Model description:

Input:

The model is defined by a set amount of inputs. Topology is constructed via identifying the lines (from\_bus, to\_bus). These lines have lengths, a globally defined susceptance/length, and a capacity limit.

Each bus can have multiple loads, renewable generation (RE) and conventional heat power plants (CHPs). The loads (+) are defined by their location and a hourly profile, so is the renewable generation (-).

The CHPs are only defined by their maximum output, location and price. The CHPs should be input in order of their price (from cheap -> expensive)

Prognosis 1:

The script sums all load profiles and RE profiles for each node. The imbalance remaining is filled with the CHPs. The first CHP is completely dispatched before the next is dispatched. This method ensure the system is inherently balanced. If there is too much RE generation at any given time, the system cannot be balanced and this will be outputted. If there is too little CHP capacity to balance the system at any given time, this will also be outputted.

Once there is a balanced prognosis, a load-flow is executed. Together with the line capacity this results in a prognosis for the amount and location of the congestion. Along with some visual representations of the system behavior

CBC functionality:

The CBC bids are defined by their direction (negative = less consumption = sell, positive = less production = buy), time and price (sell orders …TODO: clear explanation of pricing).

For the first activation strategy the expected congestion along with a predefined (config.py file) %, it is defined how much congestion should be solved by activating CBCs.

The CBCs are activated to minimize costs of activation. During the CBC selection is it assumed that any created imbalance will be mitigated by distributing the imbalance over all buses in the system (distributed slackbus). This approach does not ensure an actually optimal selection of CBCs, however, it is a reasonable approach of how TenneT might select CBCs without having to make predictions on the wholesale market. In small systems this approach can have a significant impact on the selection procedure. Once systems get bigger this effect should decrease.

* Only one upwards CBC and one downwards CBC bid per node

Market coupling:

After the CBCs have been selected, noise will be added to the load profle prognoses to simulate the discrepancy between D-2 prognoses and D-1 market bids. The CBCs will be added to the total load for each node. Subsequently, the CHPs will again deal with the imbalance so there is a balanced marketcoupling where load and RE was fixed.

The approach of treating CBCs like extra generation or load instead of coupling them with a specific generator or load does not impact the way the model runs (TODO: Add CBC bid for every RE??). (TODO: perform manual load flow to see how much congestion was actually mitigated after the CBC activation , this will be a measure of how well the distributed slack assumption works)

RD functionality:

Lastly, the RD orderbook (similar to CBC orderbook) will be used to find an optimal (minimize costs for operator) RD selection that also mitigates all congestion. RD selection procedure differs from CBC selection because of the balance constraint (volume up = volume down) inherent for RD bids.

* Only one upwards RD and one downwards RD bid per node