



**21<sup>st</sup> International Conference on Renewable Energy and Power  
Quality (ICREPQ'23)  
Madrid 24-26 May 2023**



**FLEXENER**  
*PROJECT*

*Dec-2020 - Dec-2023*

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*24/05/2023*

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Subvencionado por el CDTI

Internal Use



# Index

1. Concept
2. Objectives
3. Project organization
4. Main tasks
  - Scenario generator tool
  - Simulation platform
  - Small-scale simulation
  - Large-scale simulation
5. Preliminary Conclusions



# Concept



TSO meetings  
Complex Grid Analysis  
Max Renewables integration



Detailed Electrical  
Grid



Why not, we make  
these analysis as well?

# Concept

New project to run different simulation scenarios in order to calculate the maximum renewables integration in Spain

Spanish electrical TRANSMISION grid model

Conventional power plant models

France and Portugal interconnections

Storage and SynCon models

Wind and Solar PV power plants models

Grid forming - Inertia

Power forecast

Old and new grid codes

Grid feeding

Specific area DISTRIBUTION grid model

Real scenarios with different level of renewables

Demand performance

Generation Dispatch

Low levels of curtailments

Stability studies

Time and Frequency domain

Software package

PSS/E, DigSilent, PSCAD

Markets definition: Inertia, P/F, POD, etc

Stable grid

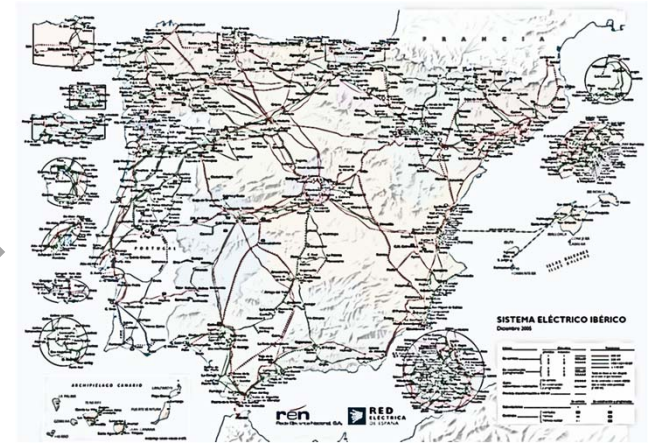
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# Concept



Flexible Energy Project

FLEXENER Project

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# Objectives

**Complex grid analysis considering different simulation scenarios and renewables technologies, maximizing renewables integration.**

**Scenarios generator tool.  
Transmission and Distribution**

**Software platform to make static and dynamic simulations.  
Globally and Locally**

**New Renewables models.  
Grid feeding and Grid forming**

✓ Generation and energy demand in 2030- PENIEC



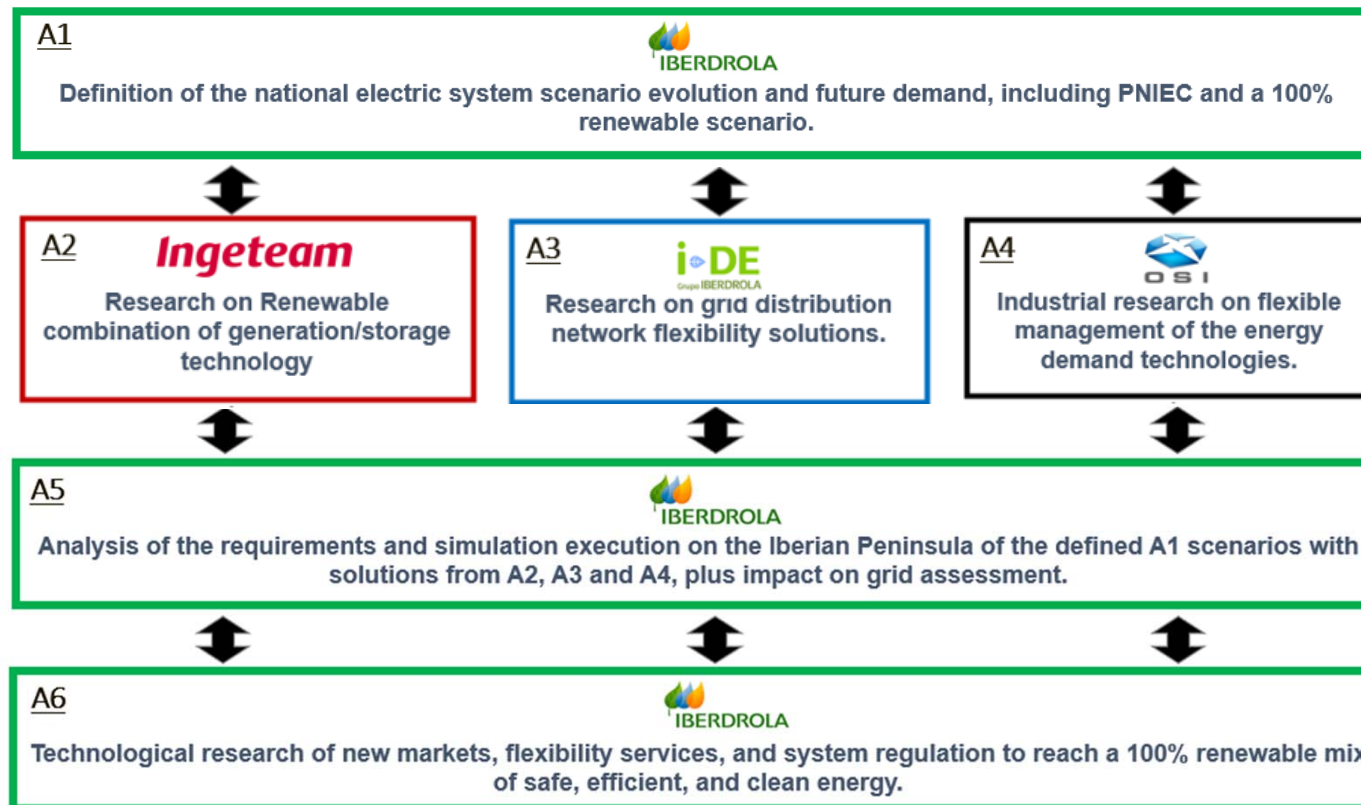
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# Project Organization

PROJECT LEADERSHIP  IBERDROLA



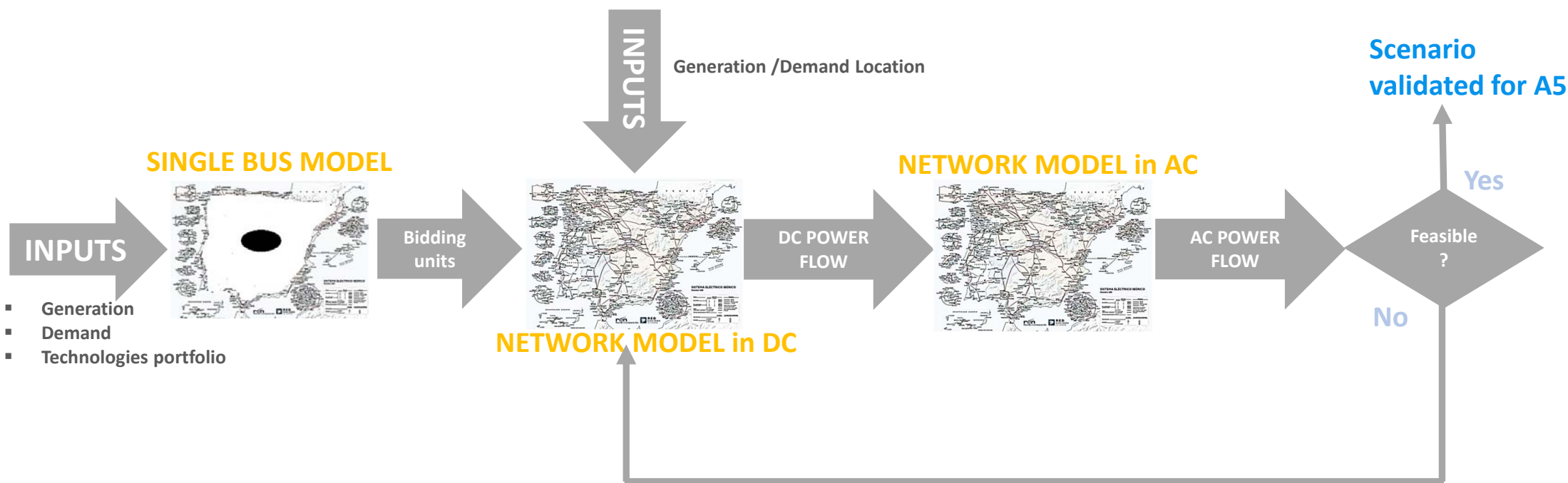
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# Scenario generation tool



- Generation
- Demand
- Technologies portfolio

Scenario validated for A5

Yes

Feasible ?

No

NETWORK MODEL in DC

NETWORK MODEL in AC

SINGLE BUS MODEL

INPUTS

Generation /Demand Location

Bidding units

DC POWER FLOW

AC POWER FLOW

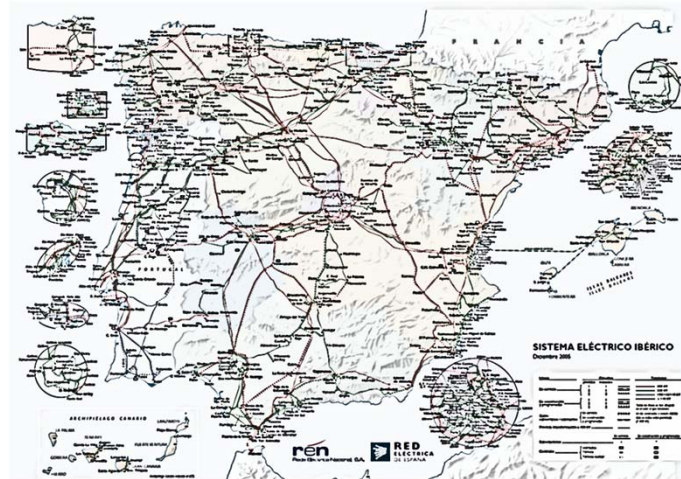
INPUTS

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# Simulation Platform

## NETWORK MODEL in AC



### INPUTS

- Transmission Lines
- Conventional Power Plants models

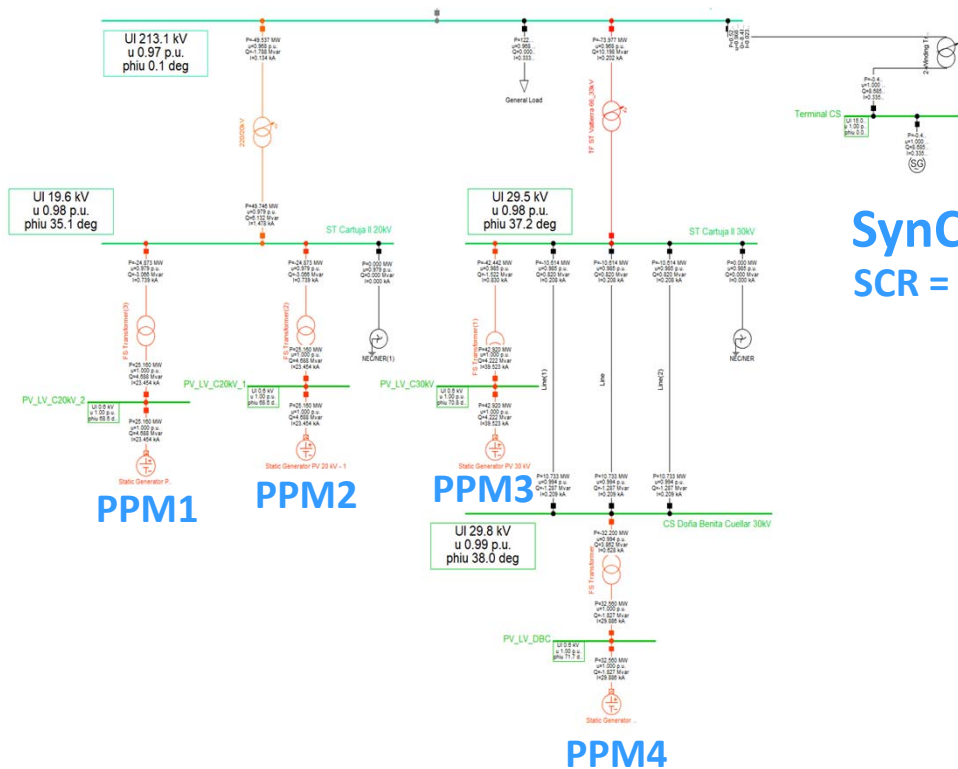
### INPUTS

- Models Grid Feeding, Grid Forming
- Different Scenarios, Generation / Demand
- Different grid events

Static Simulations

Dynamic Simulations

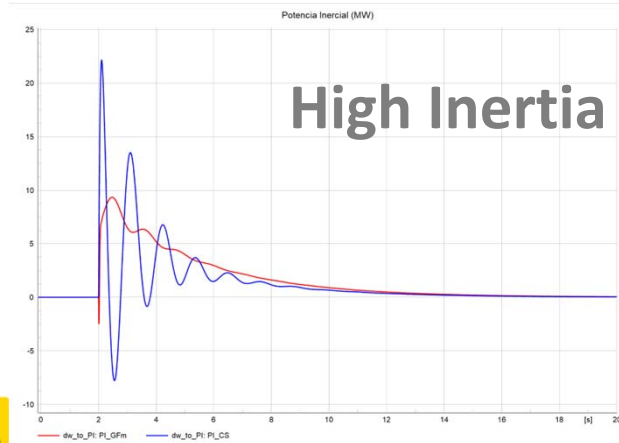
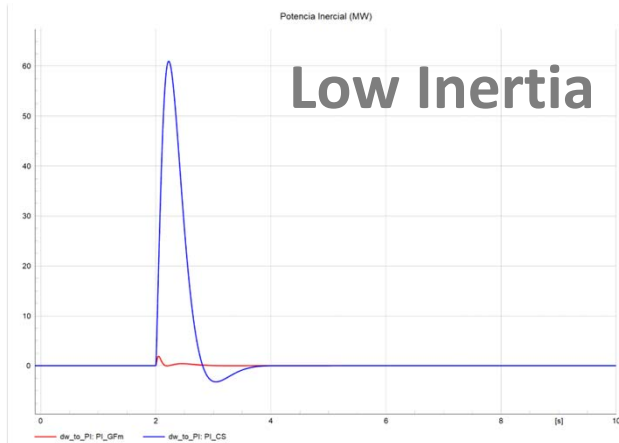
# Small-scale power system model



SynCon  
SCR = 1.5

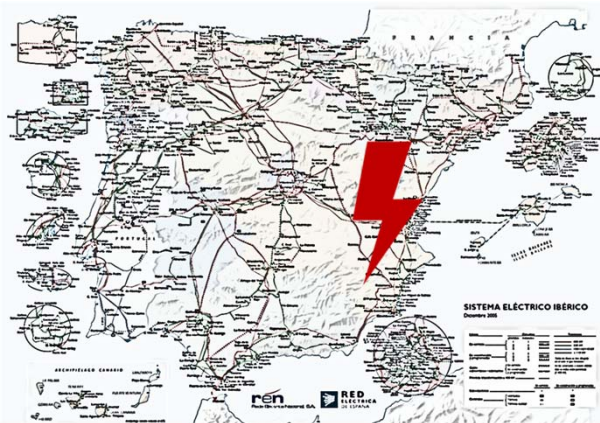
- ✓ SCR = 1.5. INDAR SynCon Model
- ✓ Models Grid feeding & grid Forming
- ✓ Combination of models from SGRE and INGTEAM
- ✓ Static & Dynamic simulations

# Small-scale power system model

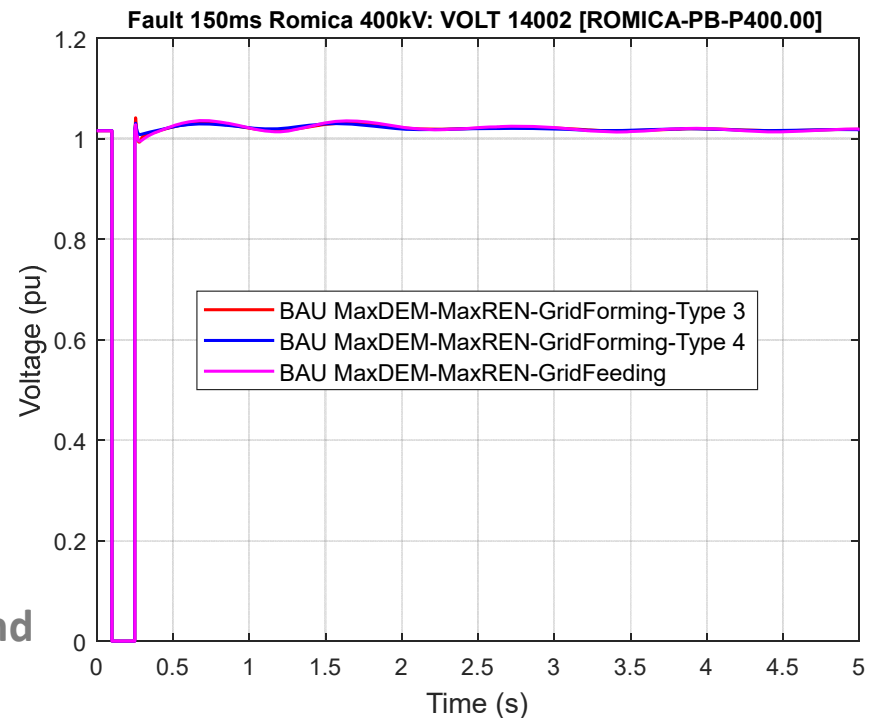


- ✓ Different performance, Ingeteam & SGRE
- ✓ Grid Forming models have an impact in the SynCon performance
- ✓ Different dynamics and interactions
- ✓ Limited information about new grid forming models
- ✓ Detailed analyses are necessary to define the best parameters that could help the system.

# Large-scale power system model

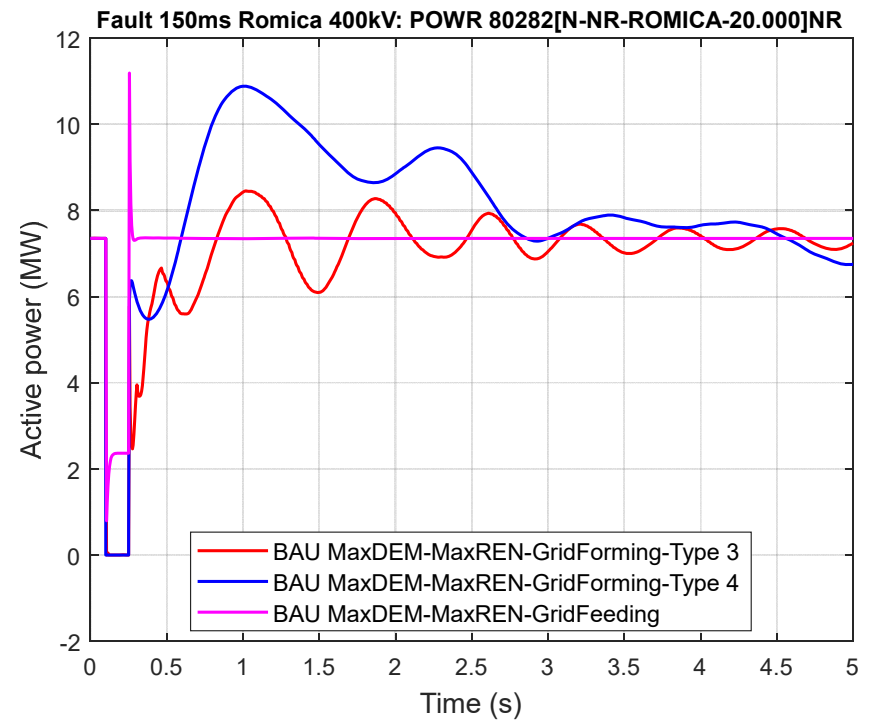
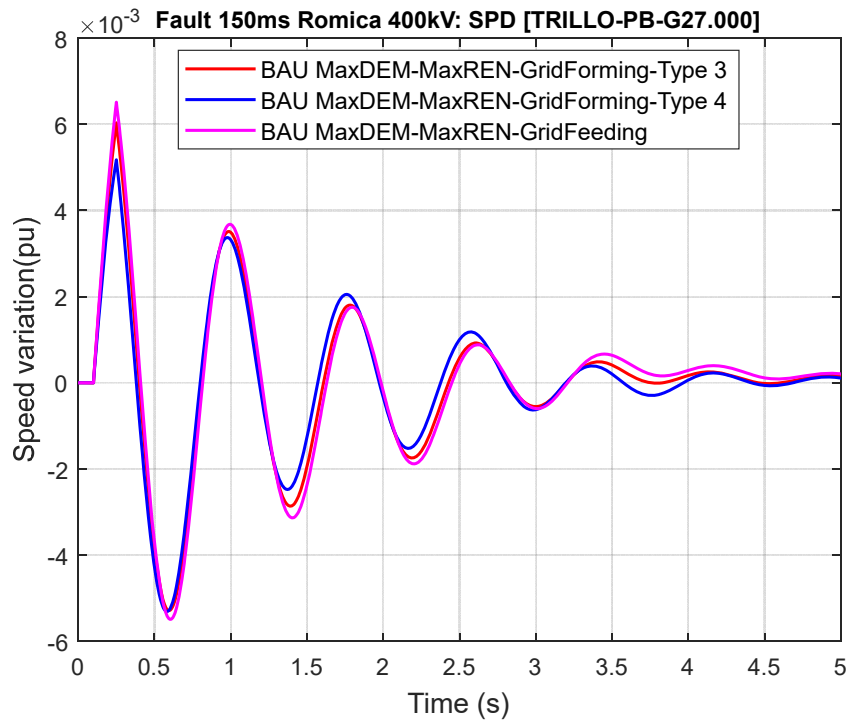


- ✓ Scenario Max demand, Max renewables generation
- ✓ 3-phase fault in Romica (Albacete)
- ✓ Comparison between Grid Forming type 3 and type 4 and grid feeding





# Large-scale power system model







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## Preliminary conclusions

- ✓ Multi-skilled team is necessary to complete this project
- ✓ The design for the scenario generator tool and simulation platform is crucial to generate global and local simulations
- ✓ Model information available will be key in understanding the performance of the complex simulation
- ✓ It will be challenging to fine tune the Grid Forming controllers to get a suitable global response
- ✓ A new grid with large integration of renewable cannot be handled by just one company. Multiple stakeholders must participate in the process

# FLEXENER TEAM

**Ingeteam**

**SIEMENS Gamesa**  
RENEWABLE ENERGY

**BALANTIA**  
ENERGY TRANSITION PARTNER!



**Indar**



**i-DE**  
Grupo IBERDROLA



**wallbox**



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