FlexPlan

Advisory Board| 24th November 2021

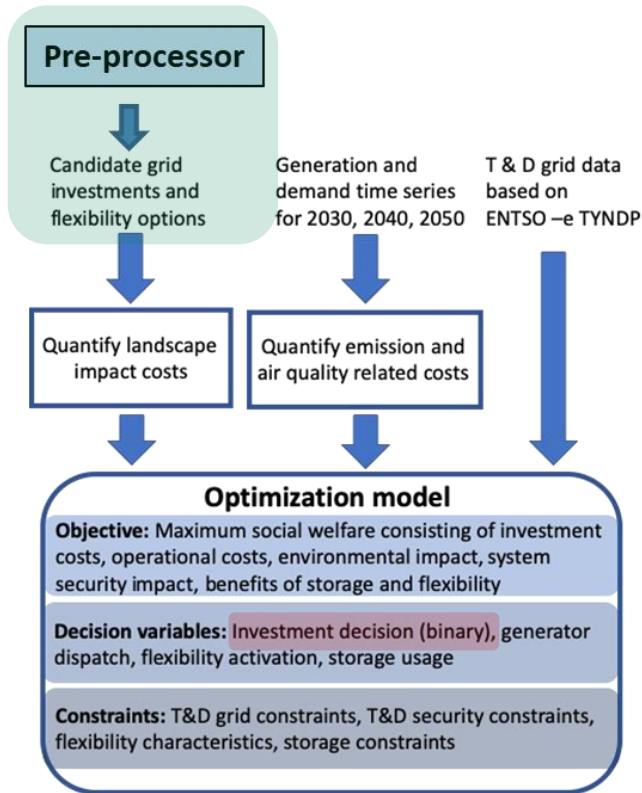# Pre-processor and planning candidates formulation

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TECNALIA

Agenda

1. Aim of the pre-processor
2. Methodology summary
3. Methodology steps
4. Pre-processor interfacing
5. Validation
6. Current and future activities
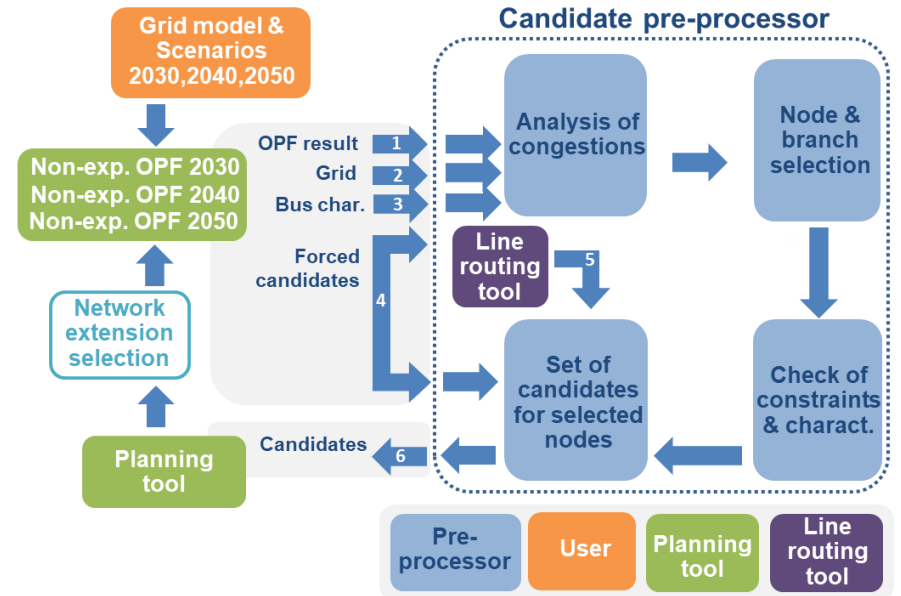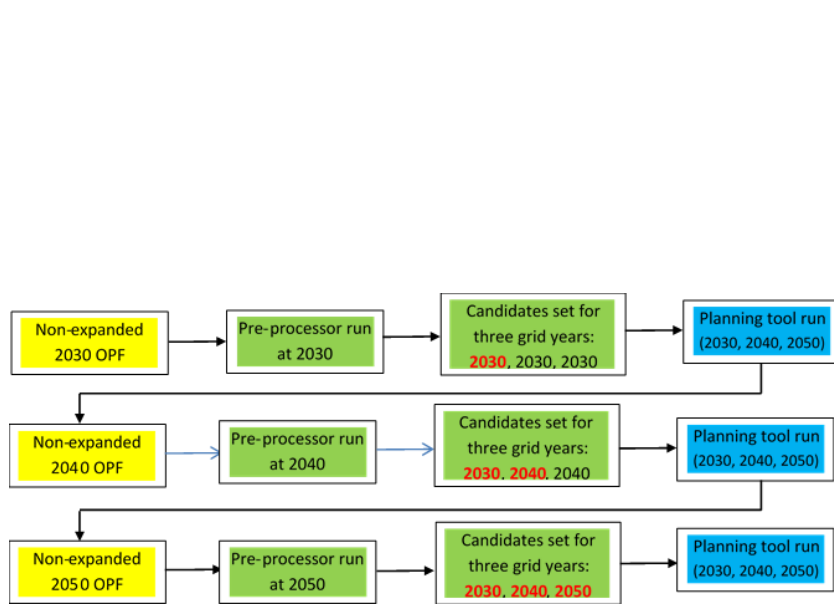7. Reference documents
8. For discussion

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- Provide the FlexPlan planning tool with a **reduced list of network locations and technology candidates** for network extension.
- Flexibility resources are presented as candidates for network planning, **competing with the conventional** network capacity extension approach, e.g., new line construction.
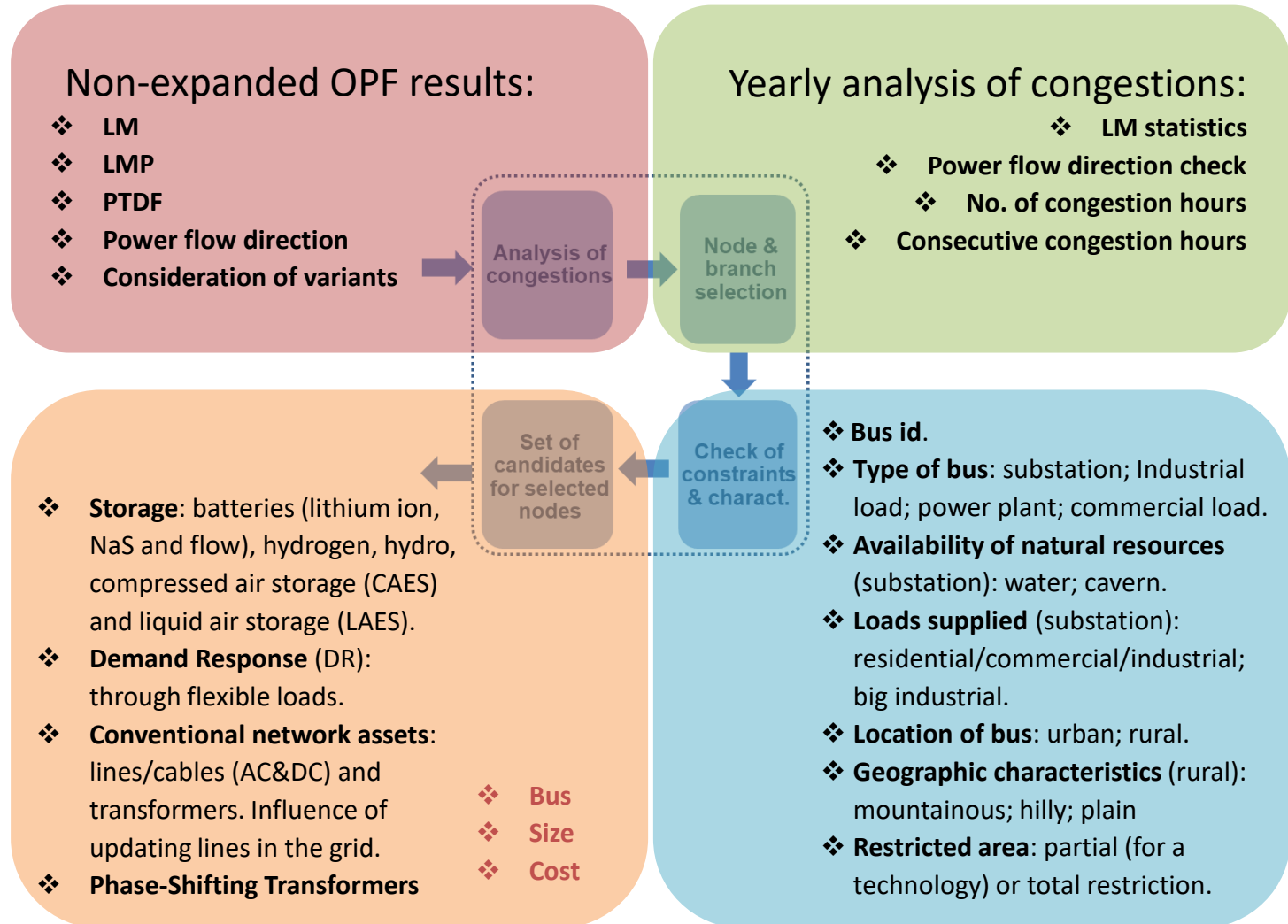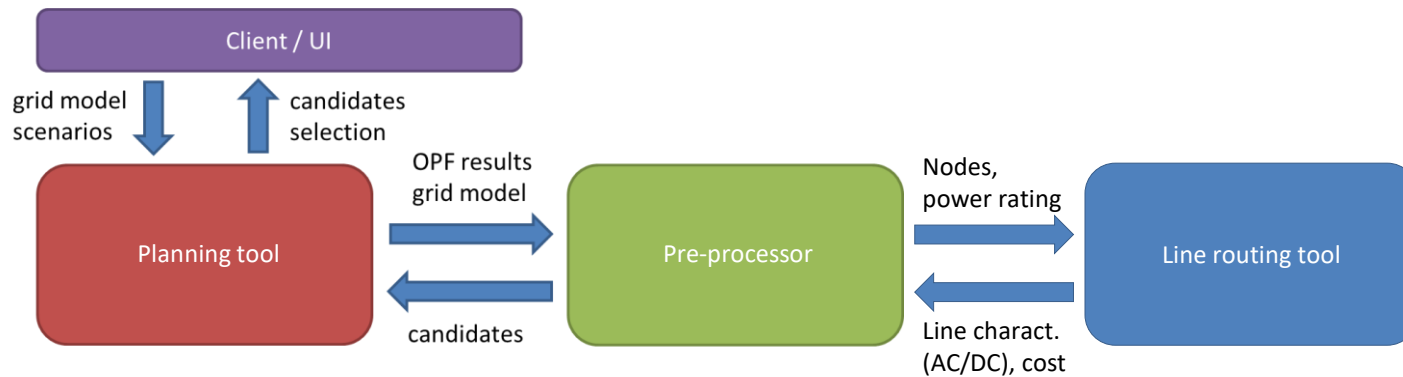
3. Pre-processor methodology steps

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Non-expanded OPF results:
- ❖ LM
- ❖ LMP
- ❖ PTDF
- ❖ Power flow direction
- ❖ Consideration of variants

Analysis of congestions

Node & branch selection

Yearly analysis of congestions:
- ❖ LM statistics
- ❖ Power flow direction check
- ❖ No. of congestion hours
- ❖ Consecutive congestion hours

Set of candidates for selected nodes

Check of constraints & charact.

- ❖ **Bus id**.
- ❖ **Type of bus**: substation; Industrial load; power plant; commercial load.
- ❖ **Availability of natural resources** (substation): water; cavern.
- ❖ **Loads supplied** (substation): residential/commercial/industrial; big industrial.
- ❖ **Location of bus**: urban; rural.
- ❖ **Geographic characteristics** (rural): mountainous; hilly; plain
- ❖ **Restricted area**: partial (for a technology) or total restriction.

- ❖ **Storage**: batteries (lithium ion, NaS and flow), hydrogen, hydro, compressed air storage (CAES) and liquid air storage (LAES).
- ❖ **Demand Response** (DR): through flexible loads.
- ❖ **Conventional network assets**: lines/cables (AC&DC) and transformers. Influence of updating lines in the grid.
- ❖ **Phase-Shifting Transformers**

- ❖ **Bus**
- ❖ **Size**
- ❖ **Cost**

4. Pre-processor interfacing

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- The user deals only with the planning tool, the pre-processor behaves in a "transparent" way.
- The pre-processor is hosted as **Docker image** in server of the planning tool.
- The integration between both tools is in progress.

5. Validation
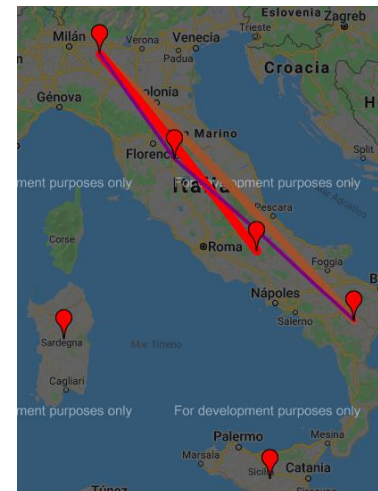
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Validation steps:
1. **Full case stand-alone**: Spanish (1 month) and Italian cases (few hours) have been tested.
2. **Six-node network integrated**: Italian case, 24 hours
3. **Full-size testing integrated**: whole Regional Case for one complete year, after both tools are integrated. Under development.

Previous validation work:
*   **Use of OPF results and PTDF matrix computed using DPF** (before the planning suite was able to provide PTDF values)**.** We forced the SW (modifying restrictions, for example) to prove that all types of candidates are provided, we checked that candidates were provided because of the influence of a congested line...
*   **Six-node network**: The SW was tested and results checked (D2.3).

Future validation:
*   The validation is performed following the integration process with the planning tool.
*   T2.4.: validate results, from a coherence perspective, using the Balkan RC, when ready.

6. Current and future activities

- The methodology is finished and coded.
- The handling of yearly variants needs to be implemented.
- The integration with the planning tool needs to be finished.
- The integration with the line routing tool is almost completed.
- We need to adapt the pre-processor to the future versions of the planning tool (still to come).

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FlexPlan public deliverables at https://flexplan-project.eu/publications/:

❖ **D2.1.** Definition and characterization of services to be provided by flexibility elements

❖ **D2.2.** Flexibility elements characterization and identification

❖ **D2.3.** Flexibility elements analysis pre-processor simulation tool (PU methodology)

- Most of the rules used in the pre-processor are heuristics and based on look-up tables.
- Aspects that are difficult to assess:
  - DR: difficult to provide a price that reflects the CAPEX and OPEX of DR for the SO.
  - Lines price: based on general numbers considering the existence of the length information: if this is not available, price per impedance or straight lines (when coordinates are available) are considered.
  - Size of candidates is difficult to assess from an OPF.
  - Certain technologies such as pumped hydro, PST, HVDC require specific studies: forced candidates.

Thank you…

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