opentunity

OPENing the electricity ecosystem to multiple actors in order to have a real decarbonization opportunity

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Project OPENTUNITY: Planning methodology for the distribution grid

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ICCS

GRID SERVICES & MARKETS GSM CONFERENCE

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The OPENTUNITY Project

- High electricity prices and a high dependence on carbon-based energy sources raise the alarm on energy poverty and climate change.
- The EU-funded **OPENTUNITY project** aims to change this by creating a **flexible and adaptable energy ecosystem** that reduces interoperability barriers and focuses on standards that help reduce emissions and costs.
- The OPENTUNITY project **aims to support energy actors**, such as grid operators, prosumers and market players by using **innovative methodologies** backed by **advanced and interoperable software modules** to provide them with **new features and services**.
- This includes **technologies** and **solutions**
  - ✓ to **increase flexibility** in prosumer environments and
  - ✓ to help grid operators **better manage grid operations**.

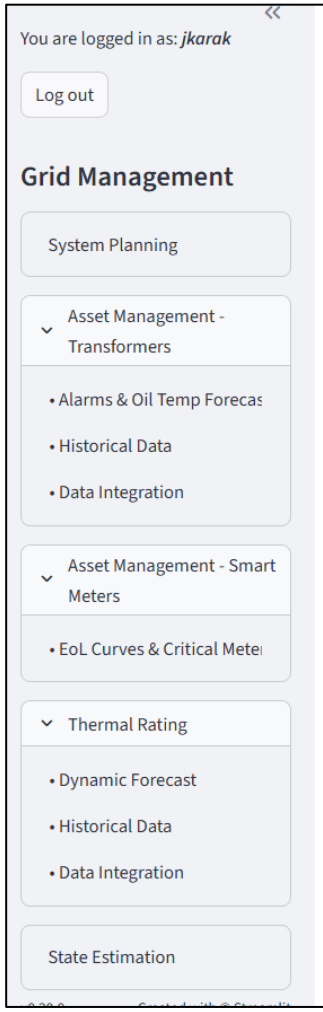
- **48** months
- **4** pilot locations
- **12** innovations
- **21** partners

OPENTUNITY: OPENGRID

OPENGRID

Supporting technologies for DSOs and TSOs to better manage grid issues.

- Focus is placed on supporting technologies for DSOs and TSOs to better manage grid-related challenges.
- **ICCS** has developed a **Grid Management Software** for:
  - ✓ **Network Planning tool**
  - ✓ Short-term asset management (transformers)
  - ✓ Long-term asset management (smart meters)
  - ✓ Real-Time Thermal Rating Tool
  - ✓ State Estimation and Topology Identification



Network Planning tool

- One of the **core modules** of ICCS' Grid Management Software is the **Network Planning tool**
- The Planning tool considers the following **needs from system operators**:
  - ✓ **Lack of flexibility integration** leads to unnecessary grid upgrades and costs.
  - ✓ Traditional network planning relies on **long processing times**, limiting multi-scenario analysis.
  - ✓ DSOs need **user-friendly, fast, and interactive** planning solutions.
- In this respect, the following **challenges** have been considered:
  - ✓ Designing an optimization engine capable of **handling multi-year formulations**.
  - ✓ Addressing the **complexity of large-scale planning problems**, while ensuring the optimization remains solvable within **acceptable time limits**.
  - ✓ Developing a **fast**, yet accurate, **load-flow algorithm** to replace conventional methods — essential for achieving real-time scenario testing.
  - ✓ Limited availability of references in literature on the effect of local energy markets and **flexibility services on distribution planning**.

Network Planning tool

- Considering the previously mentioned needs for grid operators, ICCS developed the **Network Planning Tool** within the OPENTUNITY project:
  - ✓ An **interactive**, **very fast** (minute-scale) **solution** for DSOs to address the increasing demand and RES growth in a **timely, cost-efficient and reliable way**.
- The tool comprises **three core parts**:

1. Fast Power flow calculations:

- ✓ The Fixed-Point Iteration (FPI) load-flow algorithm allows parallel processing
- ✓ Over 100 times faster than conventional Newton Raphson methods.

2. Advanced clustering methods

- ✓ The algorithm is based on K-Means clustering for scenario aggregation
- ✓ The 365 daily profiles are grouped in three distinctive clusters.

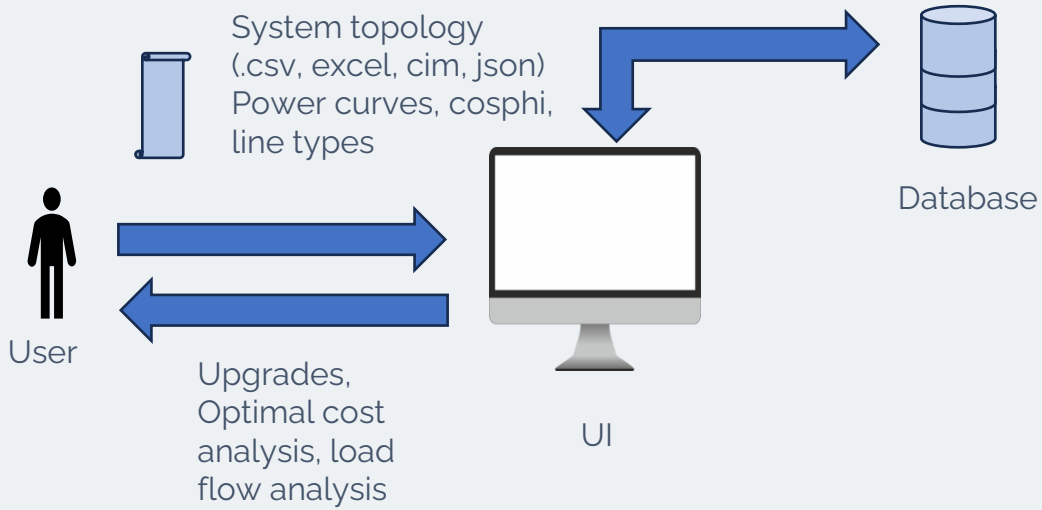
3. Advanced optimization techniques

- ✓ Advanced mathematical optimization techniques, MILP (Mixed-Integer Linear Programming) & MISOCP (Mixed-Integer Second-Order Cone Programming), that also integrate flexibility, and support:
  - i. Cost minimization
  - ii. Investment deferral
  - iii. RES maximization.

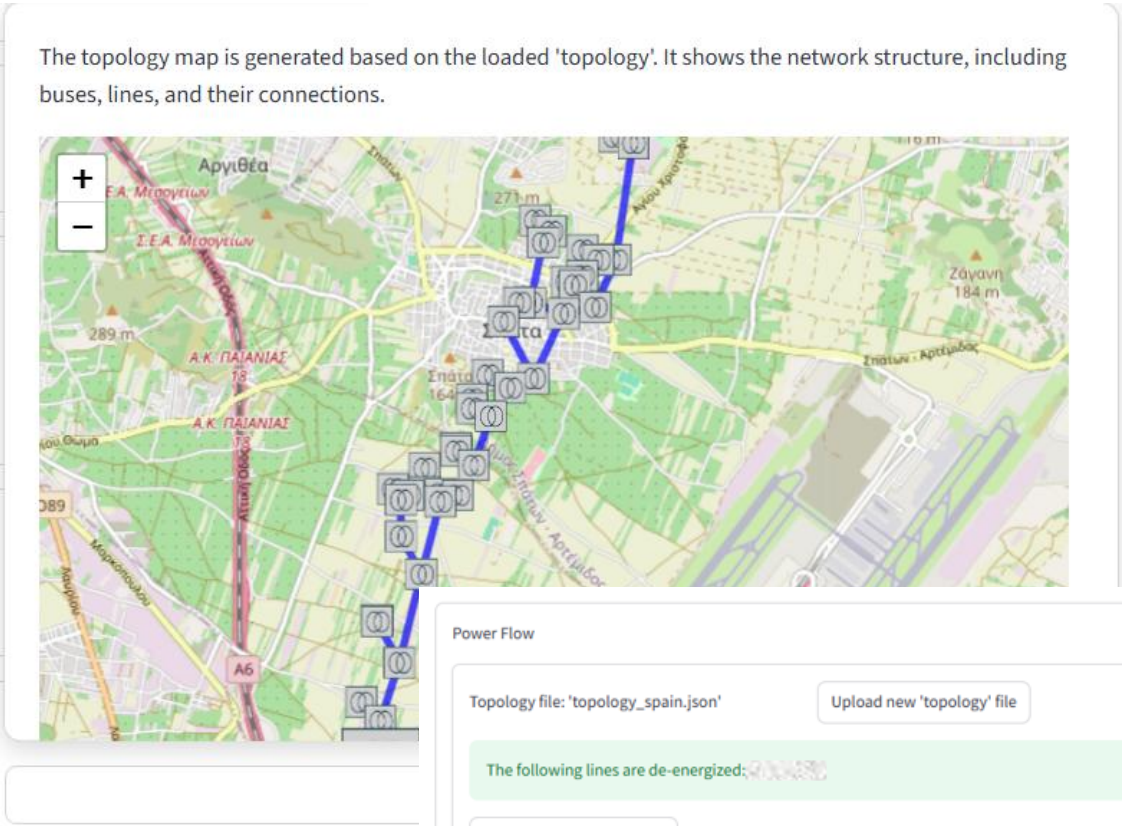
Pilot Sites and Test Cases

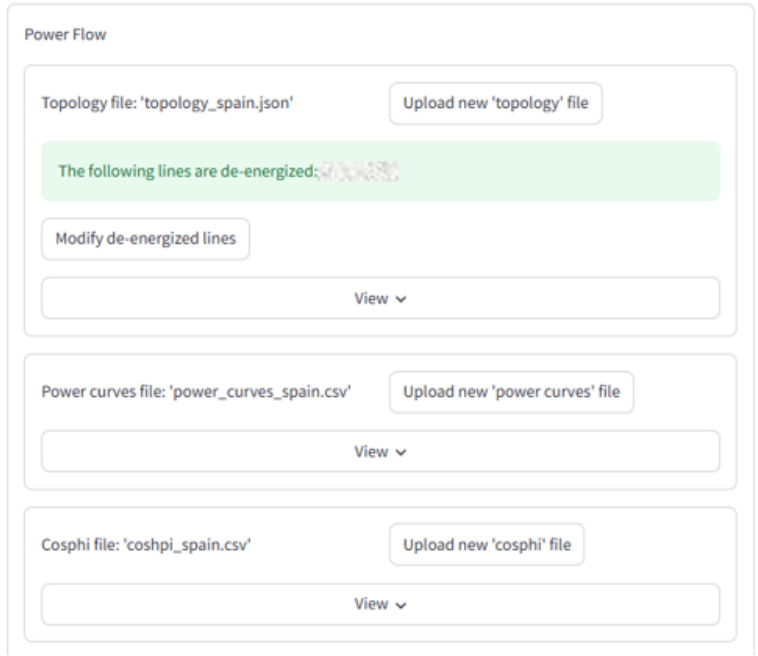
- A **user-friendly GUI** has also been developed:
  - ✓ Allows DSOs to easily configure scenarios and visualize results, supporting clear and efficient planning decisions.
- Within the OPENTUNITY project, the planning tool is currently being tested in **pilots** in the following countries:
  - ✓ Greece
  - ✓ Slovenia
  - ✓ Spain
- The following **test-cases** will be evaluated within the project:
  - ✓ *Investment Deferral*: Compute how much the investments in the network can be postponed through the utilization of flexibility.
  - ✓ *Grid planning while increasing RES integration*: Compute how much the RES integration can be increased with the effective utilization of flexibility.

Tool Structure

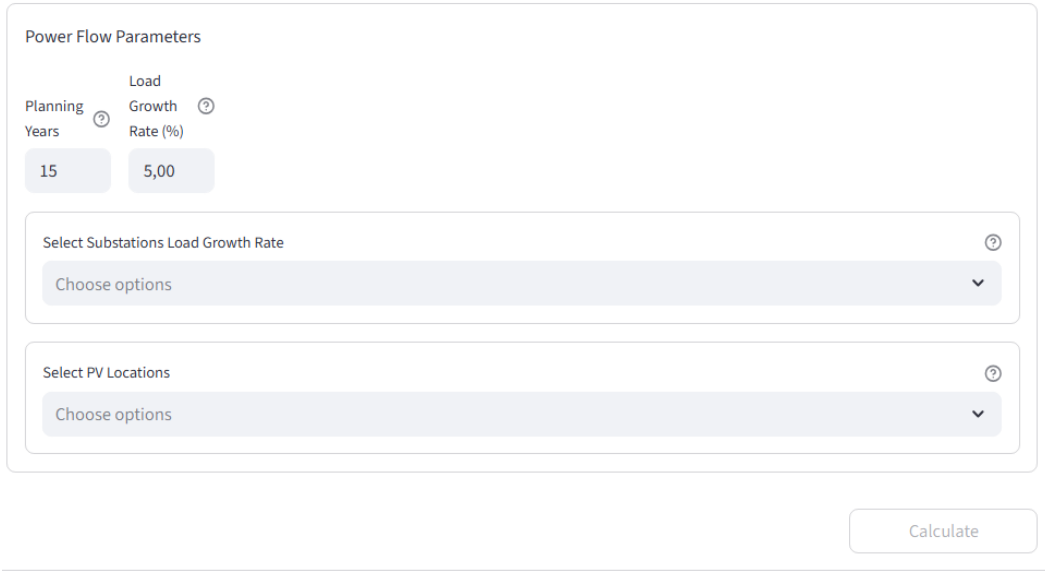


Network Planning Tool - GUI

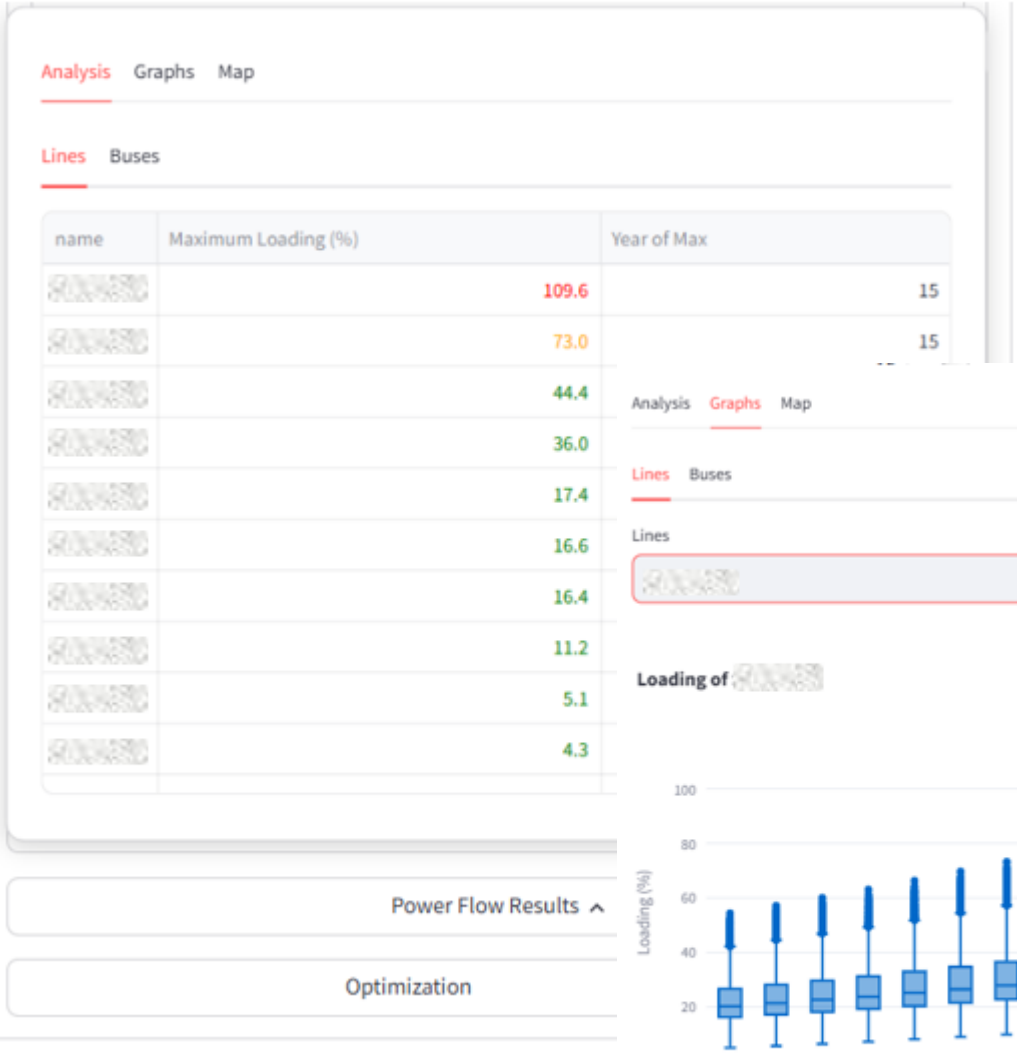




- The user can upload the **topology file** of the examined network (included options: excel, cim, json)
  - ✓ The user can **view the topology map**
- The tool calculates the load-flow results based on:
  - ✓ **Files uploaded by the user** (including information on the system's load, etc.),
  - ✓ **Parameters** selected by the user (e.g. number of Planning Years, PV capacity planned within the examined planning period, etc.)

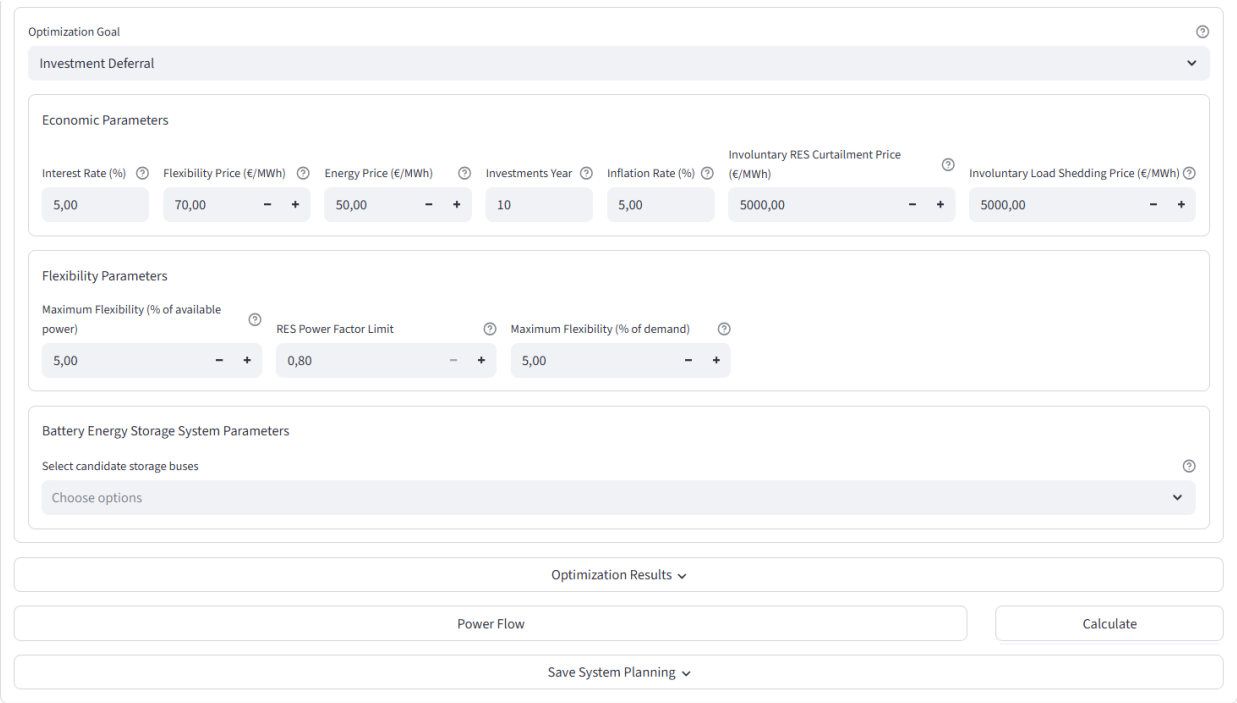


Network Planning Tool - GUI

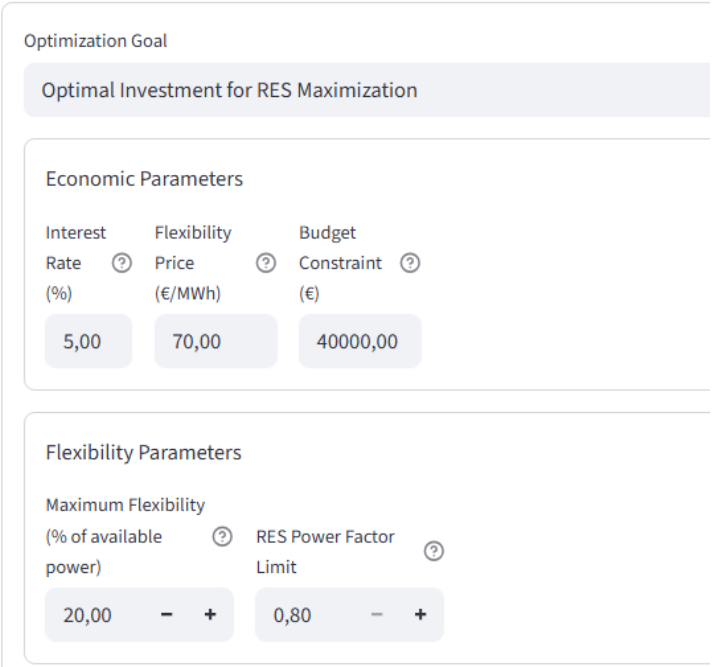


- The **power flow results** are presented to the user via the developed **GUI**
- The user can view **detailed information for the lines** or the buses.
- The user can also view the **results in the form or graphs**
  - ✓ For instance, a **box-plot** with the results appear, indicating information on the maximum, minimum, etc. voltage/loading (for selected lines/buses)
- The user can also **view the results in a map**
  - ✓ Different coloring in the lines indicates their loading

Optimization



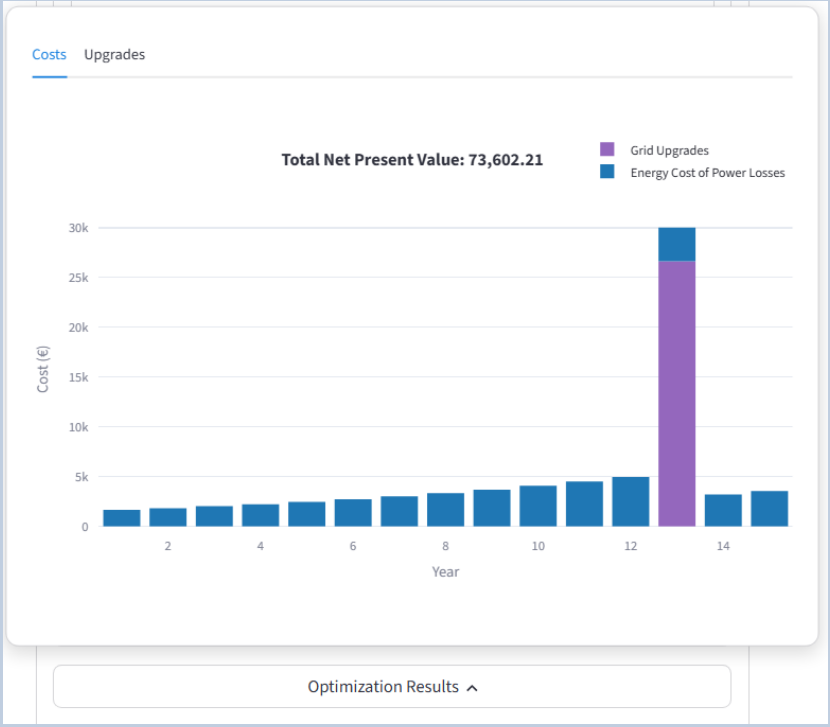
- The following (optimization) **planning options** are provided:
  1. Investment deferral
  2. Cost reduction
  3. Optimal Investment for RES Maximization
- The user easily provides the optimization **economic and flexibility parameters via the UI**

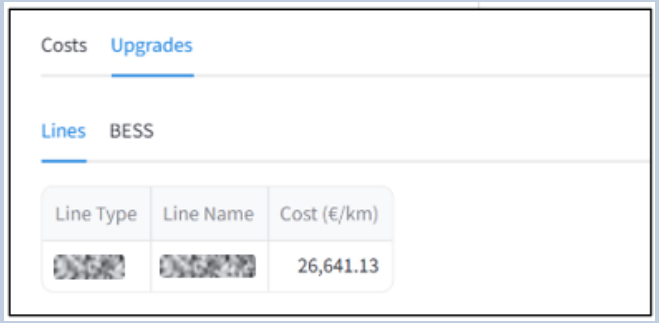


- **Results** are calculated **very fast (minute-scale)** thanks to:
  1. **Advanced clustering methods** (efficient grouping of daily profiles in three distinctive clusters)
  2. **Advanced optimization techniques** (MILP & MISOCP)

Examined Scenarios - Investment deferral

Scenario-1: Flex. 5%





Investment deferral: Indicative examined scenarios

Scenario-1: **flexibility** offered by demand and RES is equal to **5%**:

- The **flexibility is not enough** in this case **to avoid grid upgrades**
- **Grid upgrades are required in year-13:**
  - ✓ Their cost is visible in the diagram
  - ✓ Additional details are provided in the GUI (specific line to be upgraded and relevant cost).

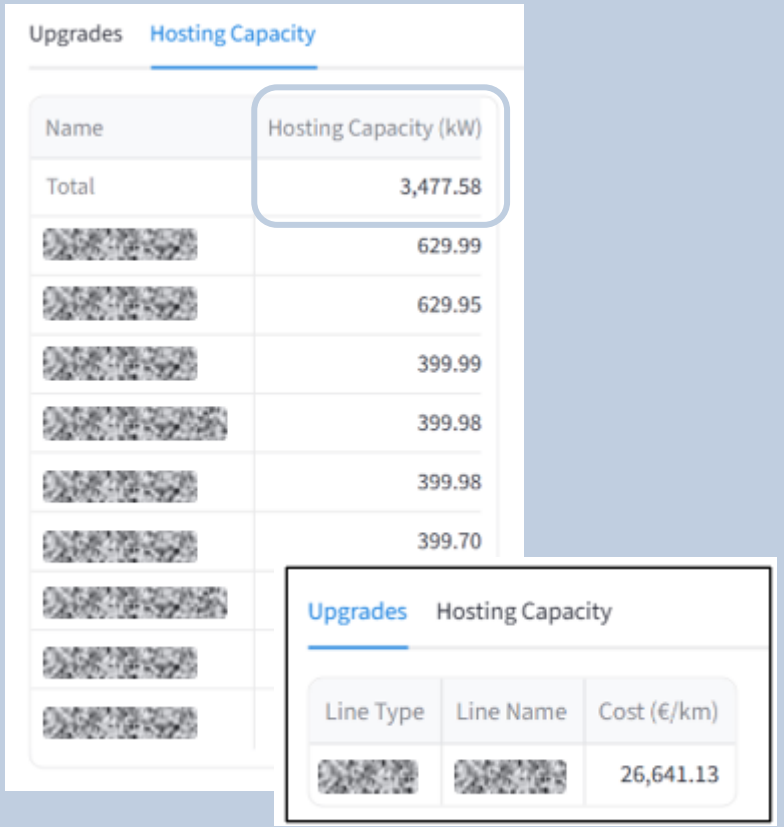
Scenario-2: **flexibility** by demand and RES is **increased to 20%**

- The flexibility is enough in this case to **avoid grid upgrades**
  - ✓ **No grid upgrades are required.**

Scenario-2 Flexibility 20%

Examined Scenarios: RES Hosting Capacity

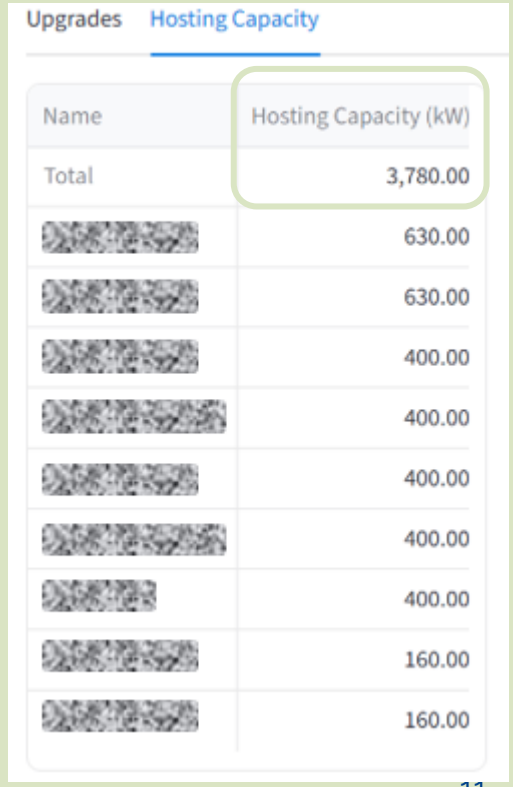
Scenario-A: Flex. 5%



- The tool also allows planning with the option for **'Optimal Investment for RES Maximization'**
  - ✓ Results indicate:
    - ✓ The RES Hosting Capacity that can be achieved (Total and per bus)
    - ✓ The required upgrades (in each line) and their relevant cost
- Indicative case **examining two cases of flexibility** in the Spanish network:
  - ✓ *Scenario-A*: 5% RES offered flexibility
  - ✓ *Scenario-B*: 20% RES offered flexibility
- The **hosting capacity can be increased** when **increasing the RES flexibility** that can be offered

Scenario	RES Flexibility	Total RES hosting capacity
Scenario-A	5 %	3478 kW
Scenario-B	20%	**+9%**: 3780 kW

Scenario-B: Flex. 20%



Conclusions

- The **OPENTUNITY Planning Tool** provides DSOs with a **fast**, **interactive** and **user-friendly methodology** for **distribution grid planning** under increasing demand and RES penetration.
- By combining **fast power-flow calculations**, **scenario clustering** and **advanced optimization techniques**, the tool enables multi-year and multi-scenario planning over practical computation times.
- The developed methodology supports **essential DSO planning objectives**:
    1. Investment deferral
    2. Cost reduction
    3. Maximization of RES hosting capacity.
- The integration of **flexibility services** into the planning process can reduce or postpone the need for conventional grid reinforcements.
    - ✓ **Higher flexibility** availability can **help avoid network upgrades** that would otherwise be required.
    - ✓ **Increased flexibility** can enable **higher integration of renewable generation** in distribution networks.
- The planning tool contributes to the **wider OPENTUNITY objective** of enabling **decarbonization** through **smarter grid operation and planning**
    - ✓ By supporting the **cost-efficient**, **flexible** and future-oriented **grid planning**

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THANK YOU!

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