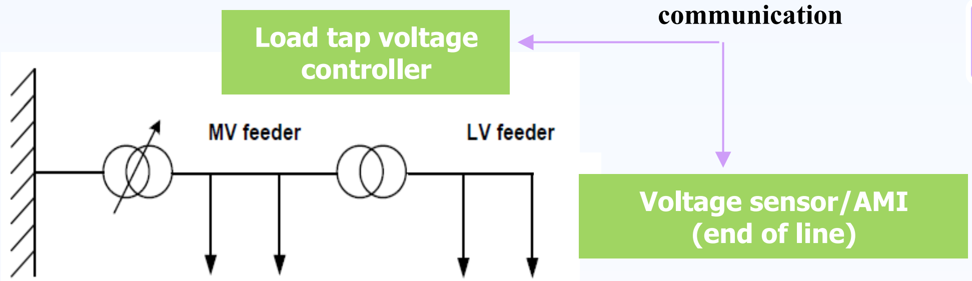
What do we mean by SMART GRID?

According to the EC Infrastructure Regulation No 347/2013:

- **Any equipment** or installation, both at transmission and distribution level
- Aiming at **two-way digital communication**, real-time or close to real-time, interactive and **intelligent monitoring and management** of electricity generation, transmission, distribution and consumption
- **Integrating the behaviour and actions of all users connected to it** — generators, consumers and those that do both
- In order to ensure an **economically efficient**, **sustainable** electricity system with **low losses** and **high quality** and **security of supply and safety**;

SMART GRID INVESTMENT- EXAMPLE (I)

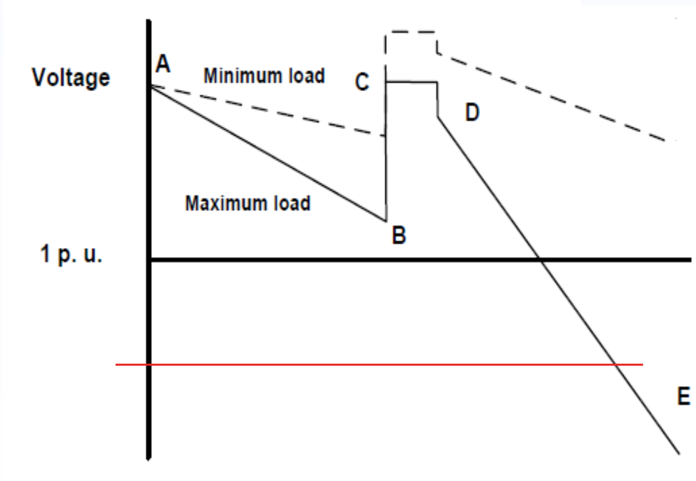
GRID “SMART” VOLTAGE CONTROL – Conservation voltage reduction



Assets
- Load tap voltage controller
- Voltage sensor/AMI

Functionalities
- Conservation voltage reduction

Impact
- Reduced losses
- Reduced energy consumption



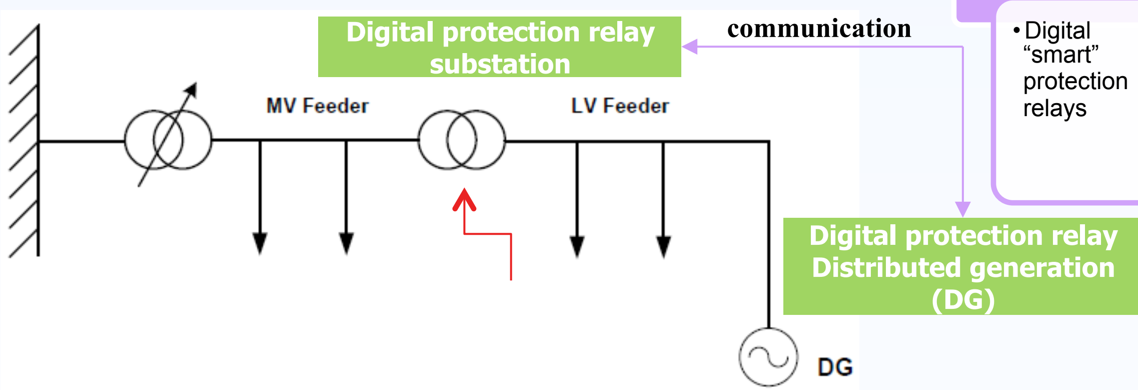
TODAY: Load tap voltage controller: typically **no automatic adjustment** based on **end-of –line voltage measurement**.

SMART SCENARIO

Voltage controller in the substation receives **real-time voltage measurement** from the feeder’s end and **automatically adjust** the transformer’s tap in order to reduce voltage while keeping it above minimum admissible value

SMART GRID INVESTMENT-EXAMPLE (II)

GRID "SMART" PROTECTION FOR DISTRIBUTED GENERATION



Assets
- Digital "smart" protection relays

Functionalities
- Adaptive DG protection scheme

Impact
- Reduced outage times
- Higher DG generation
- Extended asset lifetime

TODAY: DG relays typically rely only on local information

-If there is a fault at the transformer, the LV feeder is disconnected, but the load could still be powered by the DG (islanding).

-DG relays have a very sensitive frequency band: if there is an under-frequency situation, the DG relay would disconnect possibly increasing the gravity of the frequency problem.

SMART SCENARIO

DG relays communicate with RTU in the substation ("smart relays"), receiving information on grid conditions.

-Adaptive settings of frequency band depending on grid conditions

-Disconnection of DG if substation relay is open (anti-islanding)

CHARACTERIZATION OF SMART GRIDS INVESTMENTS

From assets to impacts

Smart assets
- 1-Voltage regulators
- 2-Adaptive protection relays
- ..
- 26-Smart Meters

Smart functionalities
- 1-Dynamic line rating
- 2-Volt/VAR control
- …
- 18-Customer electricity use optimization

KPIs
- 1-Reduction of greenhouse gas emissions
- 2-Extended hosting capacity for distributed generation
- …
- 14-Reduction of congestions

Mapping Assets-Functionalities

Mapping Functionalities-KPIs

26 Assets | **18 Function.** | **14 KPIs**

	KPI
Sustainability	1 - Reduced greenhouse gas emissions
	2 - Reduced local SOx, NOx emission
	3 – Increased share of RE in the generation mix
Integration of DERs	4 -Increased hosting capacity of distributed generation
	5 - Increased hosting capacity for Electric Vehicles and other new loads (e.g. heat pumps)
	6 - Increased number of generation hours provided by DG
Security and Quality of Supply	7 - Reduced peak demand
	8 - Reduced duration of interruptions per customer (SAIDI)
	9 - Extended asset life time
	10 - Reduced expected energy not supplied
Energy Efficiency of the Power System	11 - Reduced technical losses in transmission and in distribution networks
	12 - Reduced non-technical losses in transmission and in distribution networks
	13 - Reduced electricity consumption
	14- Reduced congestions in the system’s electrical lines

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PROPOSED ELIGIBILITY CRITERIA

- Eligibility criteria
  1. Technical eligibility criteria
  2. Legal/administrative eligibility criteria
- Competitive selection of eligible projects
  - Eligible projects to be compared based on a cost-effectiveness index

In order to support project promoters' (technical) applications:

- Excel tool for step-by-step guidance of the project technical assessment

TECHNICAL ELIGIBILITY CRITERIA

1. Minimum technical requirements	2. Impacts	3. Economic performance
• Is the project a Smart Grid investment?	• Does the project deliver positive impacts in line with European and national energy priorities?	• Does the project bring net-positive economic benefits to society? only major projects (budget>50M€)

MINIMUM TECHNICAL REQUIREMENTS AND IMPACTS

Asset has smart characteristics?

- **It has (possibly two way) communication capabilities and can be included in a digital control loop**
- **It is controllable/accessible remotely and/or has local intelligence to automatically adapt to operating conditions**

Smarter than BaU investments?

- **The "smart" characteristics of the asset are not already widely deployed in the country (e.g. not in the regulated asset base)**

Smart asset provides smart functionalities?

- **The asset is actually used to implement smart functionalities**

Smart functionalities provide positive impacts?

- **Positive score on KPI analysis**

TECHNICAL ELIGIBILITY CRITERIA

Category	Eligibility criteria's name	Description	Evaluation outcome (compared to BaU scenario)	Condition to be eligible
Technical	Minimum technical requirements	• Project includes Smart assets • Smart assets are combined to provide Smart functionalities	Comparison of Smart Grid assets/ functionalities with standard BaU investments	Project meets minimum technical requirements
Impacts in line with energy policy goals	KPI analysis	Calculation of variation of KPI values thanks to project implementation.	Qualitative global KPI score (based on KPI ranges and weights defined by national authorities)	Project meets a minimum KPI global score defined by national authorities
Economic	Economic CBA	Assessments of costs and benefits of the project for society	ENPV; EIRR	Positive net benefits

Only major projects (under the meaning of Article 100 of EU Regulation 1303/2013)

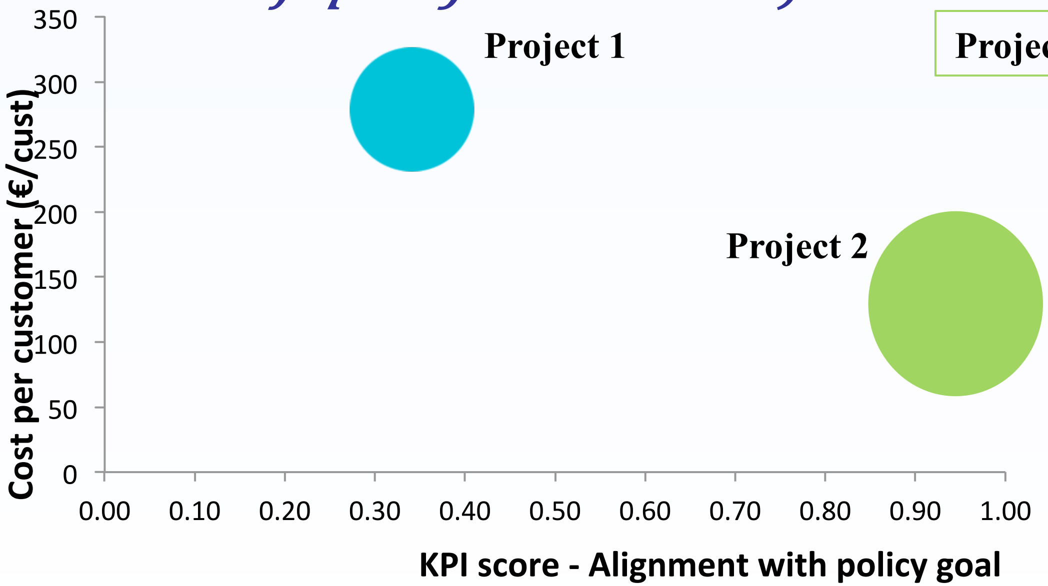
Eligible projects are then ranked according to a cost-effectiveness index

The index encapsulates the national energy priorities (KPIs score), the total project cost and the number of consumers affected (number of project users – providing an indication of the project size)

COST-EFFECTIVENESS INDEX

1. Calculate the global KPI score
2. Compute the total costs per number of project users
3. Calculate the cost-effectiveness index:

$$Cost\ effectiveness = \text{KPI score} / Total\ Project\ Cost / (number\ of\ project\ users)$$



Project 2 is more cost-effective than project 1

AGENDA

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- **Smart Grid assessment tool**

Project's score – Assessment of individual KPIs

1. Calculate the expected KPI variations at the end of the project
2. Assign a value to the impact level of each KPI: e.g. 0 for "no impact", 1 for low impact…, 3 for high impact
   - This is done by comparing the KPI value with predefined KPI ranges (set by national authorities)

	KPI	Value for the project	KPI score (1=Low; 2=Medium; 3=High)
Sustainability	1 - Reduced greenhouse gas emissions	5%	2
	2 - Reduced local SOx, NOx emission	5%	2
Integration of DERs	3 -Increased hosting capacity of distributed generation	-	
	4 - Increased hosting capacity for Electric Vehicles and other new loads (e.g. heat pumps)	-	
	5 - Increased number of generation hours provided by DG	-	
Security and Quality of Supply	6 – Increased share of RE in the generation mix	5%	1
	7 - Reduced peak demand	-	
	8 - Reduced duration and frequency of interruptions per customer (SAIDI; SAIFI)	25%	3
	9 - Extended asset life time	-	
	10 - Reduced the expected energy not supplied	-	
Energy Efficiency of the Power System	11 - Reduced technical losses in transmission and in distribution networks	2%	2
	12 - Reduced non-technical losses in transmission and in distribution networks	-	
	13 - Reduced electricity consumption	5%	2
	14- Reduced congestions in the system's electrical lines	-	

Indicative KPI ranges based on available pilot project results

	KPI	Low impact	Medium impact	High impact
Sustainability	1 - Reduced greenhouse gas emissions	< 3%	3% - 10%	> 10%
	2 - Reduced local SOx, NOx emission	< 3%	3% - 10%	> 10%
	3 – Increased share of RE in the generation mix	< 2%	2% - 4%	> 4%
Integration of DERs	4 -Increased hosting capacity of distributed generation	< 10%	10% - 25%	> 25%
	5 - Increased hosting capacity for Electric Vehicles and other new loads (e.g. heat pumps)	No estimation	No estimation	No estimation
	6 - Increased number of generation hours provided by DG	< 10%	10% - 25%	> 25%
Security and Quality of Supply	7 - Reduced peak demand	<2%	2% - 10%	> 10%
	8 - Reduced duration of interruptions per customer (SAIDI)	< 5%	5% - 20%	> 20%
	9 - Extended asset life time	No estimation	No estimation	No estimation
	10 - Reduced expected energy not supplied	No estimation	No estimation	No estimation
Energy Efficiency of the Power System	11 - Reduced technical losses in transmission and in distribution networks	< 2%	2% - 5%	> 5%
	12 - Reduced non-technical losses in transmission and in distribution networks	No estimation	No estimation	No estimation
	13 - Reduced electricity consumption	< 2%	2% - 10%	> 10%
	14- Reduced congestions in the system’s electrical lines	No estimation	No estimation	No estimation

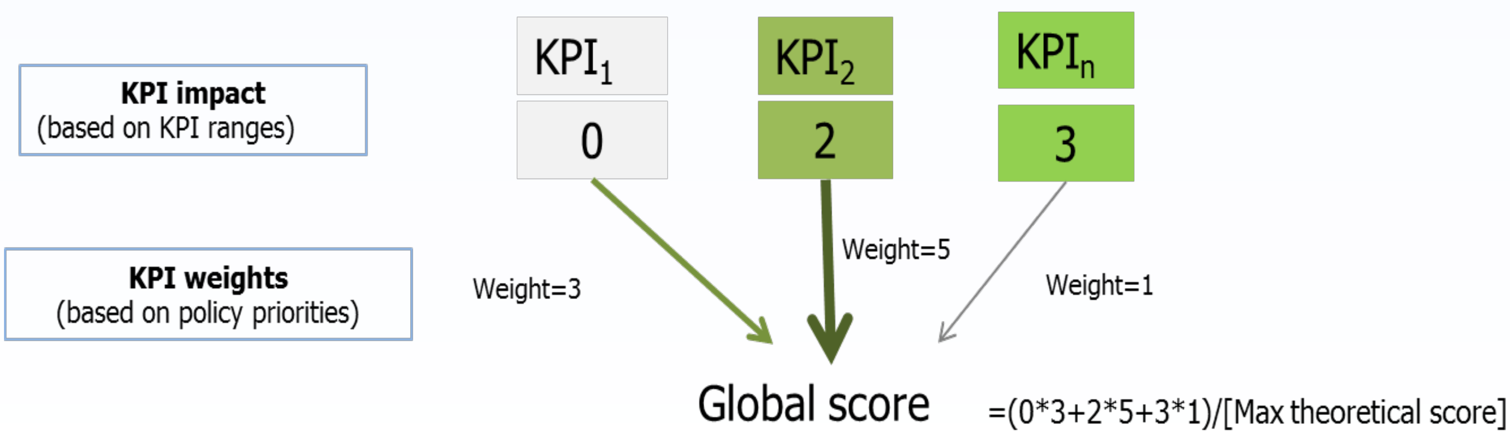
Project's score: Weighting KPIs

3. Assign a weight to each KPI, to define its relative importance compared to other KPIs: e.g. 5 for "high priority KPI", 1 for "low priority KPI".
   - KPI weights are to be defined by national authorities based on national priorities and needs
4. Combine the value of the different KPIs according to their weights

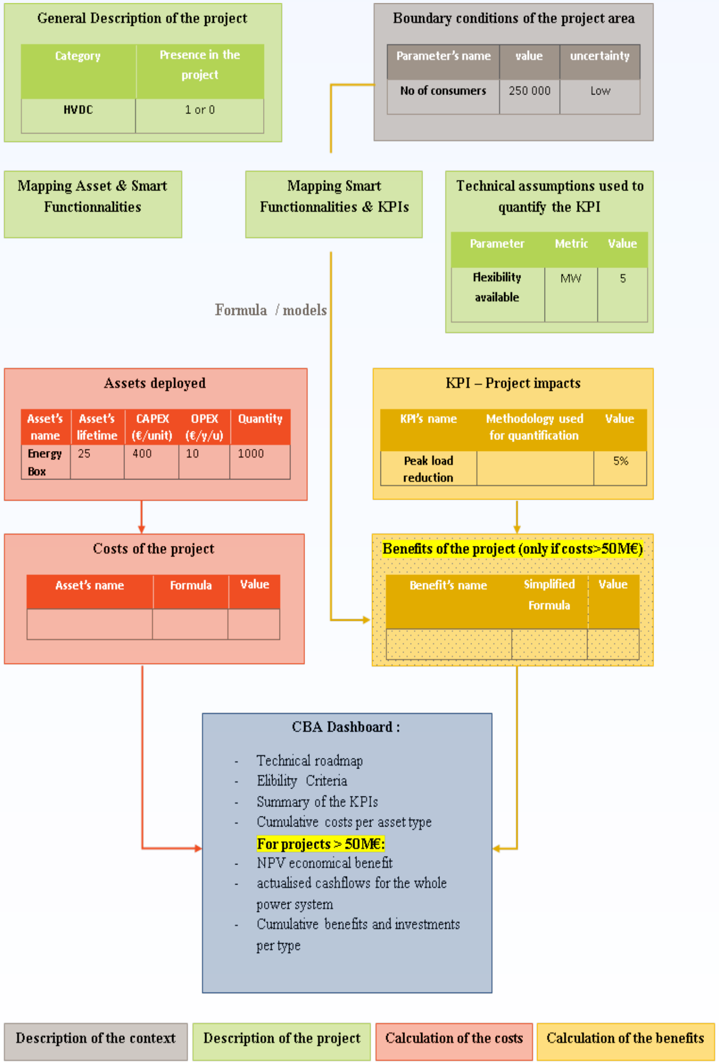
$Score=\sum_{kpi} mark(kpi)*weight(kpi)\ /Max\ theoretical\ score$

Max theoretical score: $3*\sum_{kpi} weight(kpi)$

Example:



Project assessment tool



- **Easy-to-use Excel format**
- **Two types of users**
  - Dashboard for **quick review** of project eligibility score
  - **Step-by step guidance** for detailed project assessment
- **Four sections:**
  - Description of the **context**
  - Description of the **project**
  - Calculation of the **costs**
  - Calculation of **KPIs** and **monetization of benefits**
- **Detailed characterization of the assessment framework**
  - Definition of **key parameters**
  - Detailed **formulas for monetization of impacts**
  - Automatic calculation of **CBA economic indicators**

SUMMARY OF KEY POINTS

Framework for the evaluation of Smart Grid investments in the EU funding period 2014-2020

- Detailed characterization of Smart Grid investments (assets, functionalities, KPIs)
- Technical eligibility criteria:
  1. Minimum technical requirements
  2. KPI impact
  3. Net economic benefits for society (only major projects)

  Eligible projects are then ranked according to their cost-effectiveness (KPI score/(project cost per consumer)

- Supporting material for project application and evaluation:
  - **Project assessment tool for step-by-step guidance of the evaluation process**
  - **Feedback from international experiences on Smart Grid pilot implementations**

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