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FlexPlan

Advisory Board| 29th October 2020

Pre-processor and planning candidates formulation

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Agenda

1. Methodology and interfaces
2. Selection of network locations for candidates
3. Proposal of flexibility candidates
4. Open points
5. Schedule

1. Methodology and interfaces

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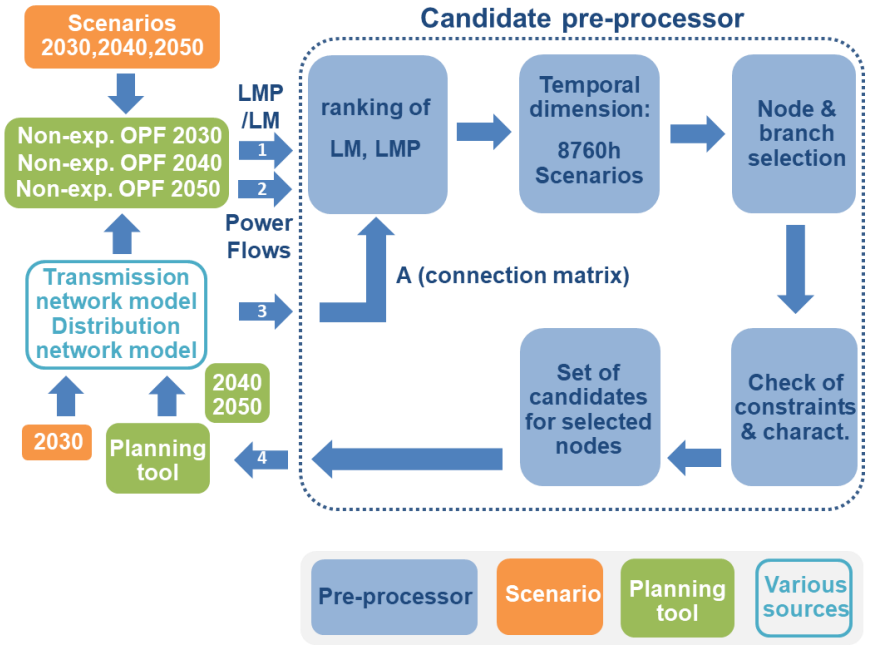

Interface	Description of required info.	Who	Format
1	LM (Lagrange Multipliers) & LMPs (Locational Marginal Prices)	Planning tool	JSON
2	Power flows in branches resulting from the OPF	Planning tool	JSON
3	Network model both for transmission and distribution: impedances, power rating of branches, connection matrix	Planning tool	JSON to interact with planning tool. PSS®E .raw format to use it locally (for the moment)
4	List of selected nodes/branches. Number of them to be defined through parameter. Set of candidates for selected nodes	Pre-processor	JSON. Including the following info: bus/branch id, technology type (code to be defined?), size, CAPEX, OPEX.

2. Selection of network locations for candidates

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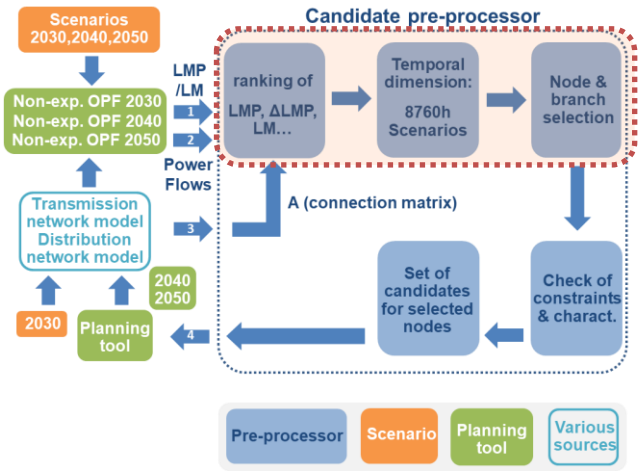

To perform the **location** selection **four steps are** proposed:

1. The ranking of Lagrange Multipliers (LMs).
2. The assessment of the temporal dimension.
3. Bottleneck elimination.
4. The node selection, through ranking.

1. LMs & LMPs

- **Lagrange Multipliers (LM)**: they provide information about the marginal cost of sending an additional MW through a branch. It permits to identify congested lines.
- **Locational Marginal Prices (LMP)**: they show the marginal cost to service the next increment of demand at a bus. It provides information useful for the location of flexible resources (storage, DR), new branches, and to cluster network areas.
- **The ranking of LM values** for a time interval should provide a preliminary ranking of candidates.

2. Temporal dimension of LMs

- Calculate the average value of absolute LMs for each branch during the year.
- Use the highest calculated average to select the most congested lines (we will have to select which statistic parameters are chosen for this selection).

2. Selection of network locations for candidates

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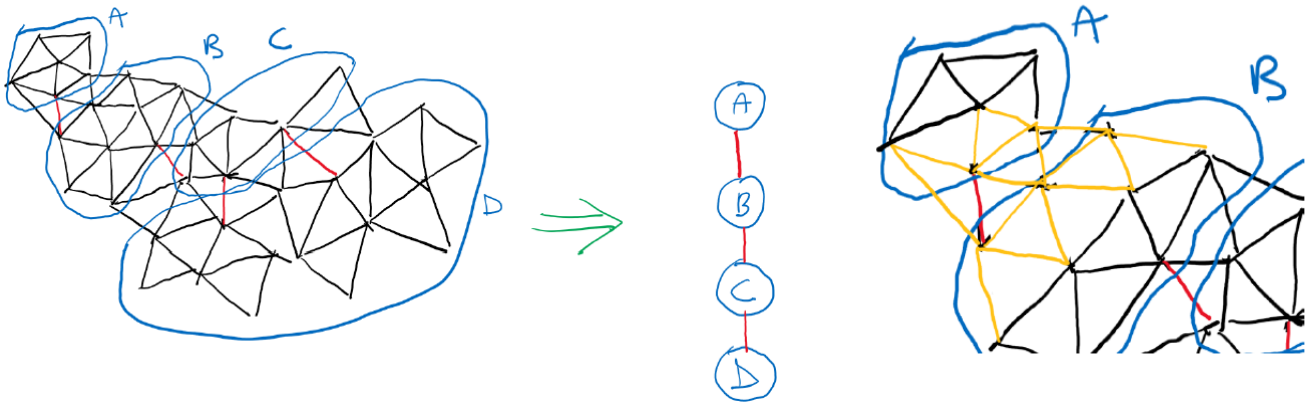
3. Bottleneck elimination

- Solving the congestion in a line may affect surrounding lines (the bottleneck might be transferred).
- A methodology has been proposed to take this into account in meshed networks.



4. Selection of location candidates

- Include congested lines (higher LMs) along with the lines more suitable to congest, as single candidates in the list.
- To provide storage or DR location candidates (buses) we will choose the higher LMP value within the selected branch.

3. Proposal of flexibility candidates

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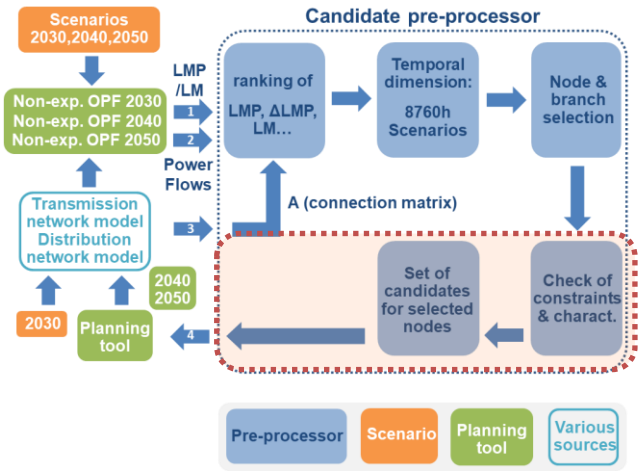

To perform the selection of flexibility candidates **two steps** were proposed:

- Check of constraints
- Selection of candidates

1. Check of constraints (and characteristics)

- We consider that, at this stage, the selection of network nodes has been performed.
- A heuristic approach is proposed to check the constraints and network characteristics at different levels:
  - **Location constraints**: the characterization of every node in the network model seems unfeasible, therefore, some iteration would be needed with regional case leaders or to use some simple rules of thumb.
  - **Branch characteristics**: for example, the power rate, number of circuits or the length of the line could be used to assess the feasibility to install a PST.
  - **Existence of industrial load at a selected node**: it permits to propose DR.

3. Proposal of flexibility candidates

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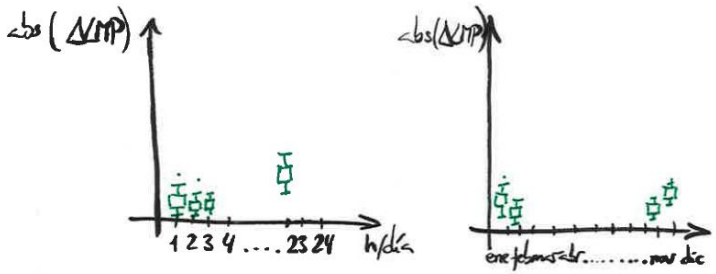
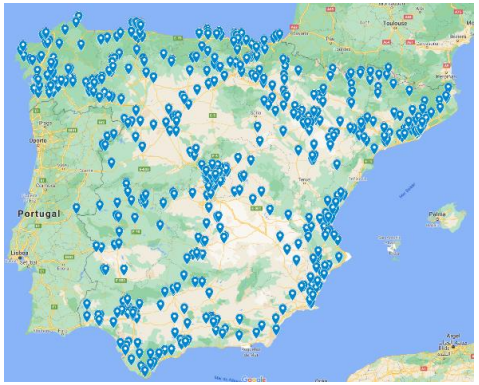
- **Congestion characteristics:** the analysis of the congestion may discard or support some flexibility technology. For the most congested branches, the following analysis is proposed:
    1. Calculate monthly and daily evolution of the congestion (statistical data)
    2. Show graphically this information: graphs, google maps. This may help to understand the nature of different congestions through the network (casuistry) and help define the methodology.





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2. Proposal of candidate list

- Simple rules of thumb are expected to select the candidate technologies of each of the selected locations based on the topic list above.
- For each technology in a specific location the following information should be provided:
  - Size: “standard” size for each technology. The planning tool will decide how many units of that standard size are optimum.
  - Cost: CAPEX and OPEX for each standard size of technology.

4. Open points

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Wide casuistry

- We expect a wide casuistry on congestions along the study period.
- Some aspects, as the bottleneck identification in meshed networks, have been anticipated but others will arise.
- Tests are foreseen to increase the understanding on what we will find through the LM analysis.

Inclusion of non-existing lines

- We should no restrict to existing lines in the current network.
- The existence of nodes with very different LMPs and close to each other may indicate that new lines are good candidates.

Stochastic approach (Monte Carlo)

- Some scenarios are being created in the frame of the project. To show the uncertainties linked to both electricity production and load, a Monte Carlo method is used.
- This presents some benefits (analysis of a higher number of “grid states”) but also some drawbacks in terms of higher effort and different candidate set proposal by the pre-processor to the planning tool.

5. Schedule

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Tasks	When
First version of the pre-processor tool	31/01/2021
Final version of the pre-processor tool	30/06/2021

Thank you…

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