



# System Development

Methods and lessons learnt from pilot tests



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EXPERT POWER  
SYSTEM PLANNING



**Elia**

BELGIUM





**2 public deliverables  
2 internal deliverables**



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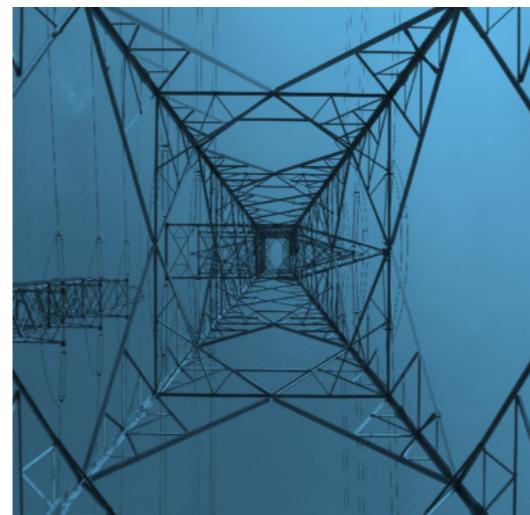
# OUTLINE



**Main challenges of the system development process**



**Proposed workflow for system development analysis in the GARPUR framework**



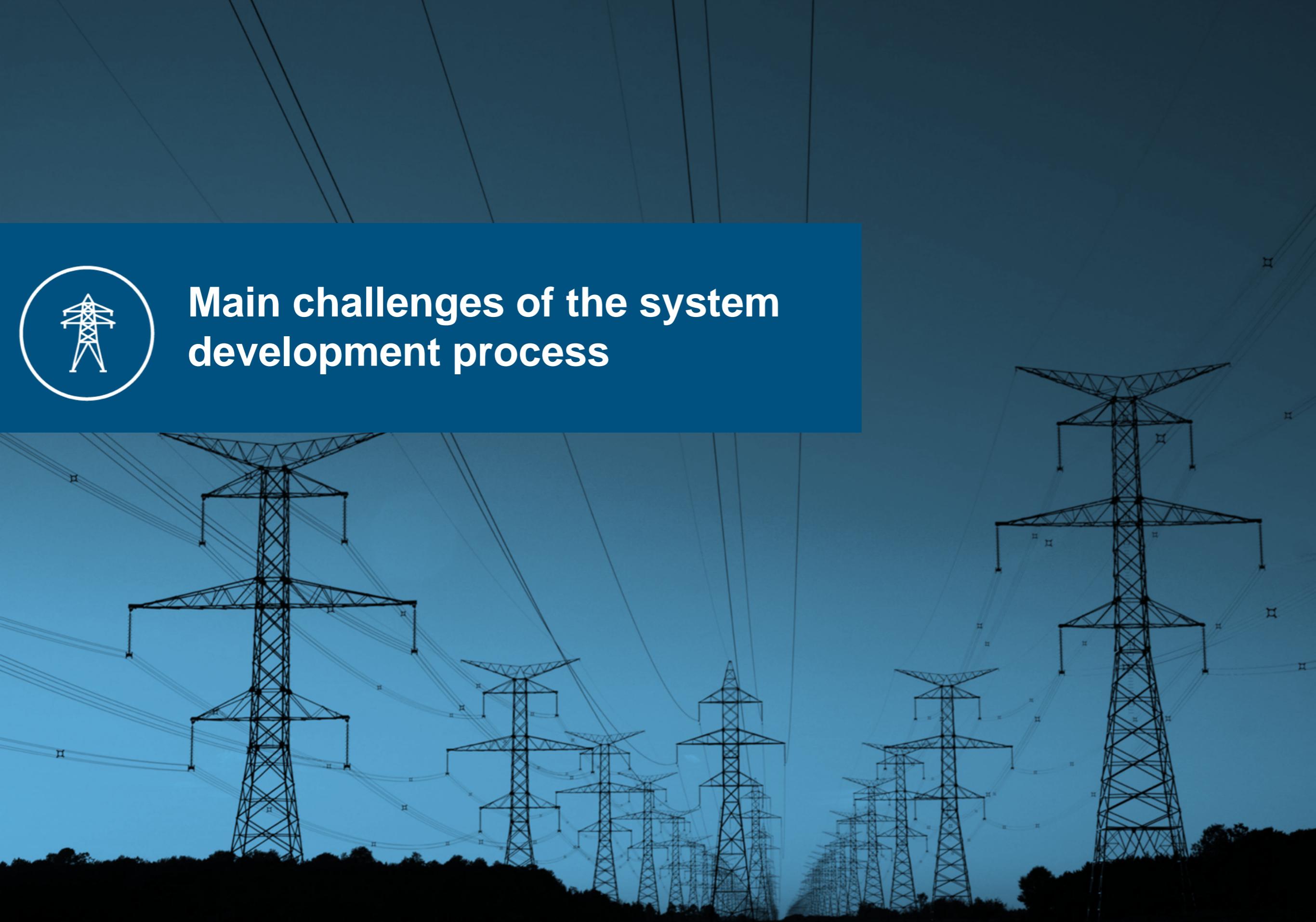
**Near real-life pilot testing**



**Lessons learnt and main recommendations**

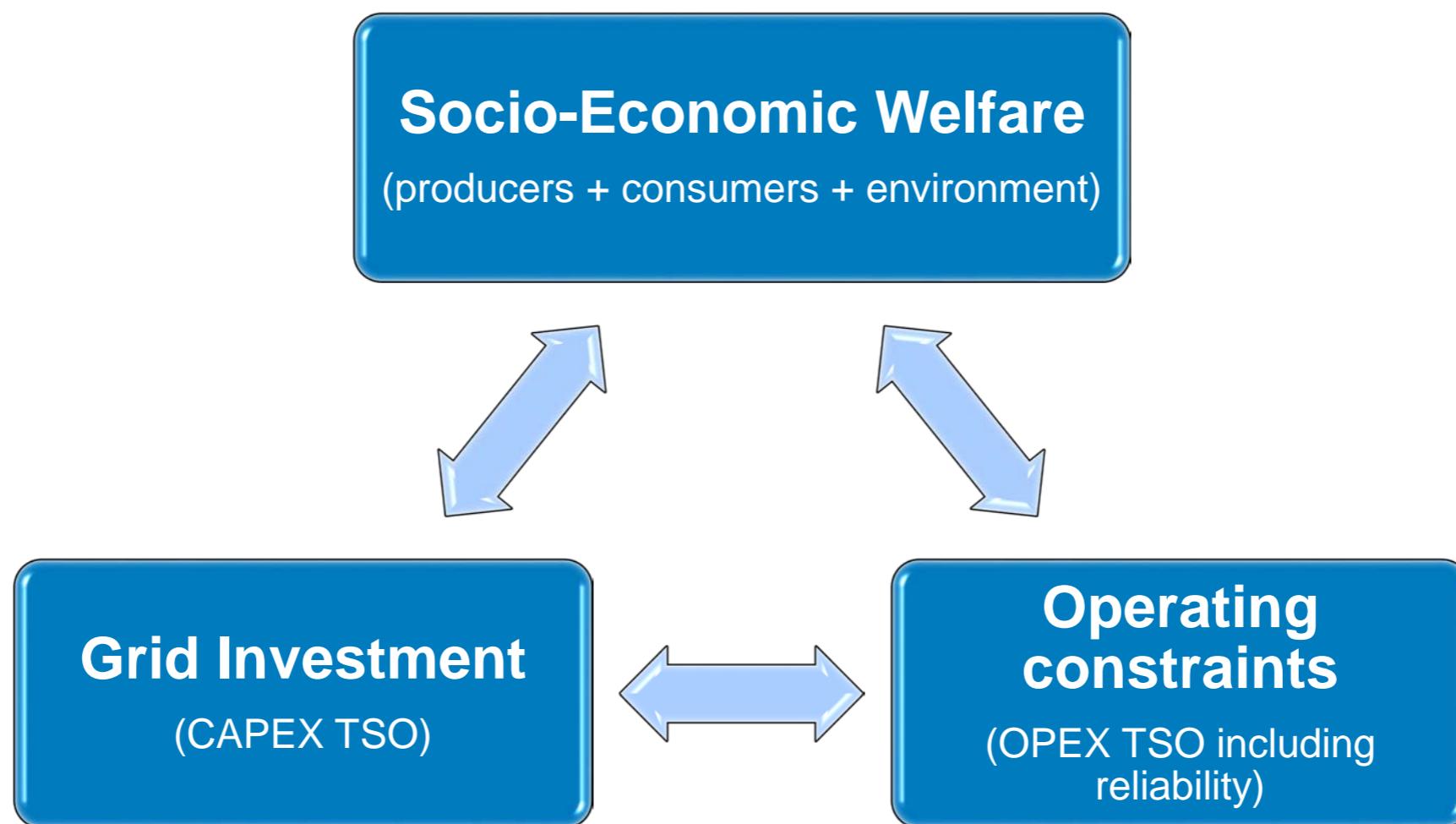


# Main challenges of the system development process



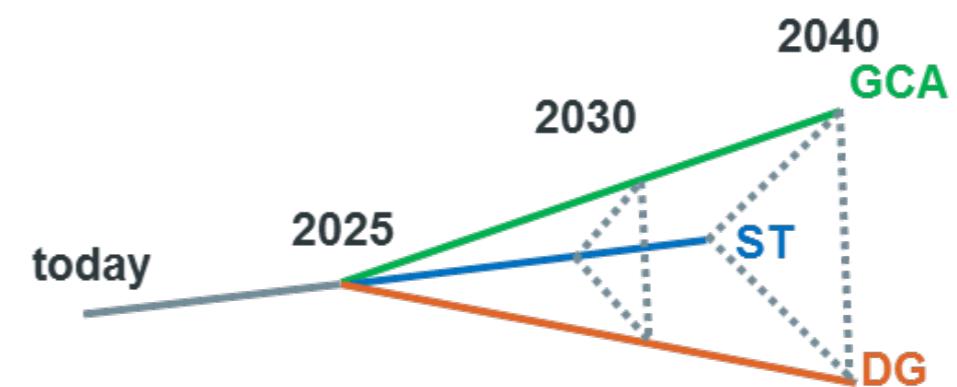
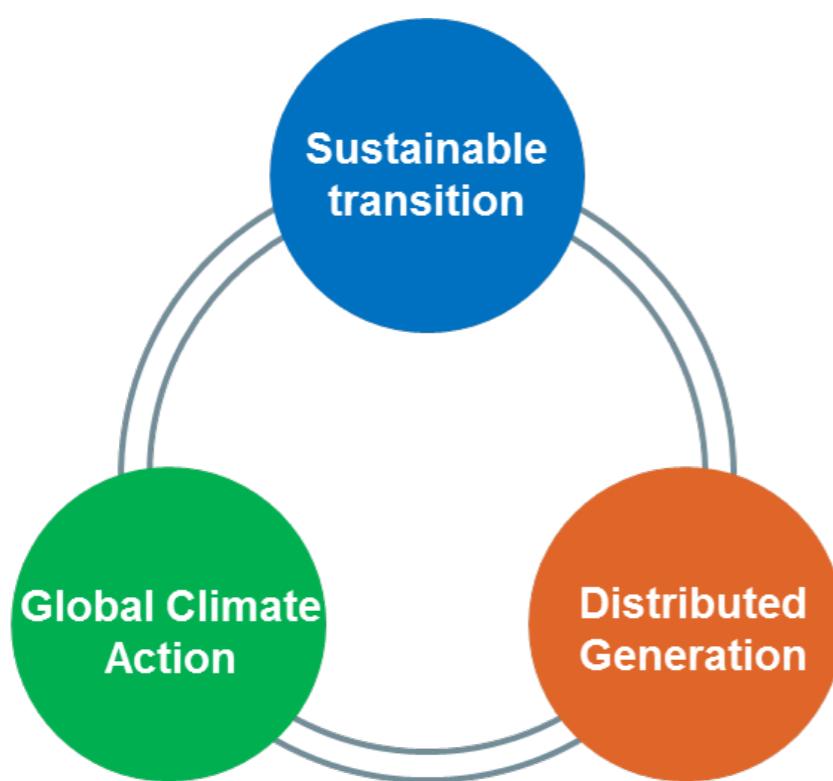
# Main challenges of the system development process

- The core of system development is development of an adequate transmission system in taking into account economic efficiency



# Main challenges of the system development process

- System development looks very far ahead in time → very large range of uncertainties
  - Macro-scenarios group the uncertainties about fuel prices, technology prices & maturity, load evolution, generation mix & location...

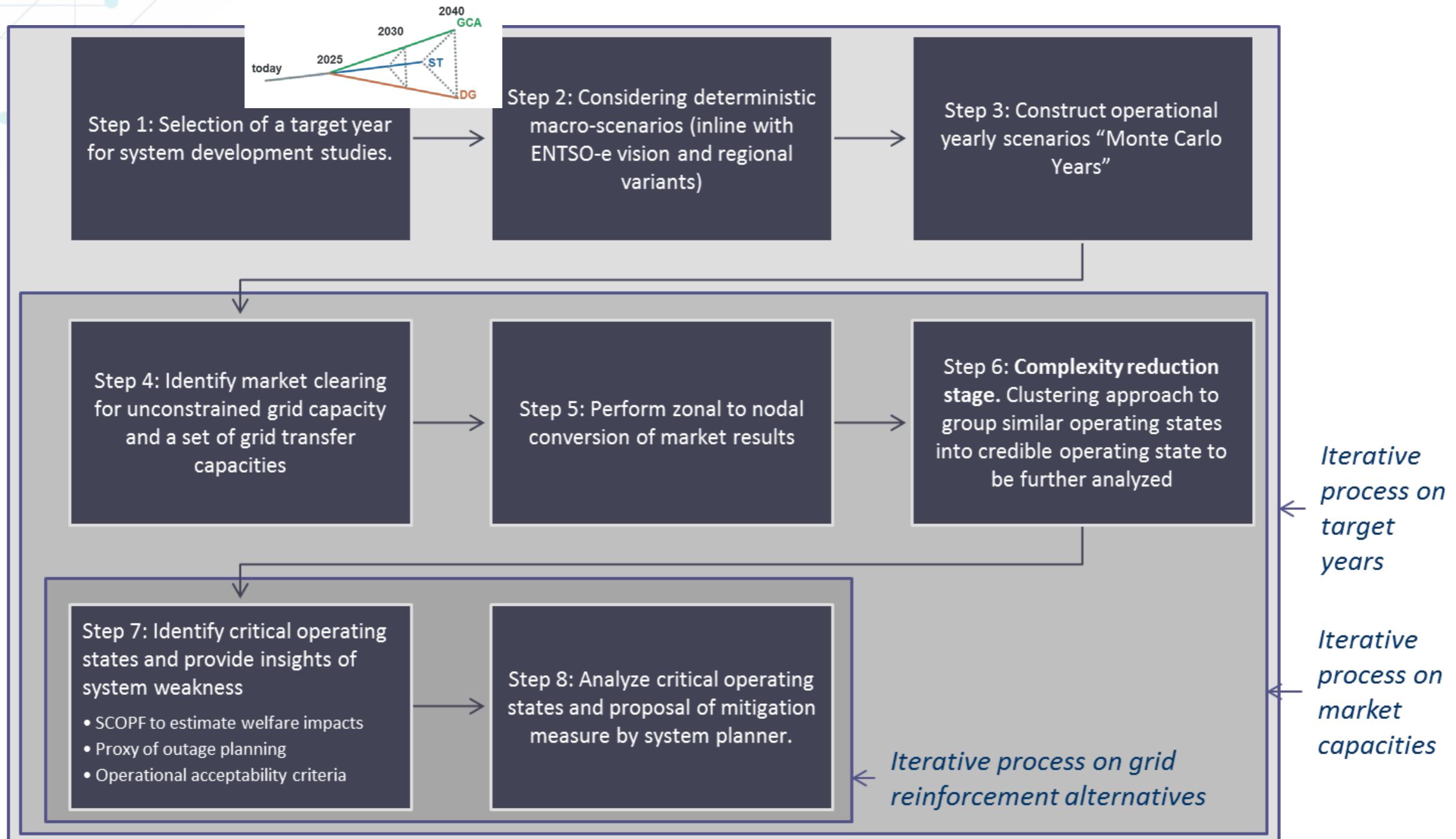


i.e.: Macro-scenario TYNDP 2018



# Proposed workflow for system development analysis in the GARPUR framework

# Proposed workflow for system development analysis in the GARPUR framework





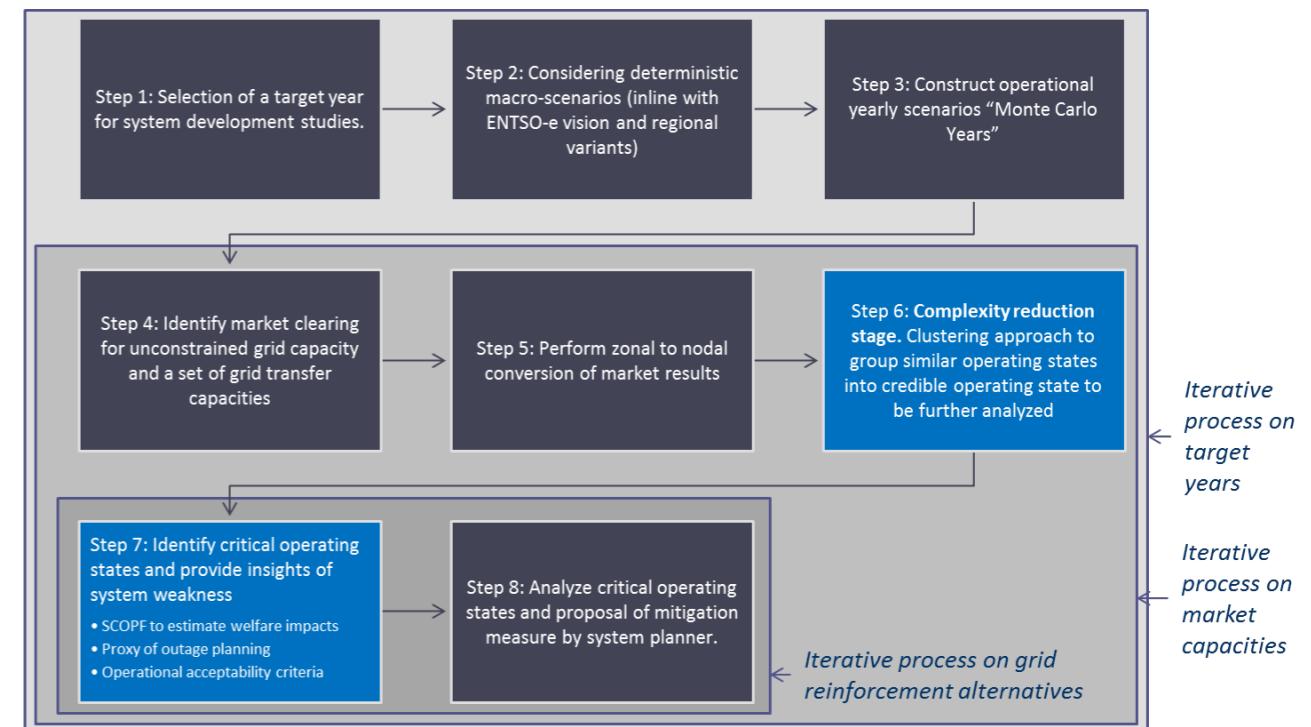
## Near real-life pilot testing



# Near real-life pilot testing

## Pilot test objectives:

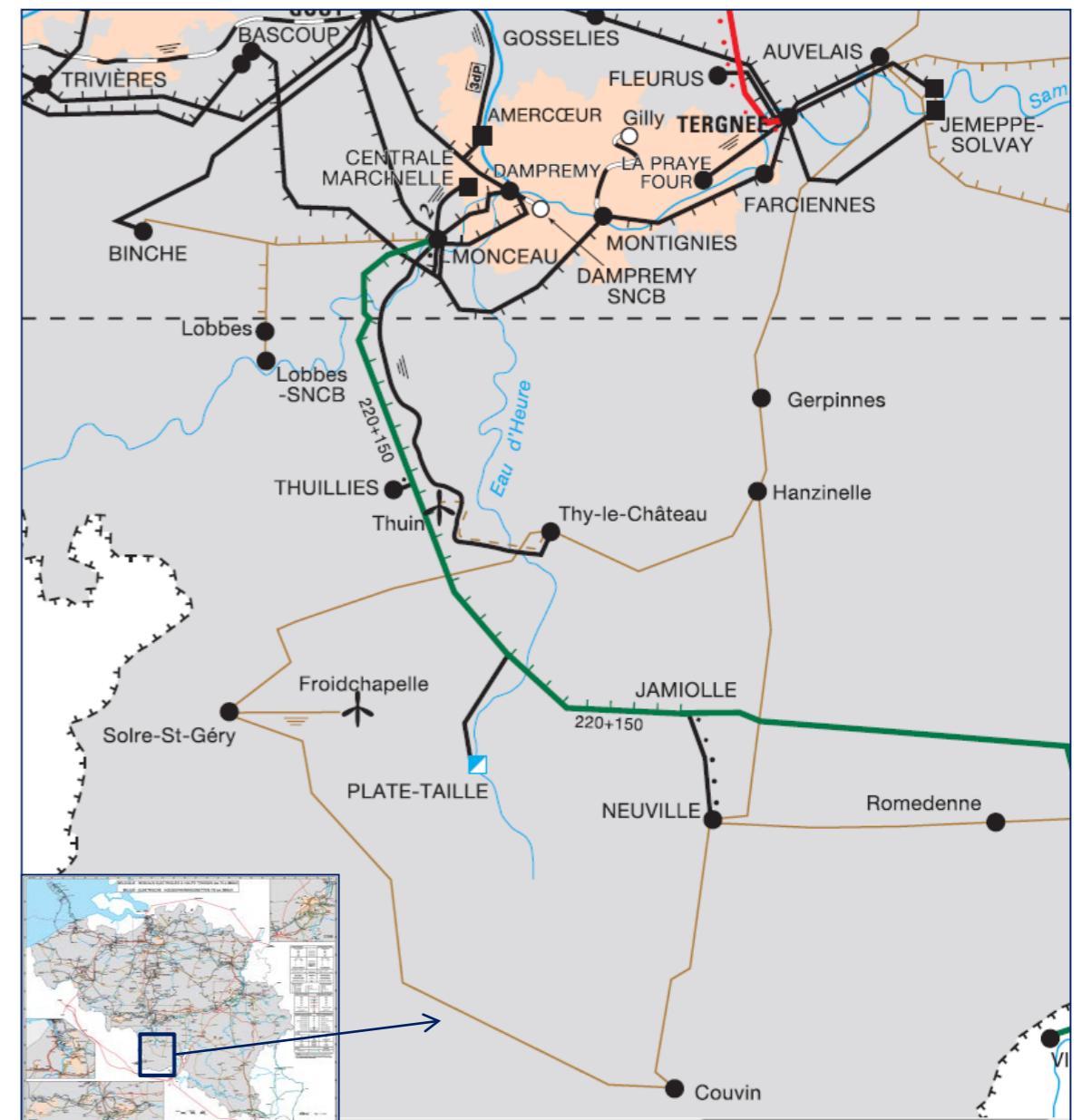
- To validate the concept proposed by GARPUR for the screening of operating states in a near-real life environment
- To compare its performance with more conventional approaches implemented in the same environment
- Recommendations for improvement of the new approach



# Near real-life pilot testing

## Belgian regional transmission grid:

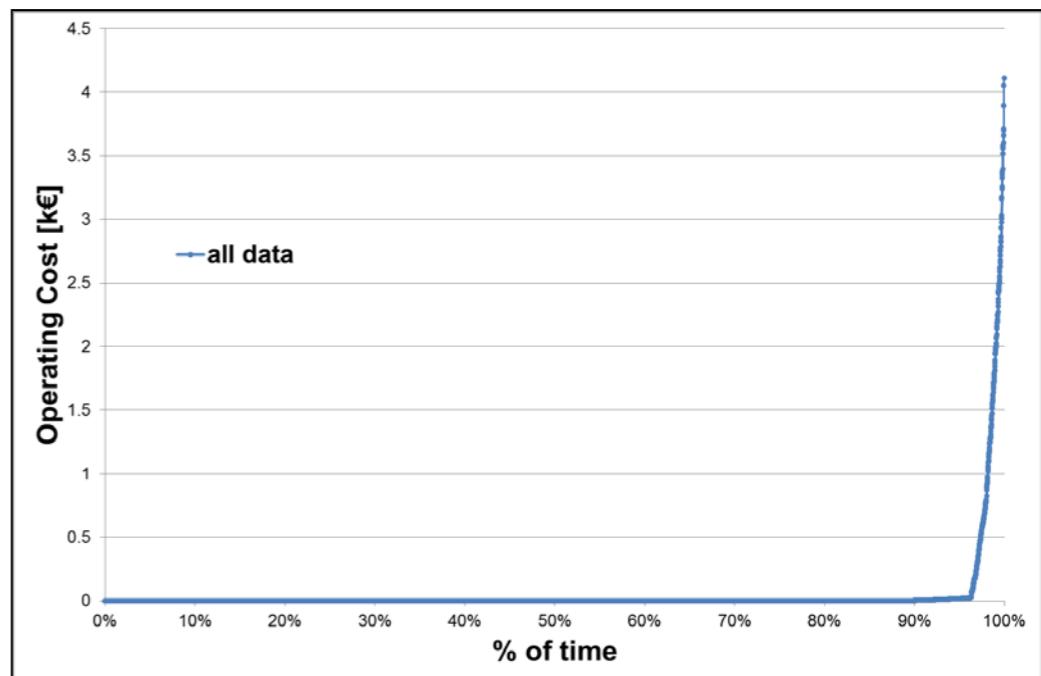
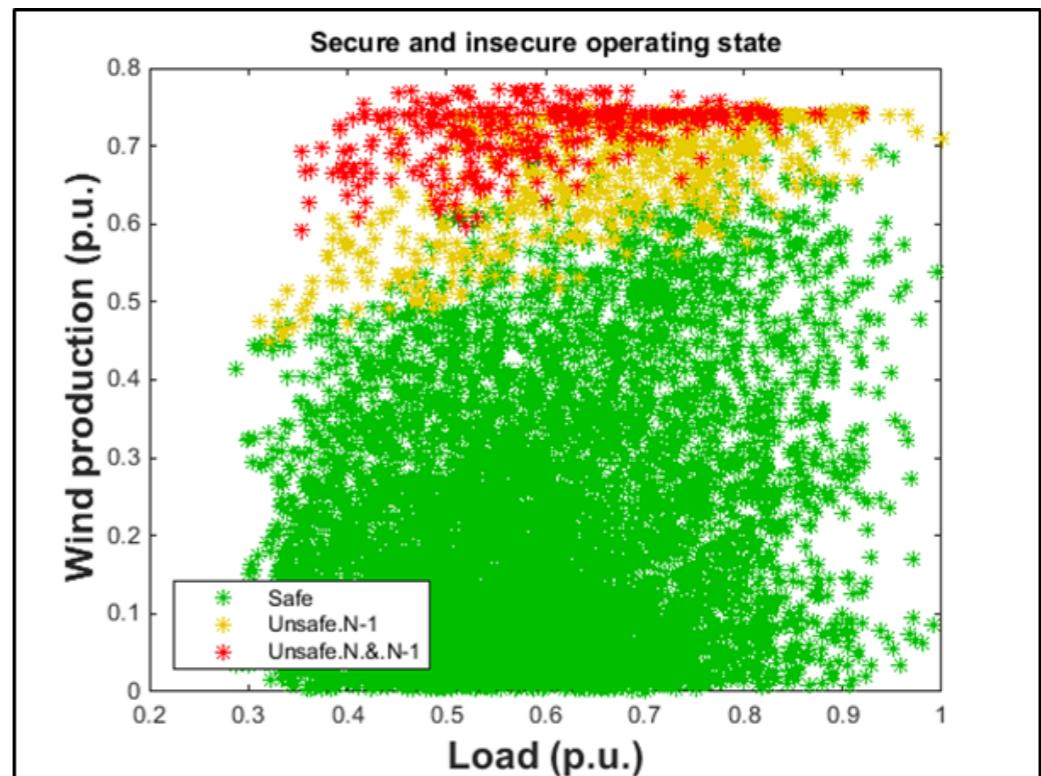
- Rural 150 - 70 kV grid
- Main needs in LT:
  - End of Life: [2025 – 2030]
  - Wind integration
  - Maintainability assessment



# Near real-life pilot testing

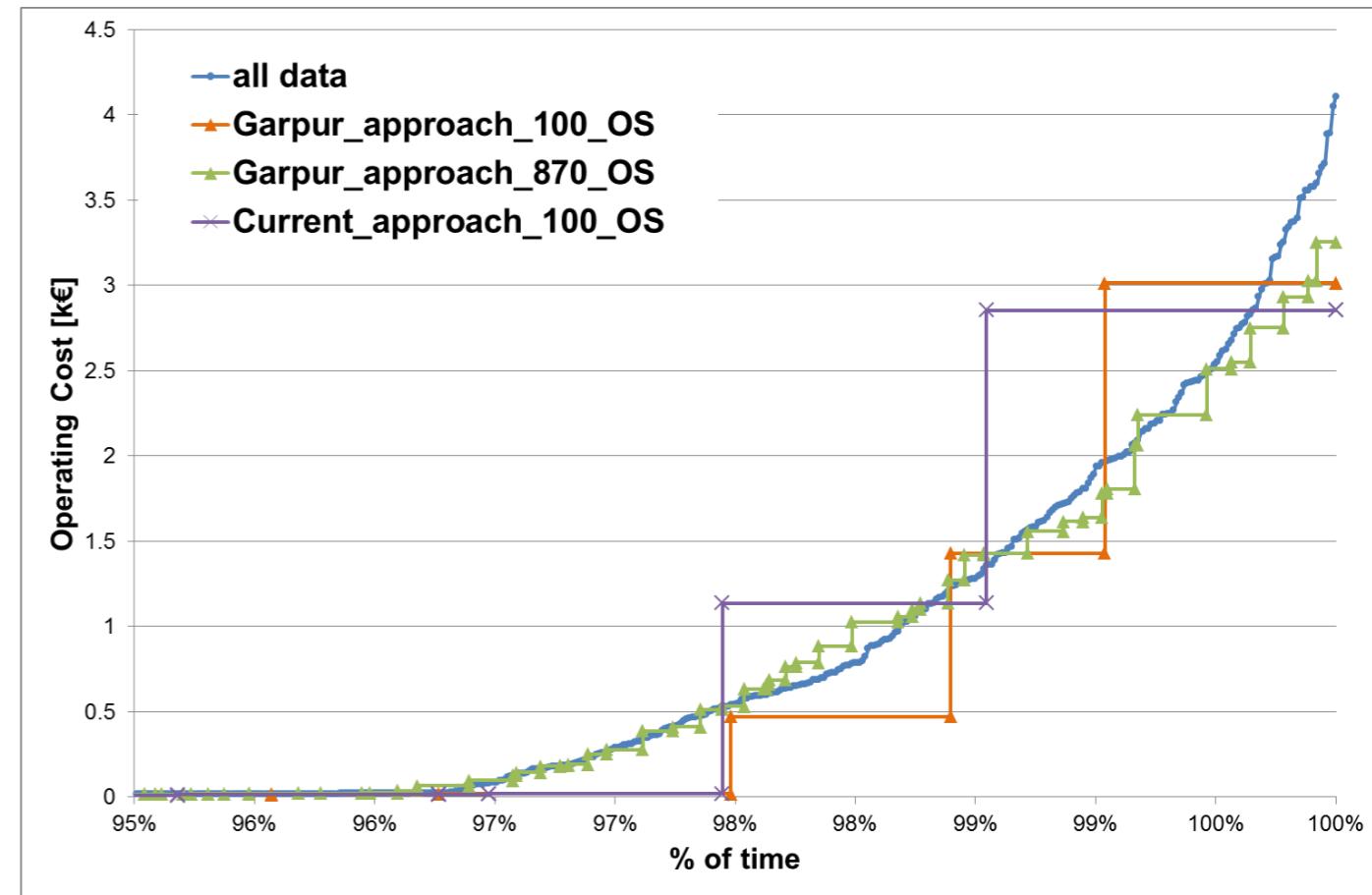
Results on full year data set (1 point = 1 hour)

- 14% of the operating cases were insecure (N and N-1)
- Only 4% of the operating cases are a significant operating cost (OPEX) if taking into account the failure rate (Insecure in N)
- Global operating cost is 414 k€/yr



# Near real-life pilot testing

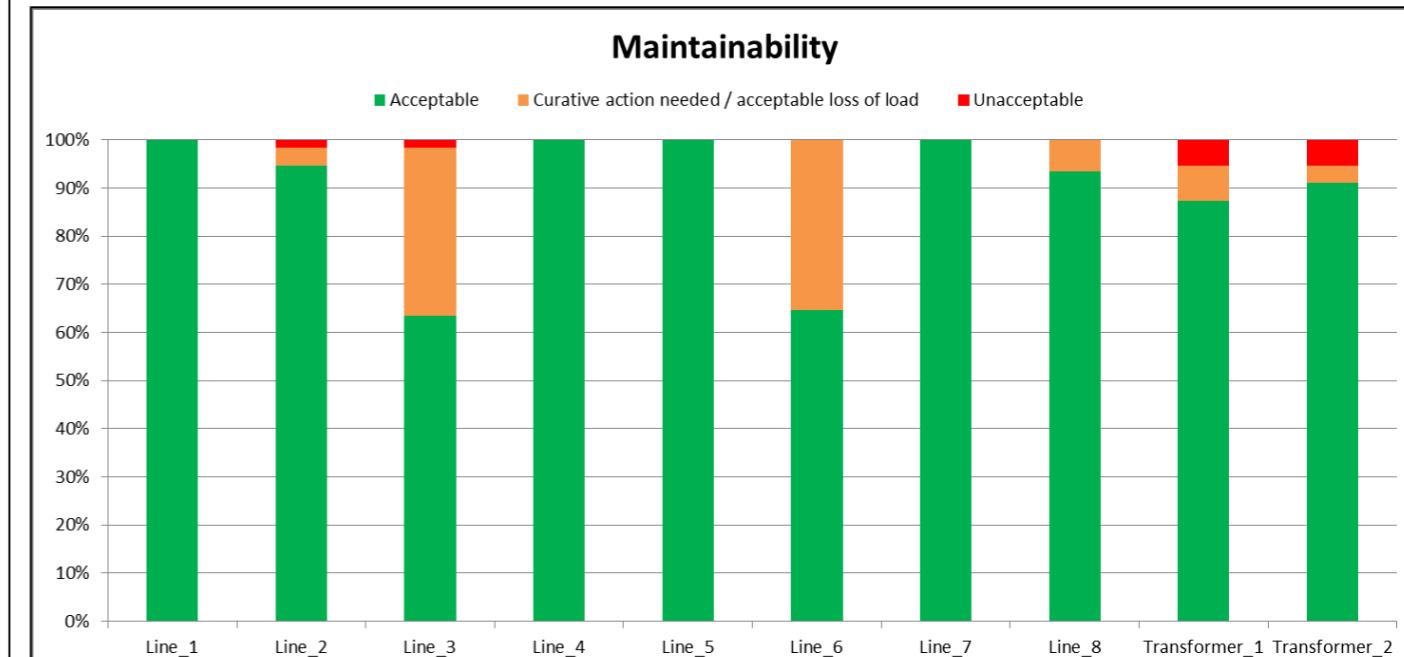
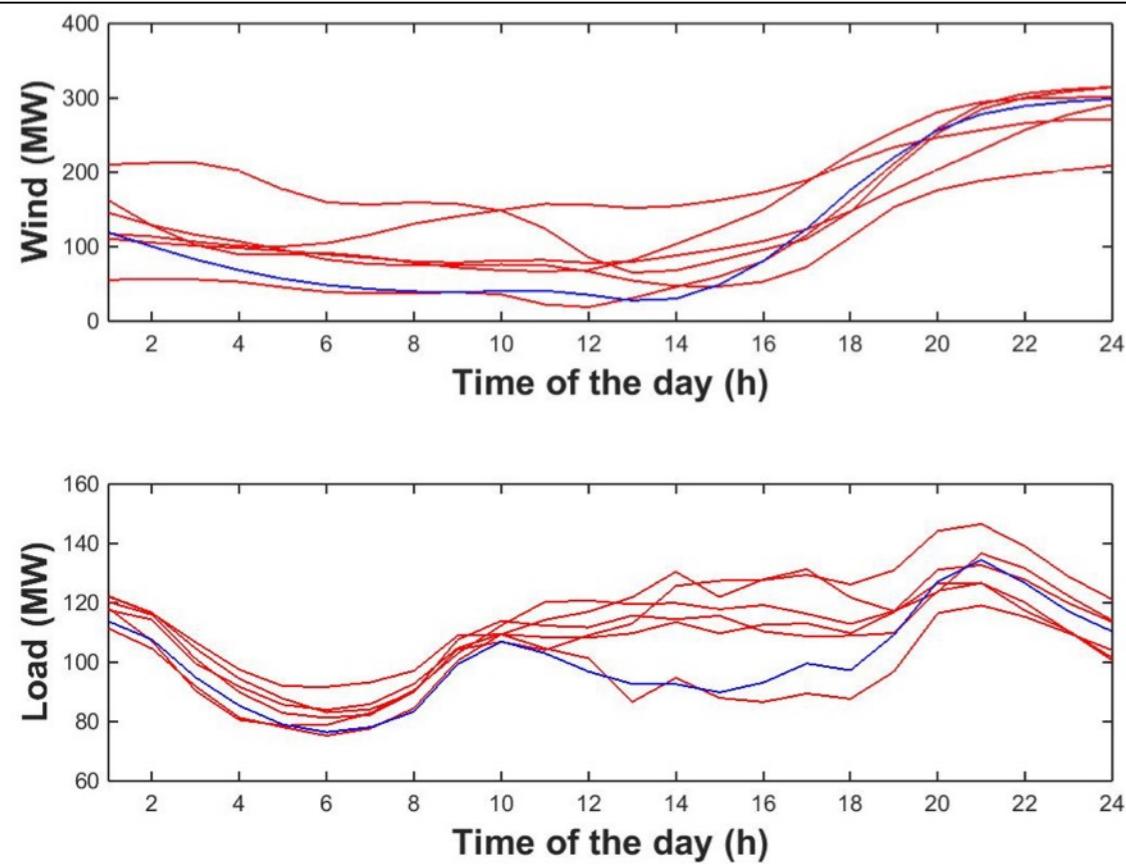
- All assessed clustering methodologies failed to capture the high impact / low probability operating state.
- Computation time to cluster all data to 100 representative Operating States (OS)
  - Current method : 15 minutes (Solver Tool in Excel)
  - K-means : 1 minute (Matlab)
  - (3.4 GHz – 8 cores – 16 GB)



Approach	Operating cost	
	[k€]	Relative Error
Full data set	414	0%
Clustering GARPUR (K-means)	100	-8.9%
	870	-4.1%
Clustering Current (Solver in Excel)	100	15.2%

# Near real-life pilot testing

- To evaluate the “maintainability” of the grid:
  - To compute all the N-1-X (the first -1 being a planned outage and the –X being a contingency list) on the typical reference days (result of 24 h time series clustering).





## Lessons learnt and main recommendations



# Lessons learnt

- Proposed workflow for system development analysis:
  - The implementation of the reliability criterion and socio-economic assessment
  - To be adapted to different power systems
  - The migration from current TSO practices
- Method/proxies validated on a real test case and in a real-life environment ([Tools used within Elia](#)) with main focus on:
  - Complexity reduction stage
  - Impact quantification
  - Assessment of maintainability



# Main recommendations

- Recommendation 1 - “Collect and share outage data”
  - Define a framework for collecting context dependent asset outage data.
  - Adopt framework on a larger sampling base to improve data quality
- Recommendation 2 - “Study a wide variety of contexts and clustering”
  - Establish grid development standards to consider the different expected future operating conditions and their evolution to plan the power system
  - Adopt suitable clustering methods to allow a greater but not excessive number of ‘micro-scenarios’ to be assessed
- Recommendation 3 - “Consider and quantify operational impact of events”
  - Improve the SCOPF algorithm to mimic the actions of the operator in short-term / real-time
  - Define at EU level the factors to be considered for adequate evaluation of the societal impact of events on grid users, TSOs and regulators
- Recommendation 4 - “Take into account maintenance scheduling in grid development context”
  - Adopt methods for the analysis and quantification of impact of maintenance and project work



# THANK YOU FOR YOUR ATTENTION

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