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ISGAN – Annex 3

Smart grid evaluation toolkit

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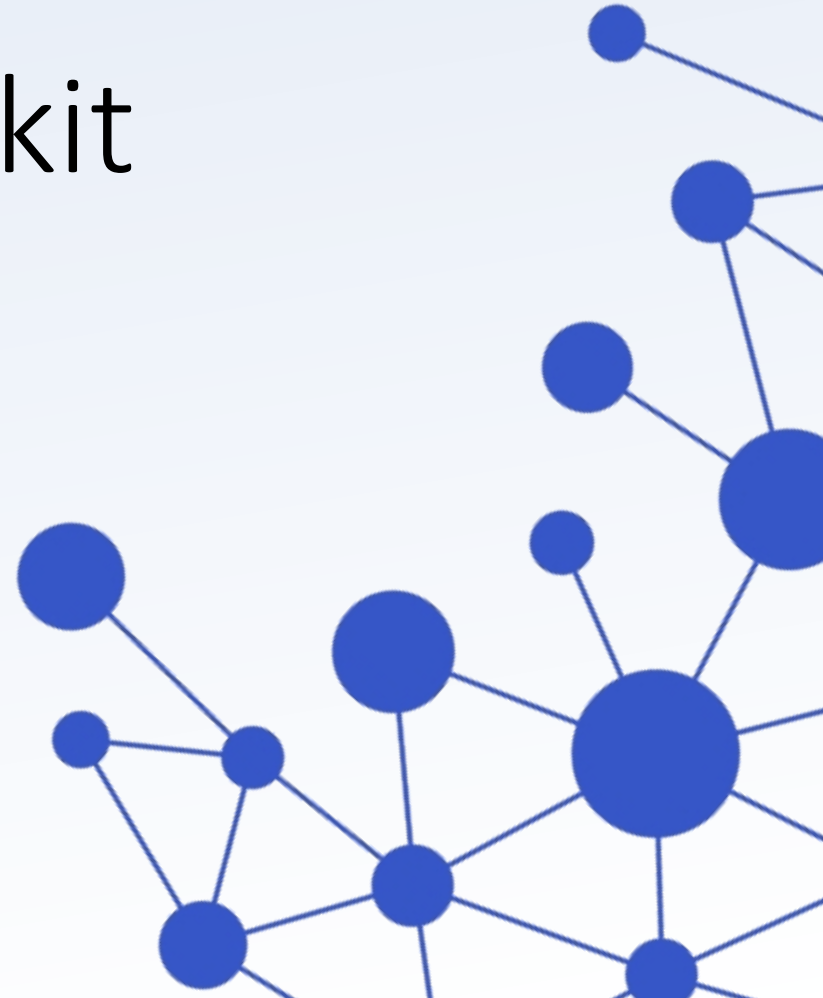
Joint ISGAN-MI IC#1 event
International Smart Grid Action Network

Vancouver, Canada, 27-29 May 2019



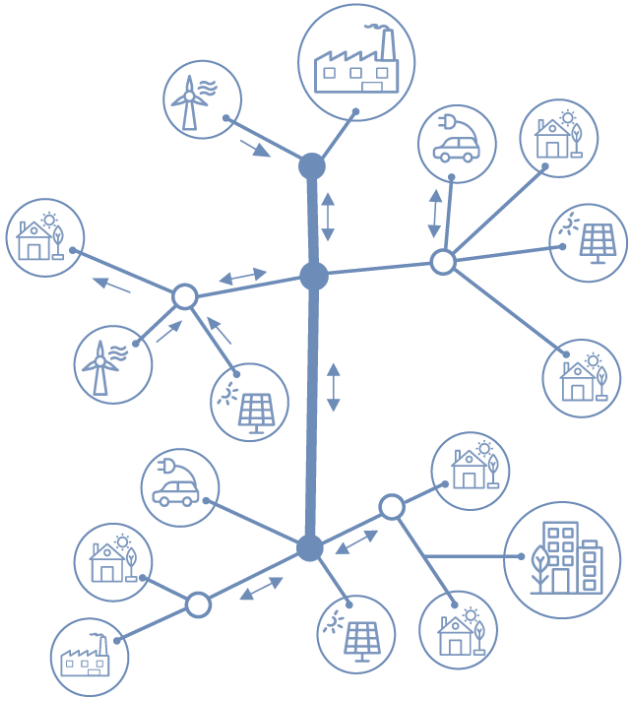
Context and motivation

Smart grids: impacts span over the power system borders

Novel features and enabled services will produce relevant socio-economic impacts

Impact characteristics:

- Wide range impacts
- Indirect/side effects
- Intangible impacts
- Lack of data availability
- Data uncertainty



Implications:

- Not only monetary aspects are of interest
- Identify the impact allocation is difficult
- Quantify all impacts is not possible
- Strategic decision making is under uncertainty

Smart grid planning calls for effective tools for complex decision-making problems

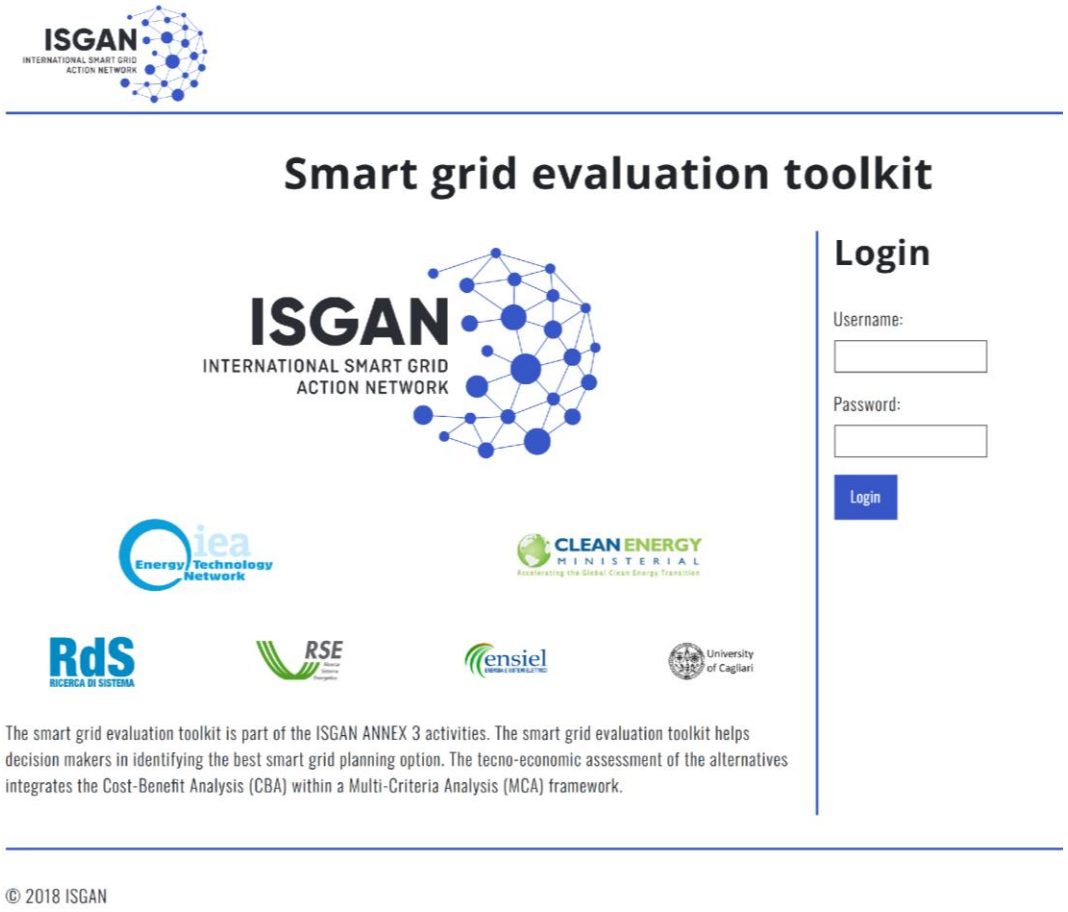
ISGAN smart grid evaluation toolkit

Objective:

Provide a reliable support tool for orienting the investments and the regulatory policies on smart grids

ISGAN smart grid evaluation toolkit

- Decision support tool for evaluating smart grid projects
- Combines Cost Benefit Analysis (CBA) and Multi-Criteria Analysis (MCA)
- Allows an output-based assessment of smart grid initiatives based on an automated procedure
- Considers monetary and non-monetary impacts
- Includes the stakeholders' view in the analysis
- The evaluation can be based on synthetic weights



Overview of the assessment

The main goal is to identify the best smart grid option

Complies with international guidelines on project assessment (i.e. EU Joint Research Centre - JRC)

Evaluates the options on 3 different areas

Economic assessment (CBA)

> Net Present Value (NPV)
> Internal Rate of Return (IRR)
> Cost Benefit Ratio (CBR)

Smart grid deployment merit assessment

EC – JRC output based indexes:

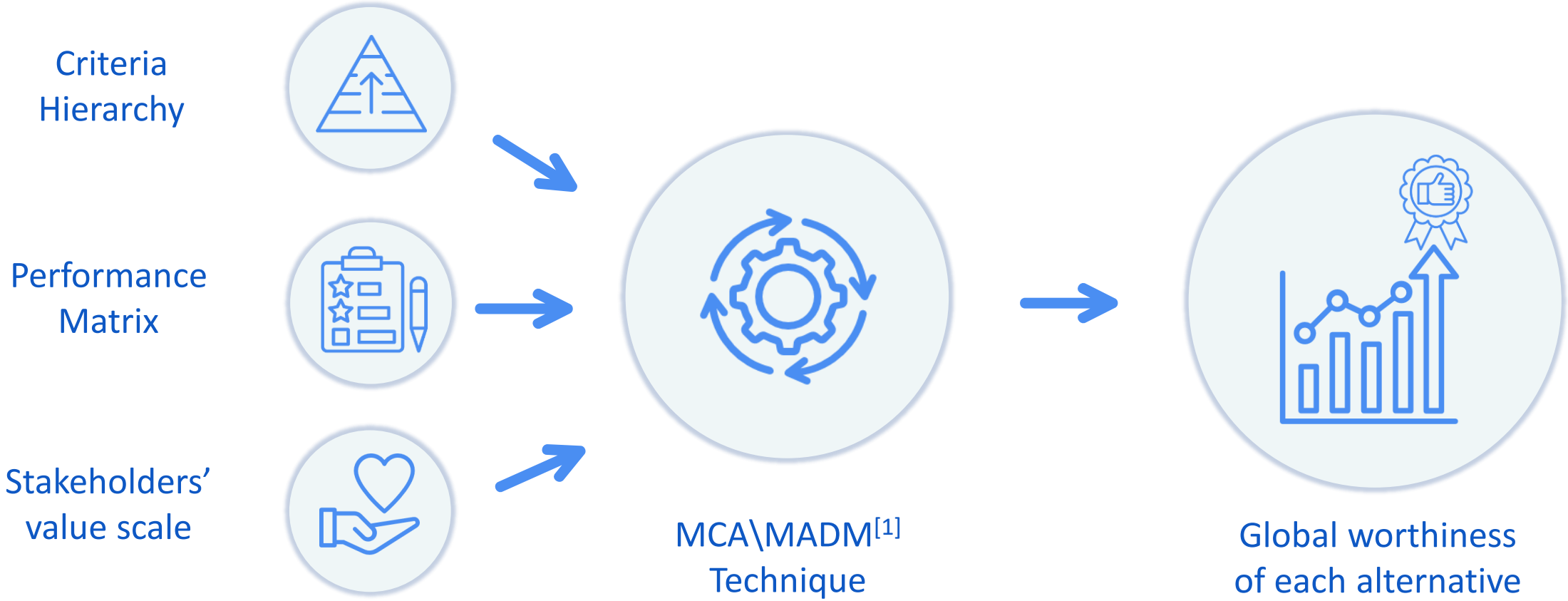
> Policy Criteria (PCs)
> Key Performance Indicators (KPIs)

Externality impact assessment

Externality indicators:

> Externality Impact Areas (EIAs)
> Key Performance Indicators (EKPIs)

The evaluation procedure



[1] Multi - Criteria Analysis \ Multi-Attribute Decision Making

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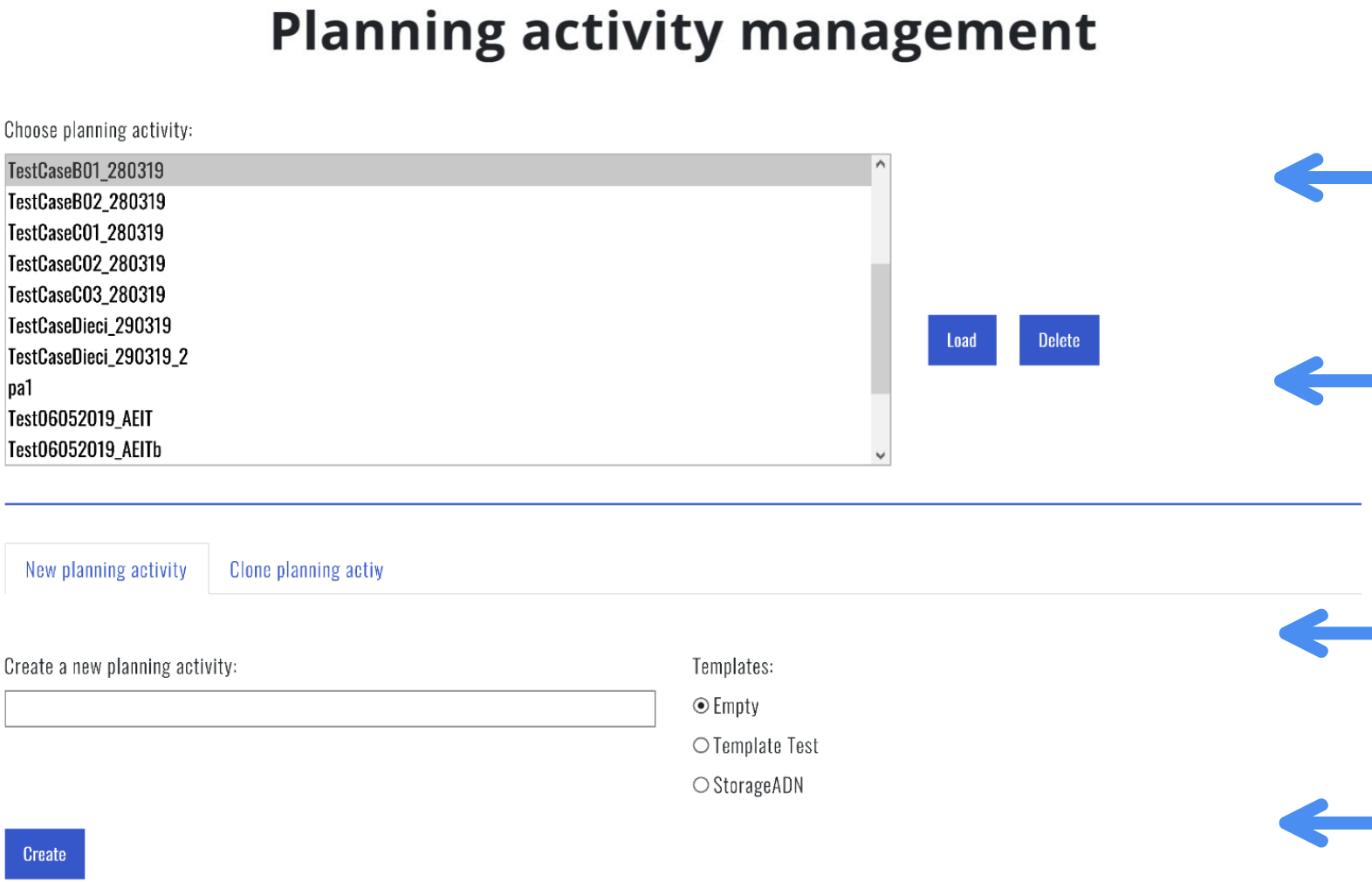

Load an existing planning activity

Delete an existing planning activity

Create a new evaluation process

Clone an existing planning activity

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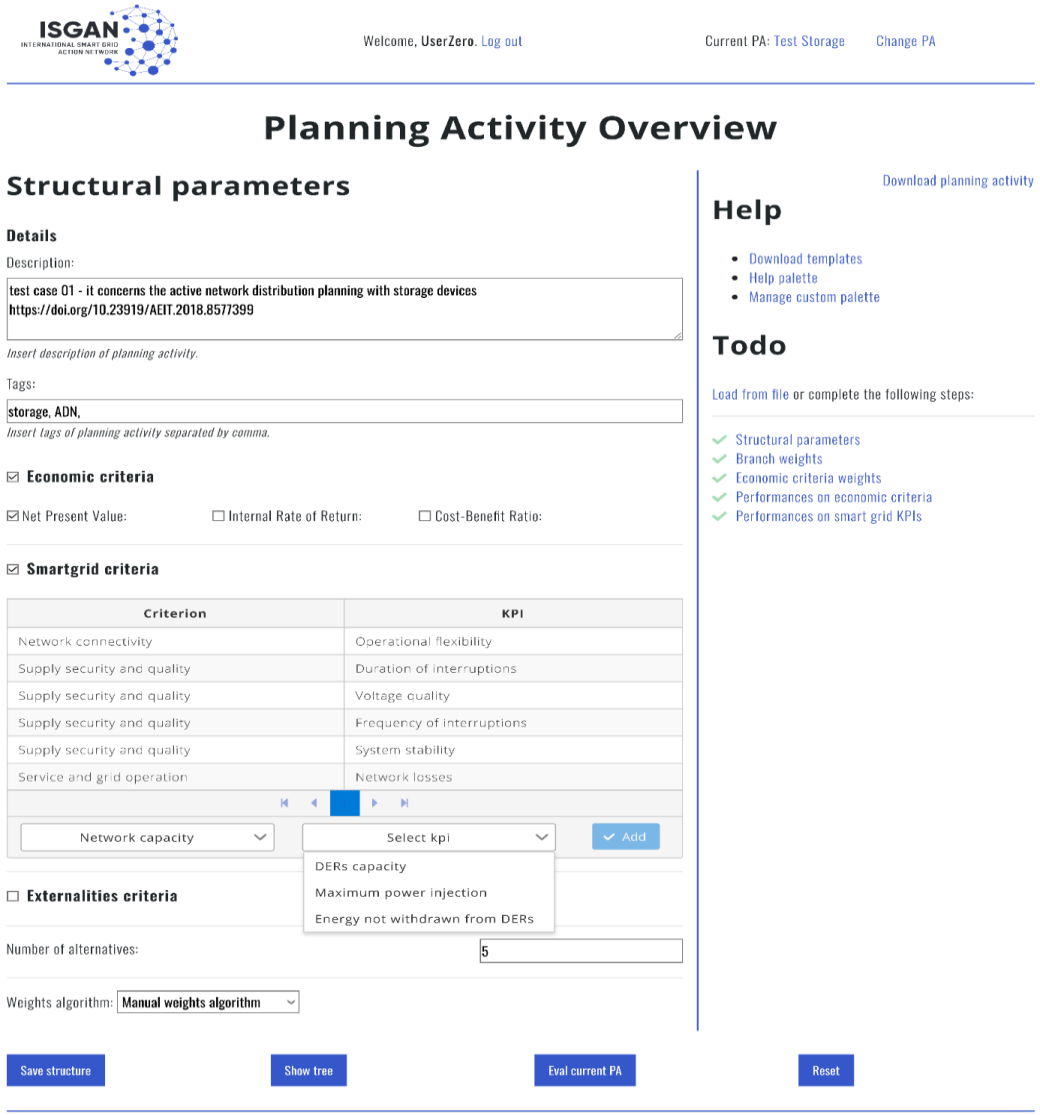


Dashboard of the evaluation activity

- Simple user interface that guide the user during the evaluation process
- No specific expertise is required
- Only output based data on projects and stakeholder view information is demanded

The user can

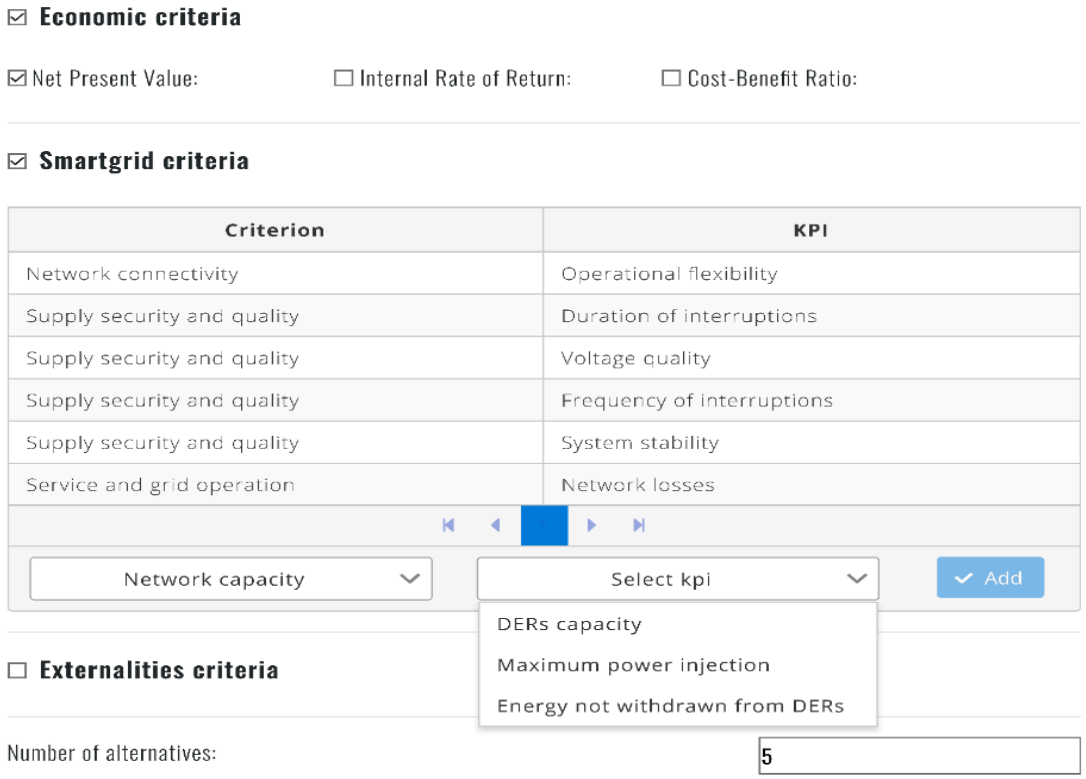
- Select and/or define the evaluation criteria
- Define the number of planning alternatives
- Check the evaluation progress
- Save the defined structure
- Watch the defined criteria tree
- See the evaluation result

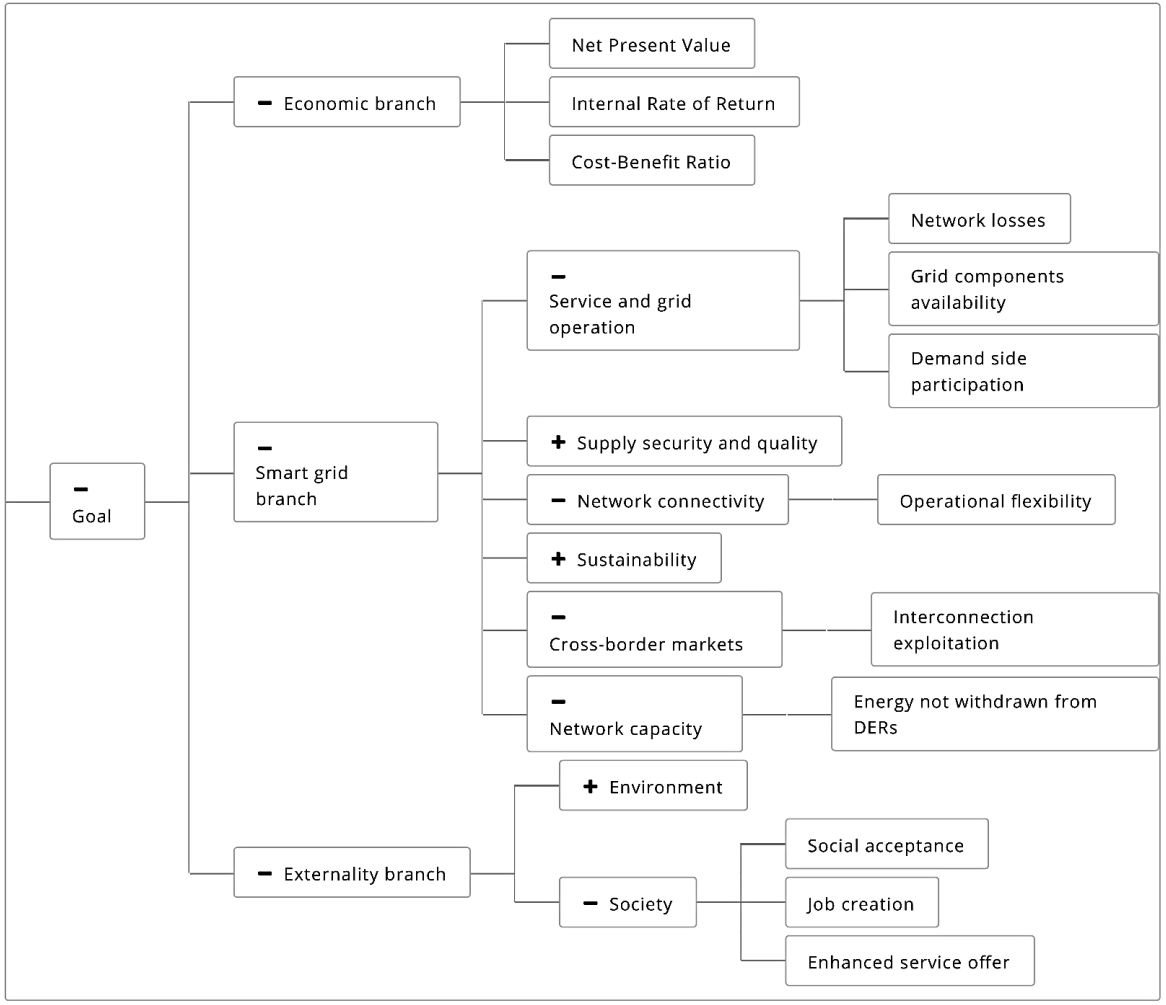
Building the tree of criteria

The evaluation criteria can be selected from the default palette and the custom palette

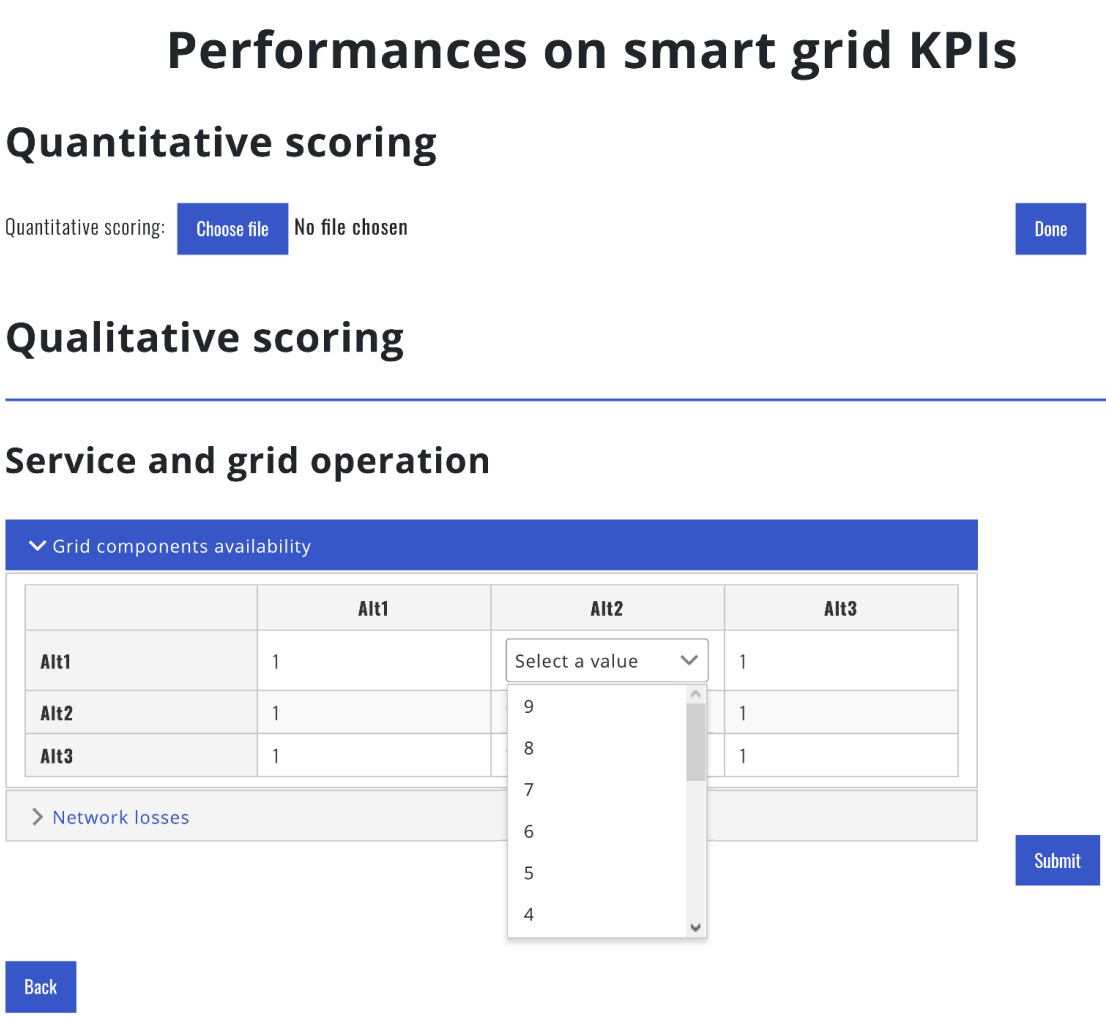
Tree of criteria is interactive and responsive

Gives an overview of the whole hierarchy





Scoring of the alternatives



The evaluation of each criterion can be based on

- Quantitative performance indicators

  by loading spreadsheets

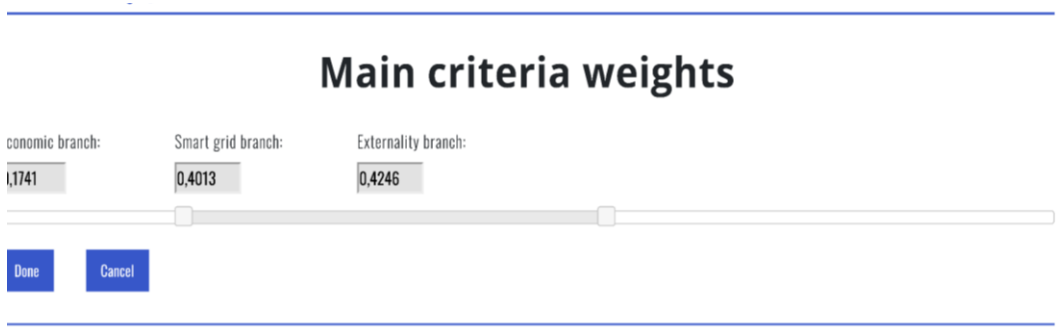
or

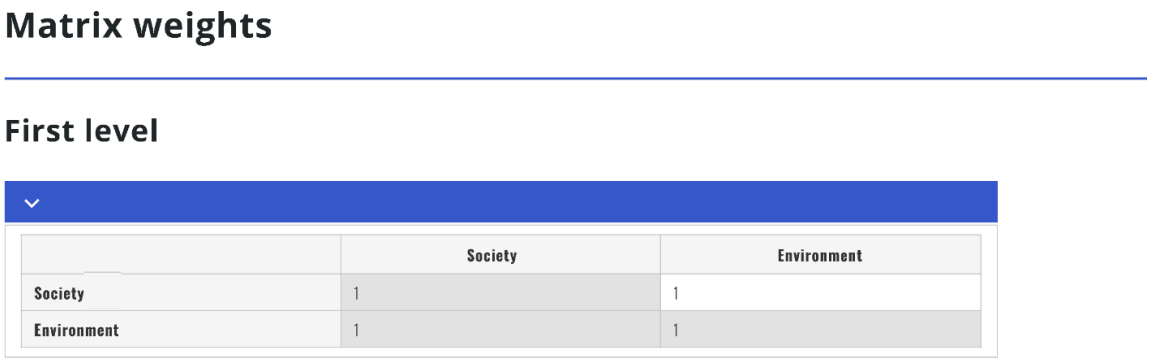
- A qualitative assessment of the performances based on the AHP[1] pairwise comparison

[1] T. L. Saaty, 'How to make a decision: The analytic hierarchy process', *Eur. J. Oper. Res.*, vol. 48, no. 1, pp. 9–26, Sep. 1990.

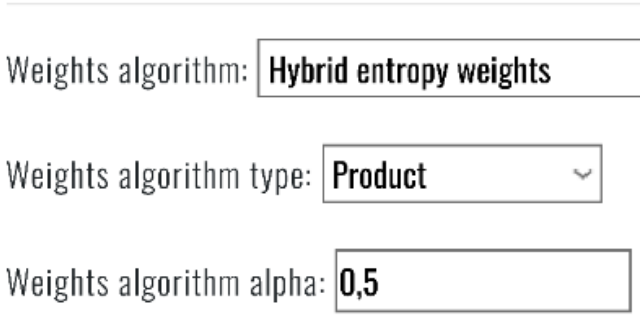
Weighting the evaluation criteria

Weights of the criteria can be assigned manually
by attributing the local priority vector or by using the Saaty's preference matrix [1]





Or can be calculated according to selected algorithms on the basis of the performances of the alternatives



Weighting algorithms:

- Entropy weights
- Standard deviation weights
- Ideal Point weights
- Hybrid weighting

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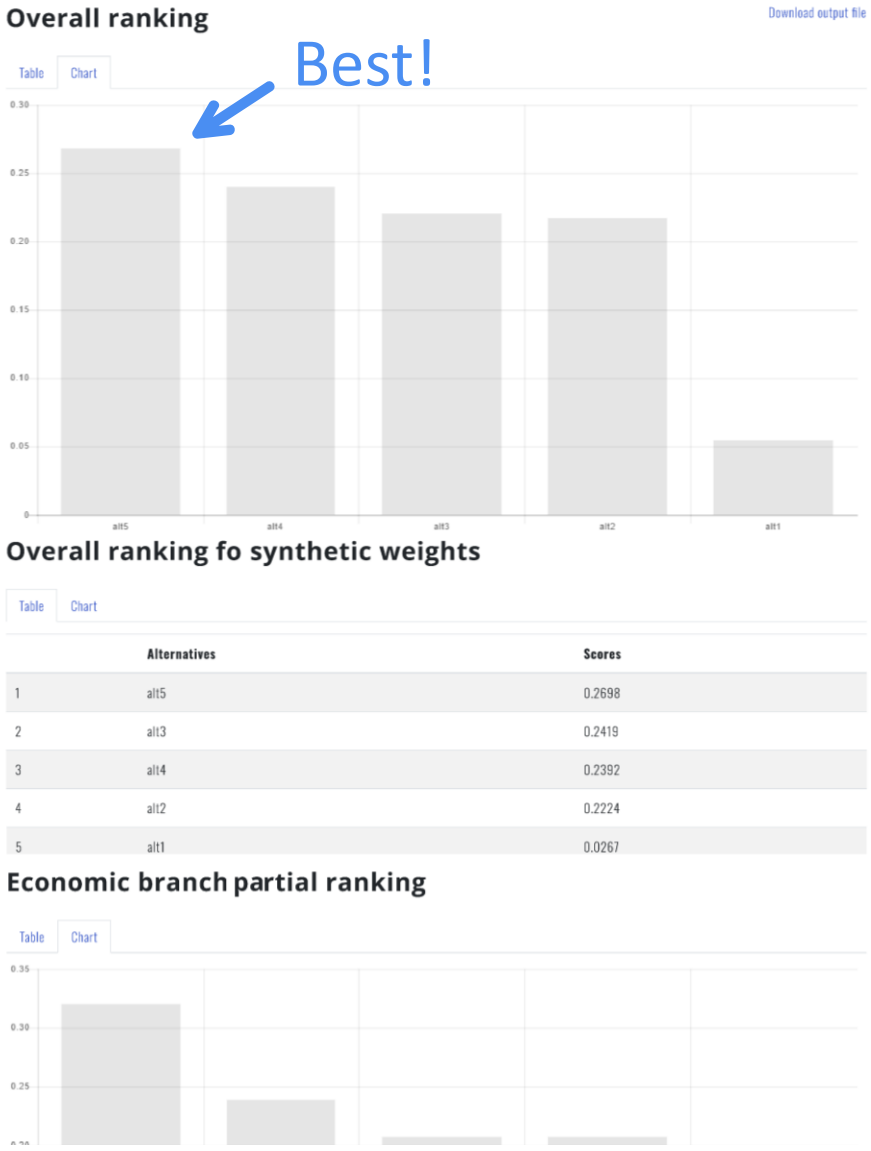
Results of the evaluation



Each alternative obtains an overall score which depends on its merit on the evaluation criteria

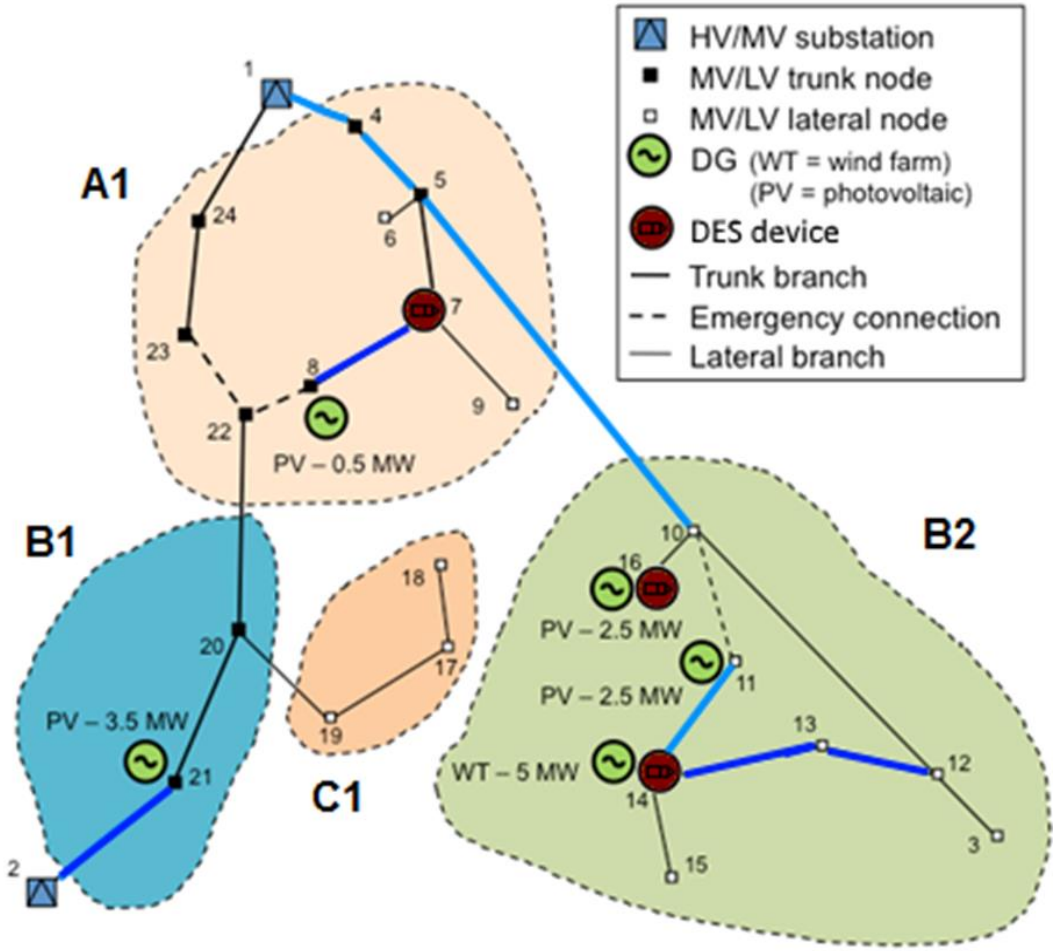
The Best alternative has the Highest score

Outcome:

- Overall ranking according to subjective weights
- Overall ranking according to objective weights
- Overall ranking according to combined weights
- Partial ranking according to each branch
- Flat weights for the terminal criteria
- Stability index of the first position in the ranking

Brief and extensive information for the decision maker

Case study: distribution grid planning of a MV rural grid



Evaluation of several Active Distribution Network (ADN) planning options devised by a multi-objective algorithm (NSGA-II)

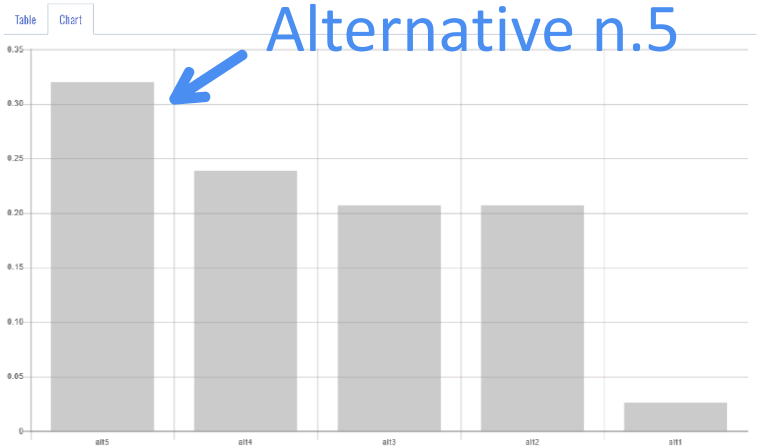
Each considered planning option consists in:

- traditional network reinforcement
- siting and sizing of distributed energy storage (DES)

  - Time horizon: 10 years
  - Topology of the network is fixed
  - Load growth rate: 3% for each bus
  - Operation is evaluated by a probabilistic load flow

Results for the case study

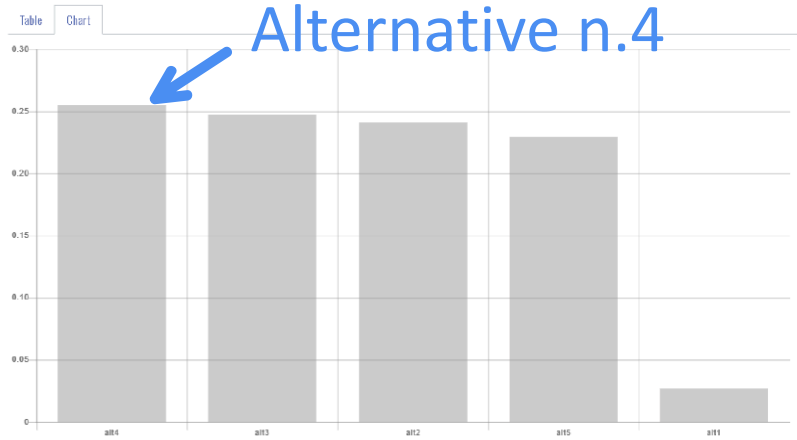
Economic branch partial ranking



DES Topology information

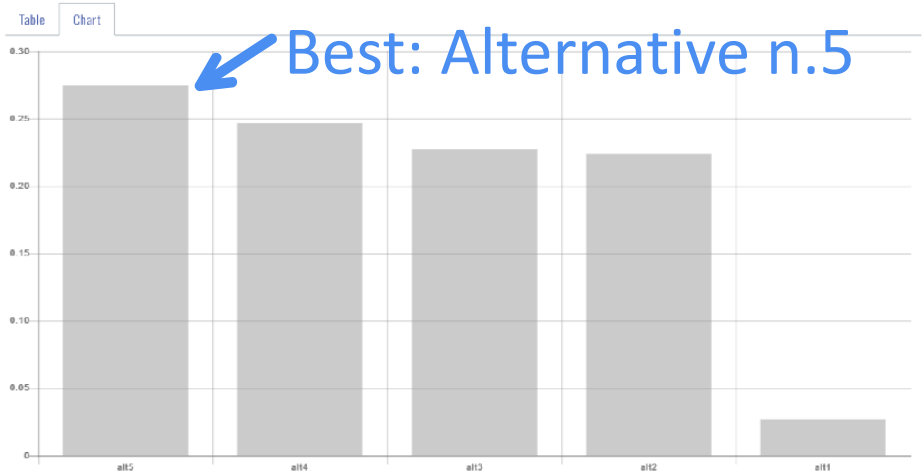
Alt.	Bus equipped with DES	P_{DES} [kW]	E_{DES} [kWh]
A_1	No DES	0	0
A_2	7	100	100
A_3	14	200	400
A_4	16	100	100
A_5	14	100	100

Smartgrid branch partial ranking



Overall ranking

Download output file



ISGAN smart grid evaluation toolkit

The ISGAN smart grid evaluation toolkit:

- Provides a simple framework for project assessment with the aim to overcome the gap between users and tools
- Promotes data sharing about smart grid initiatives for improving the effectiveness of the assessment frameworks

The aim is to develop an

open structure for sharing data, point of views, and results

build a collaborative community for promoting the smart grid development by supporting the strategic decision making of government bodies and companies

How to get it?

Request your invitation code by writing at: info.smartgrideval@gmail.com

Check your e-mail, in a while you will receive your personal invitation code

Go to the website: http://smartgrideval.infora.it/

Log-in in the website with username: smartgrideval and password: smartgrideval

Click on the Signup button

Fill the gaps in the Signup page

Click on the Signup button on the bottom of the Signup page

Registration completed, you can log-in with your credentials at: http://smartgrideval.infora.it/

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Thank you

A webinar on the ISGAN smart grid evaluation toolkit will be available soon...

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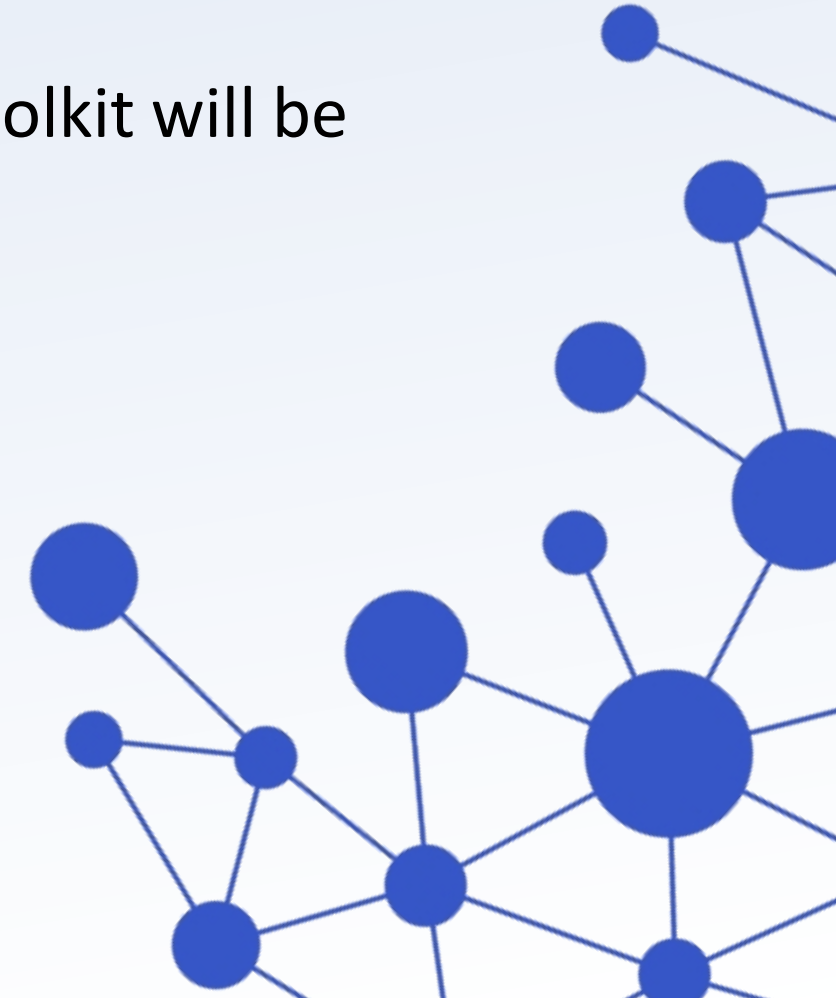

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