INESC TEC

INSTITUTO DE ENGENHARIA
DE SISTEMAS E COMPUTADORES,
TECNOLOGIA E CIÊNCIA



Principais tecnologias para resposta às necessidades futuras de estabilidade e flexibilidade

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ELECPOR webinar

Novembro 2026

Breaking News





Setting the Stage - New Big Challenges (and Opportunities)

Electrical demand will grow significantly → New loads:

- **Electrification of industry / new industries**;
- **Electric mobility** (smart charging, V2G, fast and ultra-fast charging);
- **Data centers**;
- Cryptocurrency mining - Bitcoins;
- **Heat pumps**;
- **Electrolysers**.

Renewable generation needs to increase PNEC / RMSA

- **Solar PV**
- **Wind generation (onshore and offshore)**

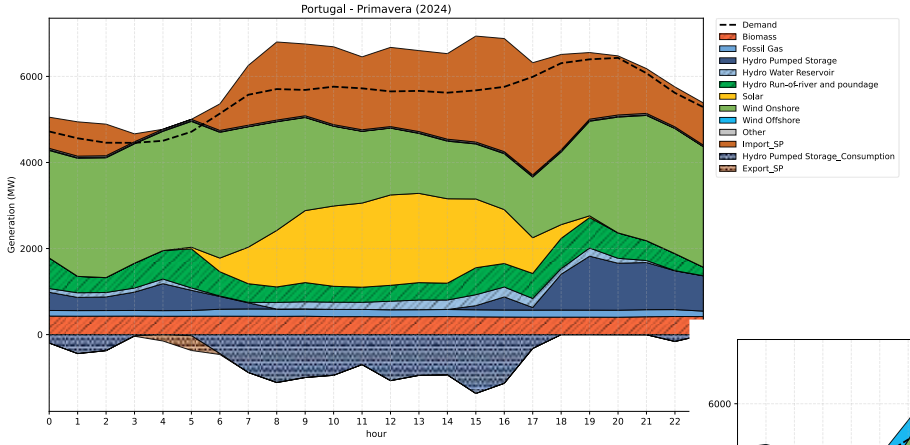
- **Eletrical grids need to to be expanded and reinforced**

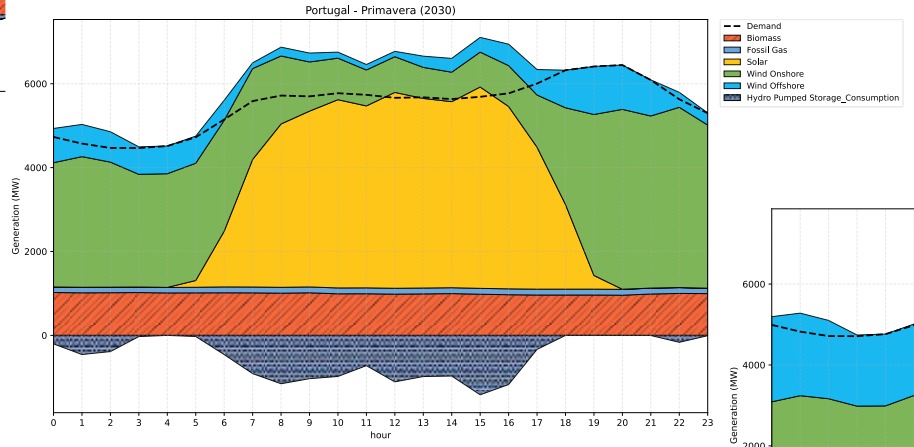
More fragile system

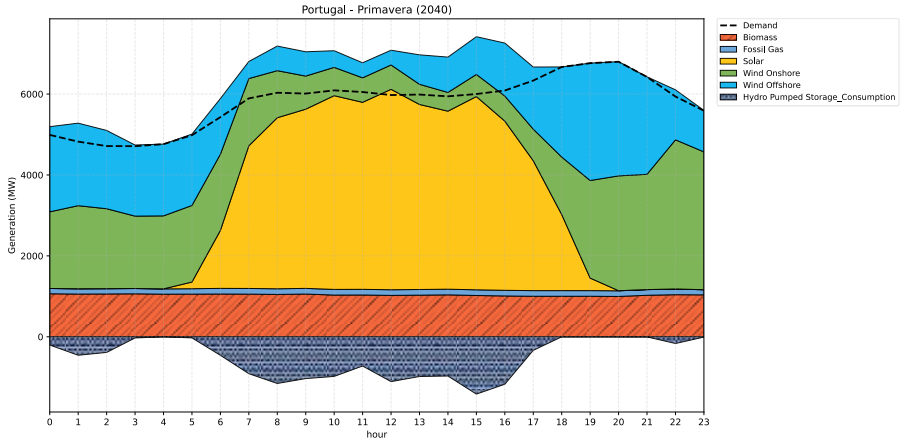
- **Energy storage and flexibility will be key for this electrification path**

Setting the Stage – New Scenarios of Operation

Spring Scenarios

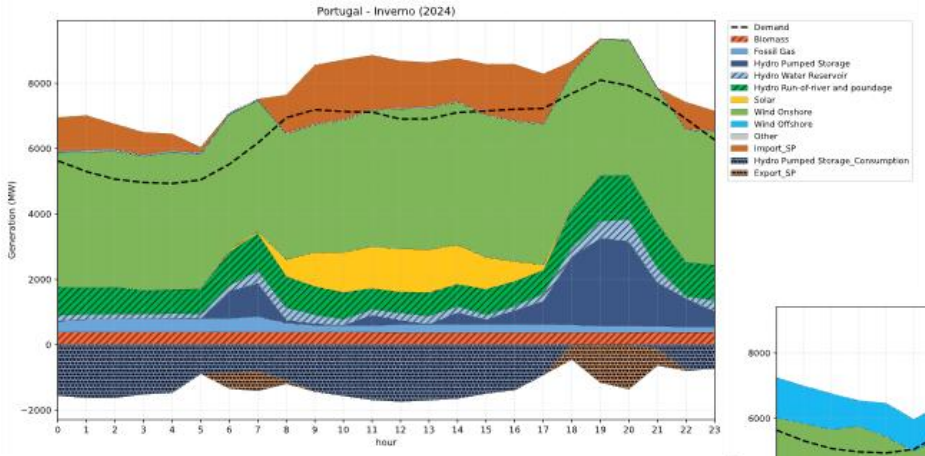


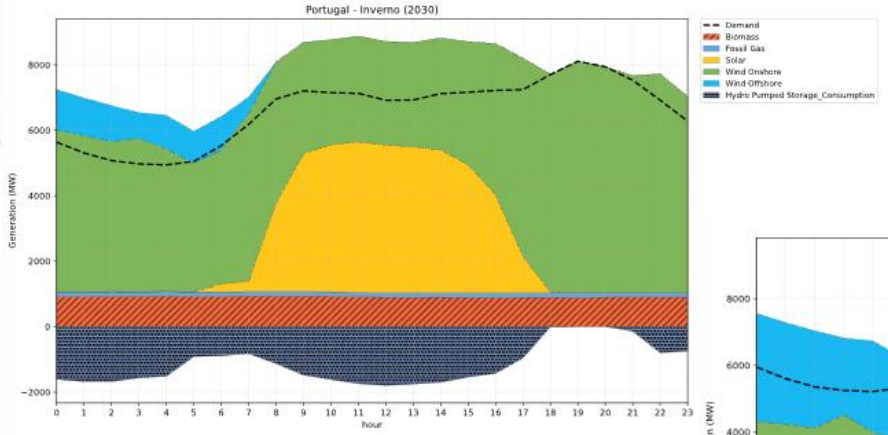


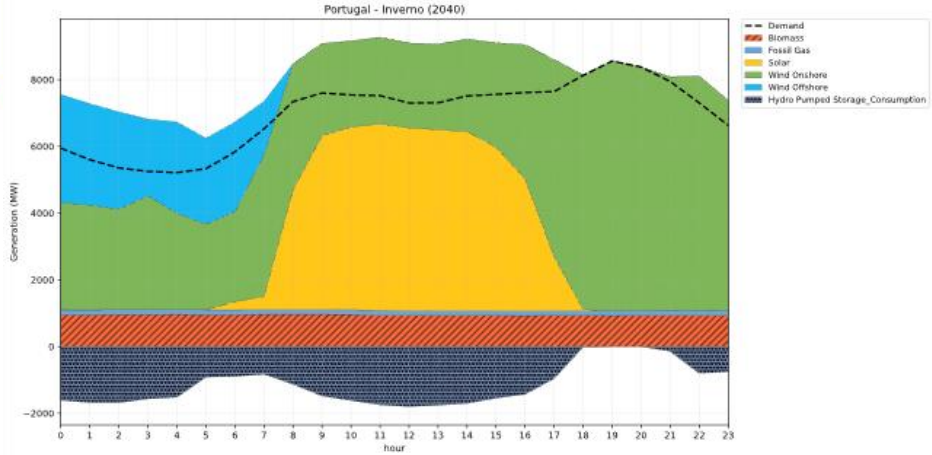


Setting the Stage – New Scenarios of Operation

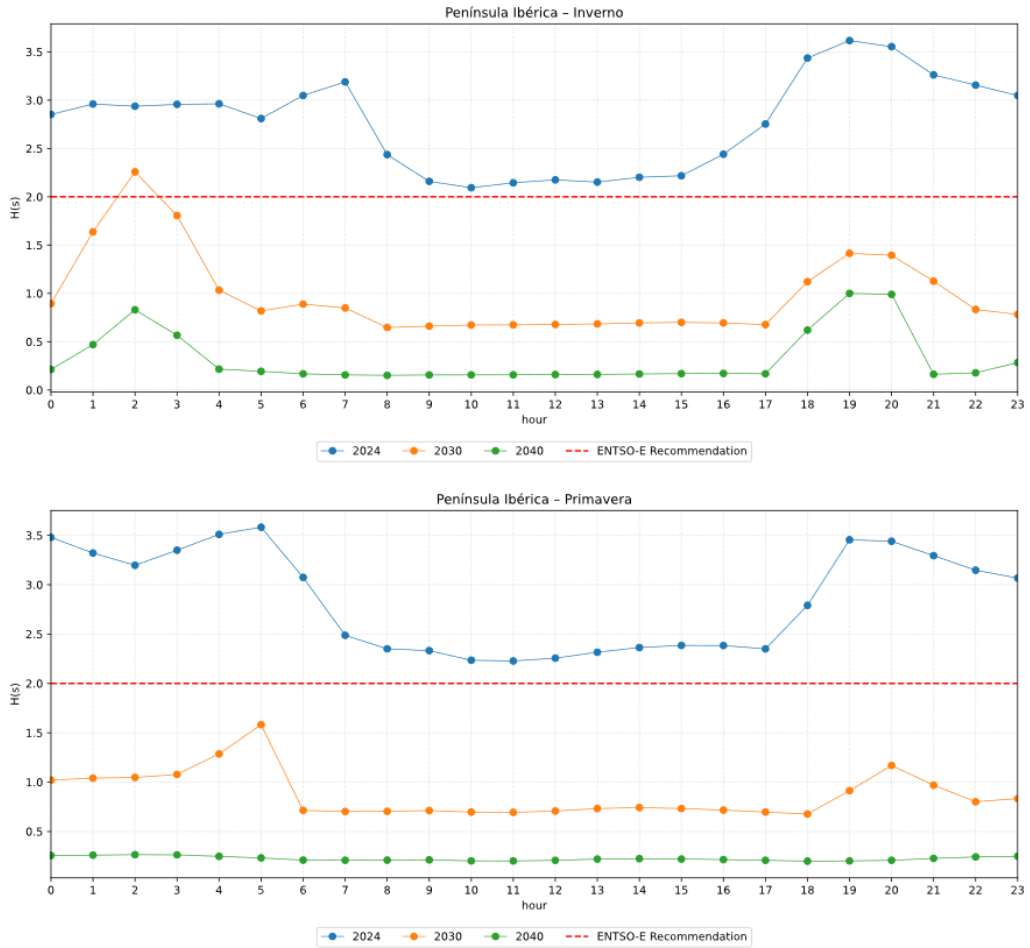
Winter scenarios







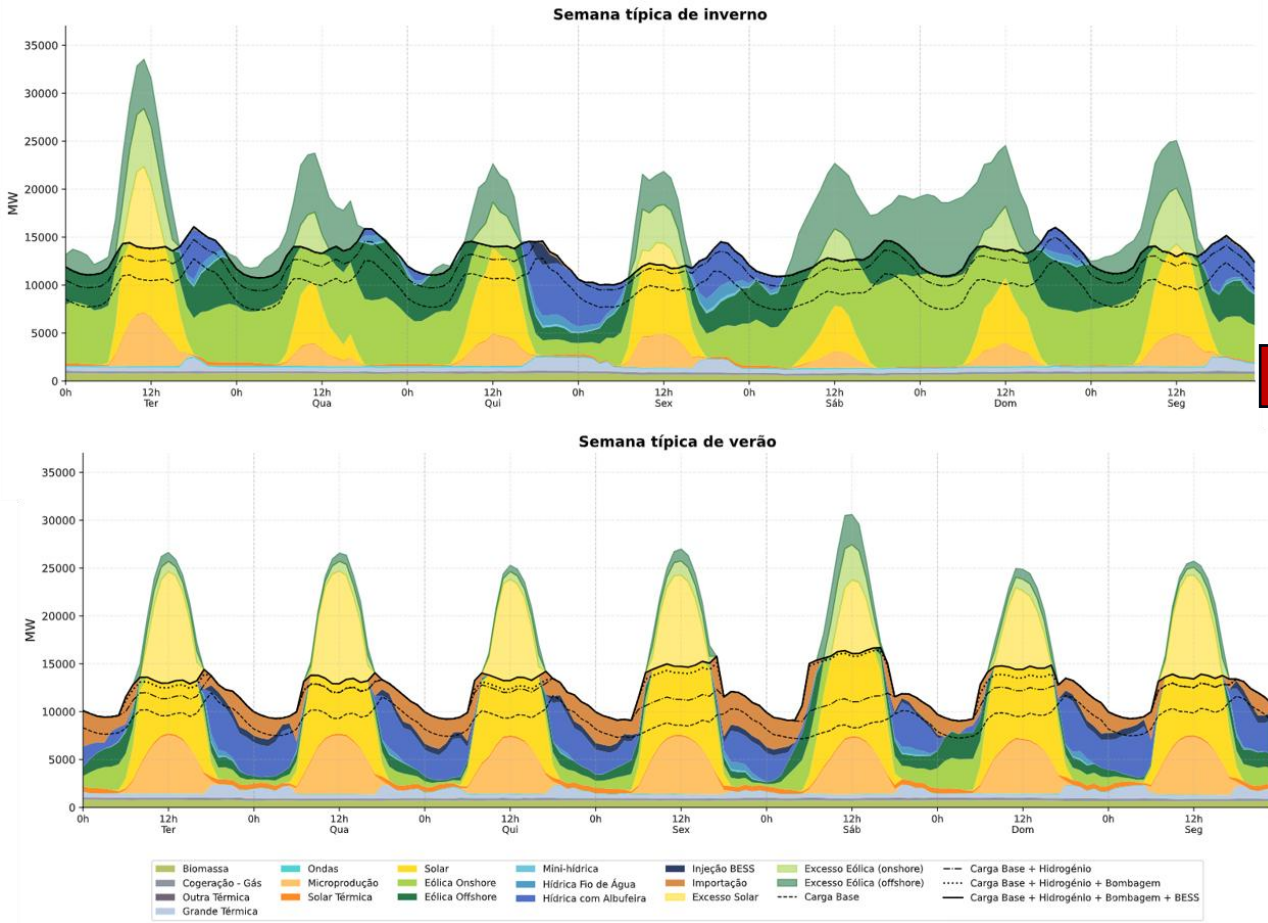
Evolution of the Inertia in the Iberian System



- Synchronous inertia falls below the 2 s threshold in 2030 and 2040 — particularly during daylight hours — due to the presence of solar photovoltaic generation.
- This decline in inertia levels on the Iberian Peninsula in 2030 and 2040 is also partly a result of the progressive decomissioning of nuclear power plants in Spain.
- Natural damping will also decrease as a result of more power converts on the grid.

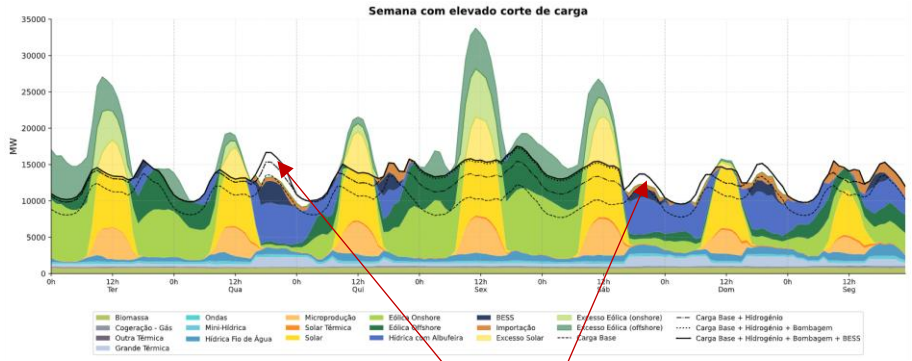
Energy Storage and Seasonal Storage

Load demand and generation (with large renewable generation) – Portugal 2040 Modified Ambition scenario



Increase in storage (everywhere):
Exploit demand flexibility

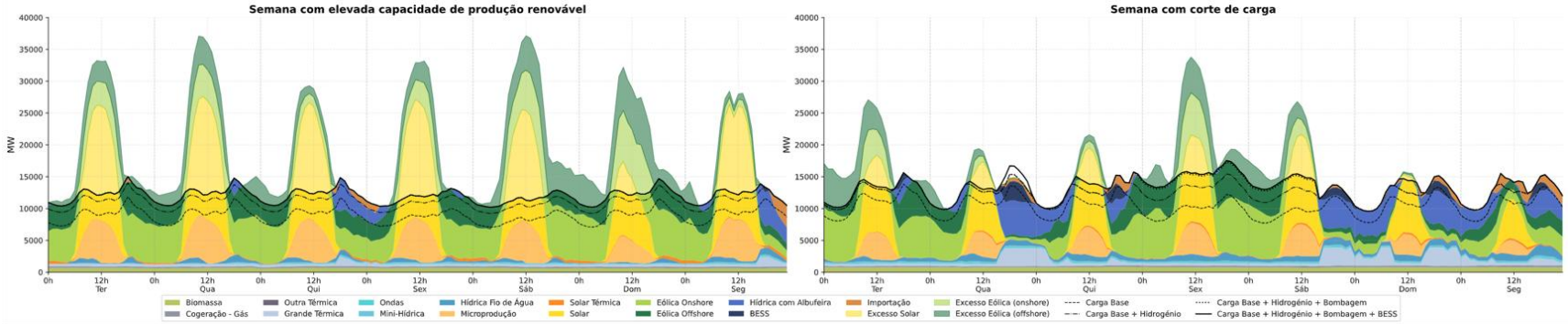
5,26 GW Hydro pump.
4,5 GW BESS

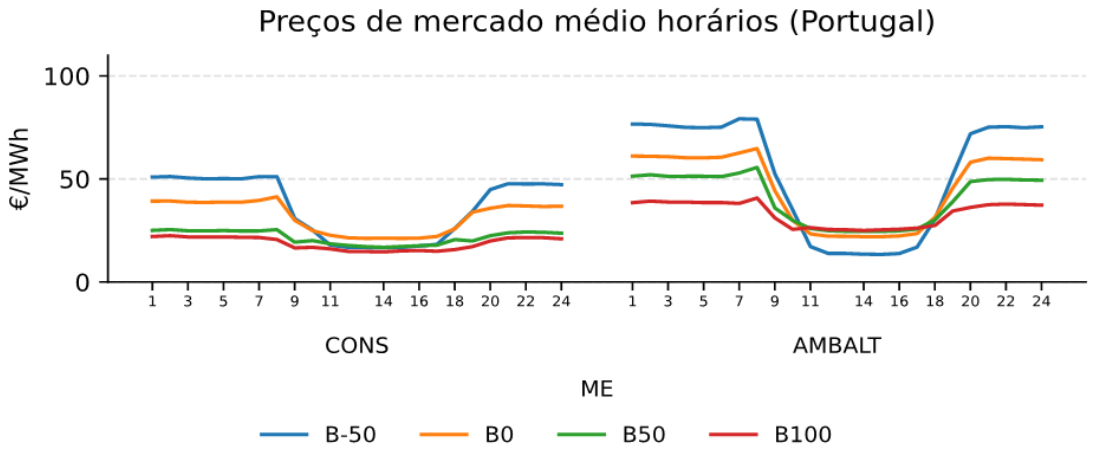


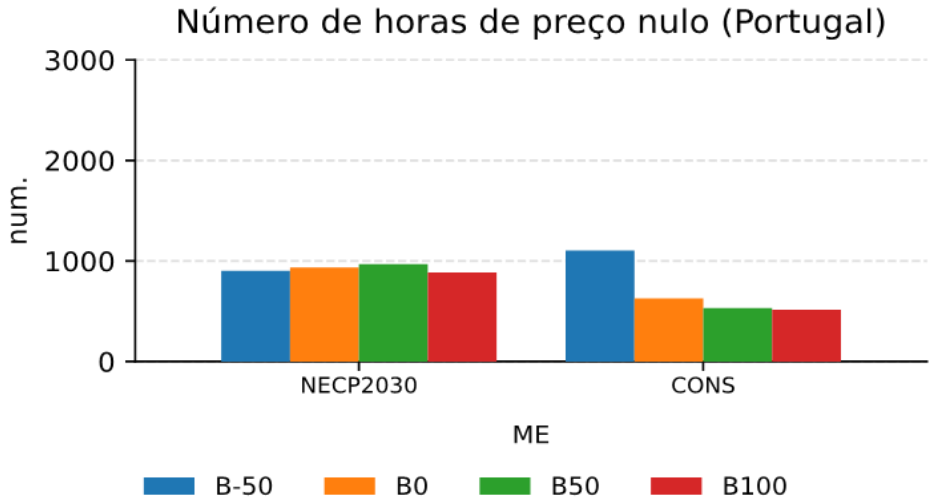
Demand non supplied → CCGT should be kept available

Seasonal storage

Increase of Renewable Generation plus Energy Storage (National Energy Storage Strategy)



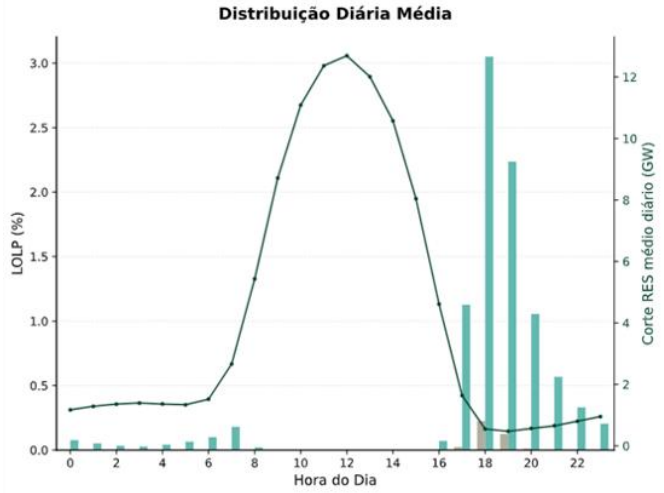


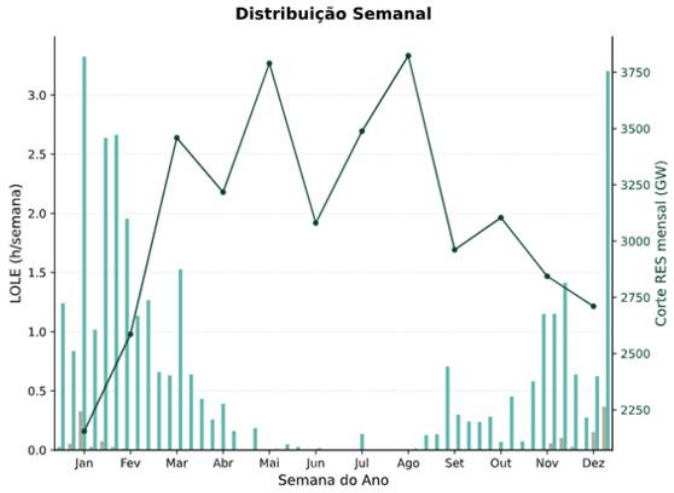


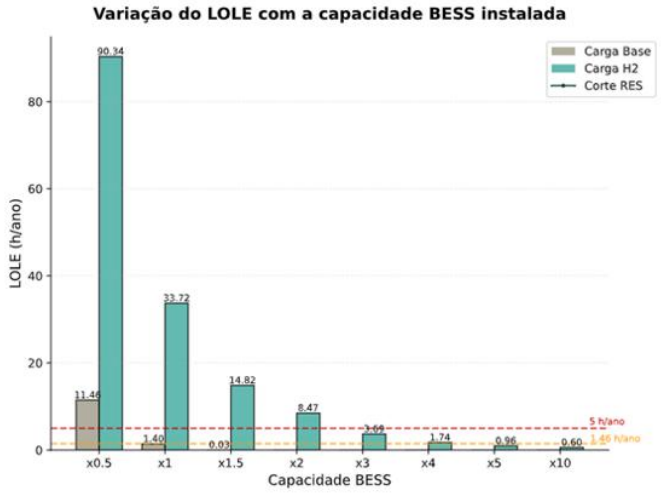
Security of Supply

Generation adequacy verification becomes more and more importante

- **Results for 2040**





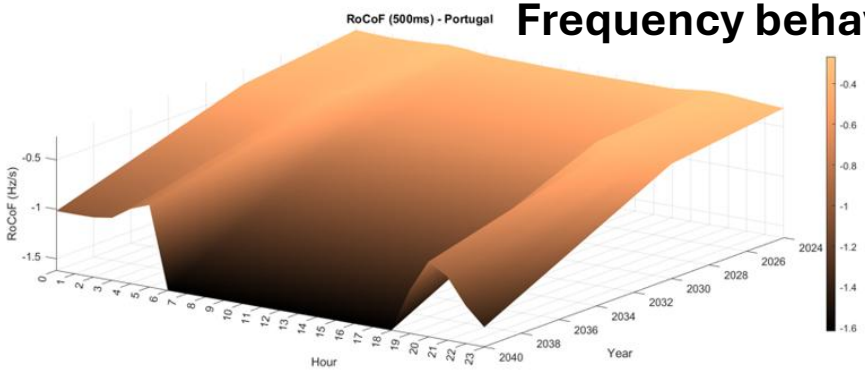


Componentes da carga	RMSA Conservador			RMSA Ambição Alternativo		
	LOLE (h/ano)	LOLF (oc./ano)	EENS (MWh/ano)	LOLE (h/ano)	LOLF (oc./ano)	EENS (MWh/ano)
Carga Base	0	0	0.2	1.4	0.83	761.5
H2	3.64	1.82	1 210.70	33.72	14.6	13 768.30

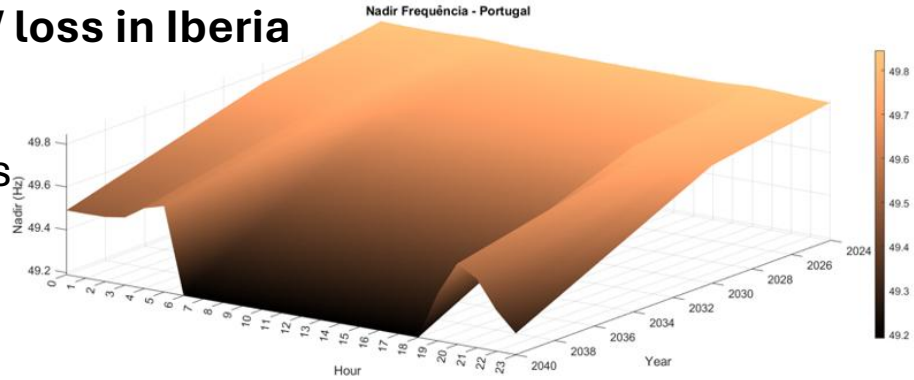
New Challanges (and Opportunities) – New Ancillary Services

Very low inertias & low natural damping in the system

Frequency behaviour after 2 GW loss in Iberia



Spring Scenarios

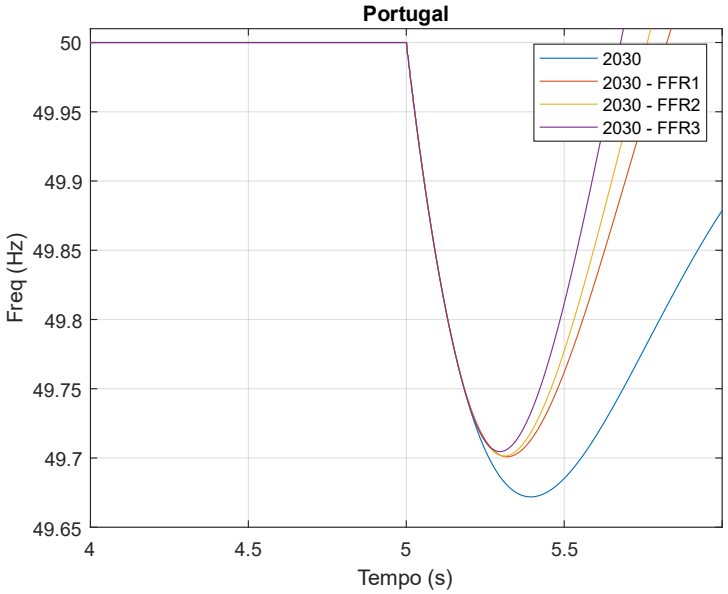


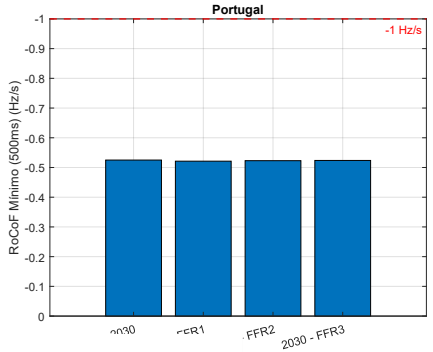
- **New ancillary services are needed:**
  - **Fast frequency response (FFR) → to reduce nadirs;**
  - **Synchronous inertia via the installation of synchronous condensers → to reduce RoCoF;**
  - **Syntetic inertia via power electronic converters → to reduce RoCoF;**
  - **Fast coordinated dynamic voltage support.**

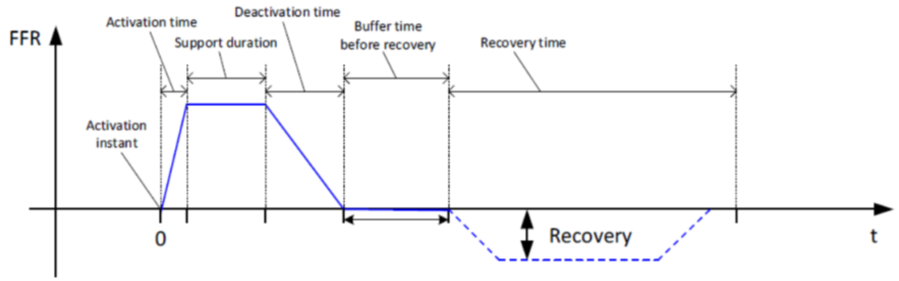
New ancillary services markets

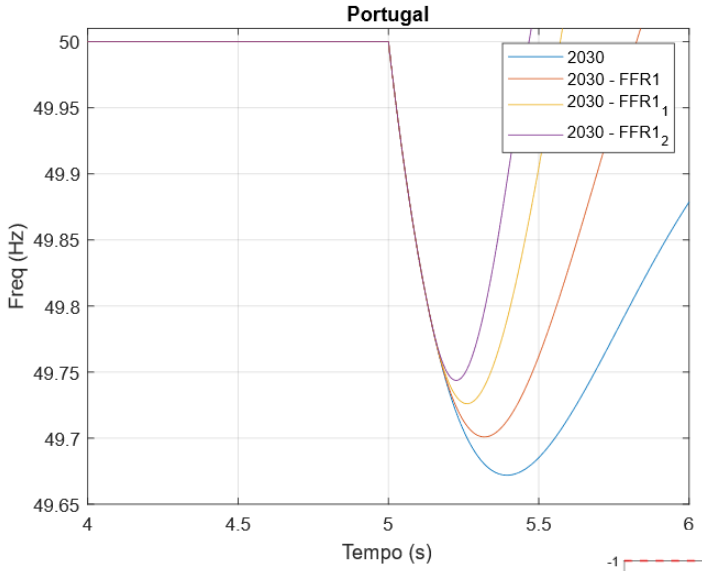
New tools to be used at dispatch level:
- **Monitor system robustness (DT);**
- **Help in decision making.**

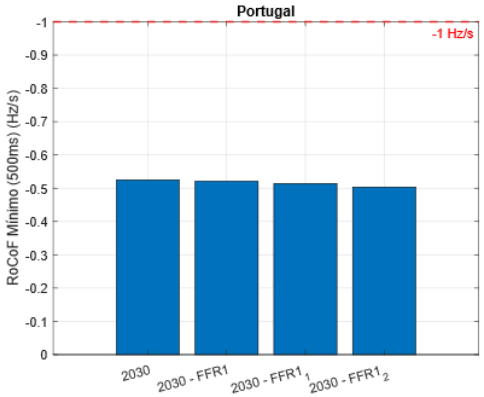
New Ancillary Services – FFR (2030)



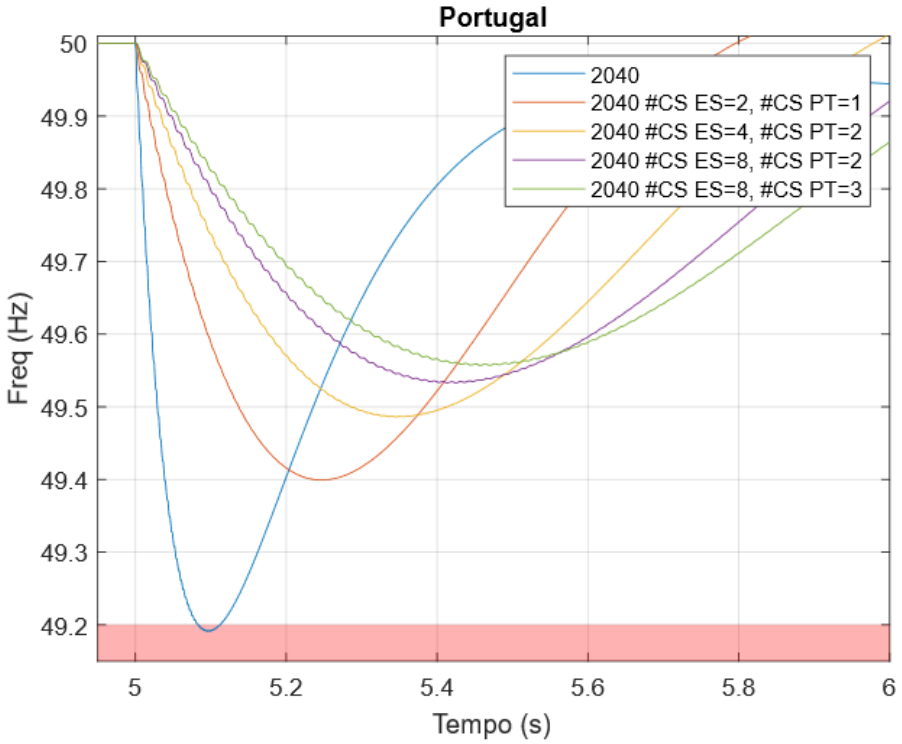


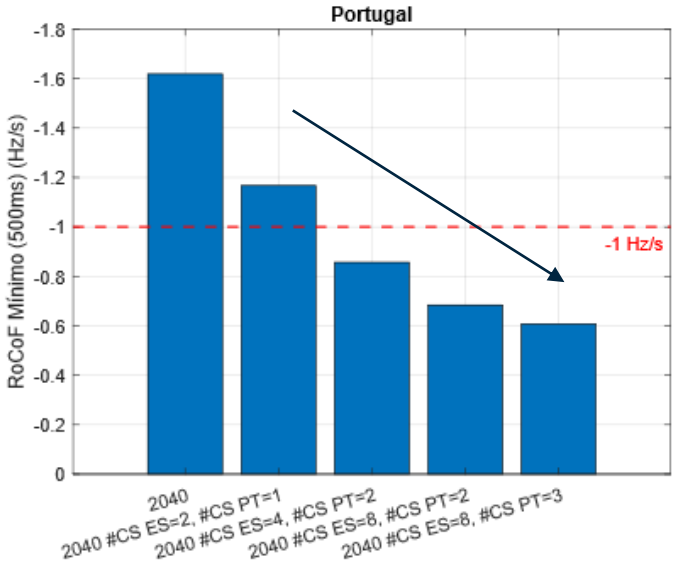






New Ancillary Services – Synchronous Inertia (2040)



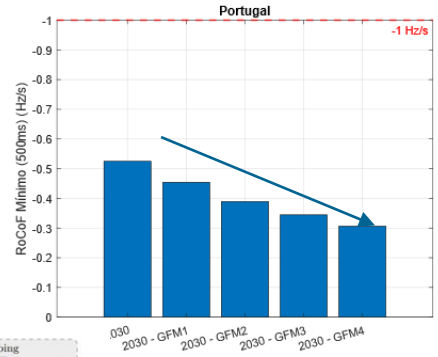


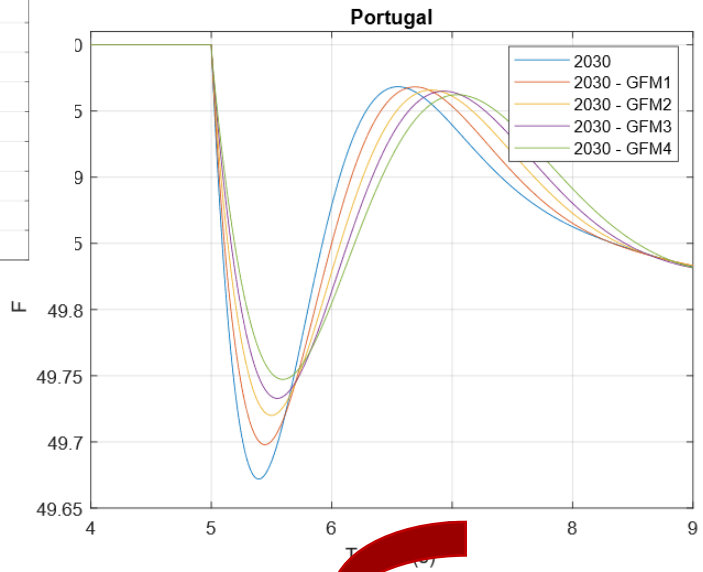
RoCoF < 1 Hz/s

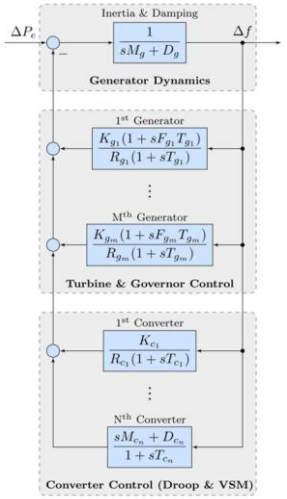
Solution: 4 SC in Spain + 2 SC in Portugal.

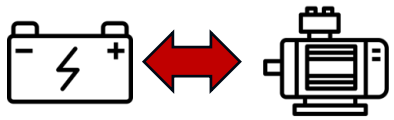
New Ancillary services: Syntetic Inertia / Batteries in GFM

2030





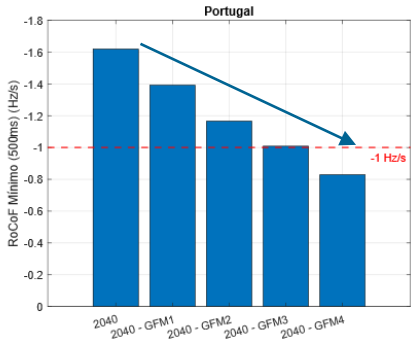


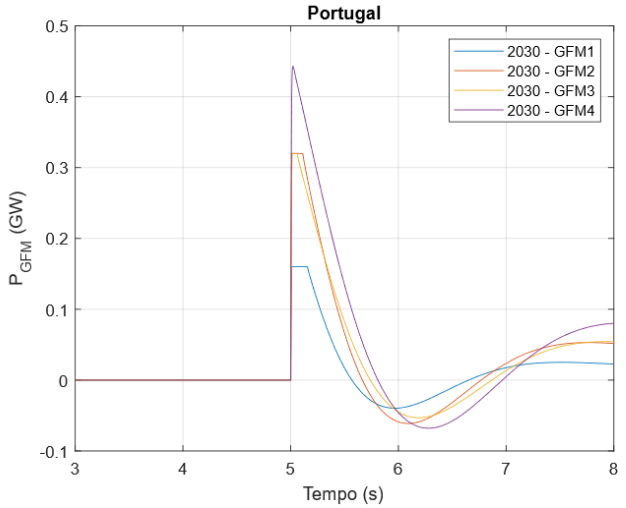


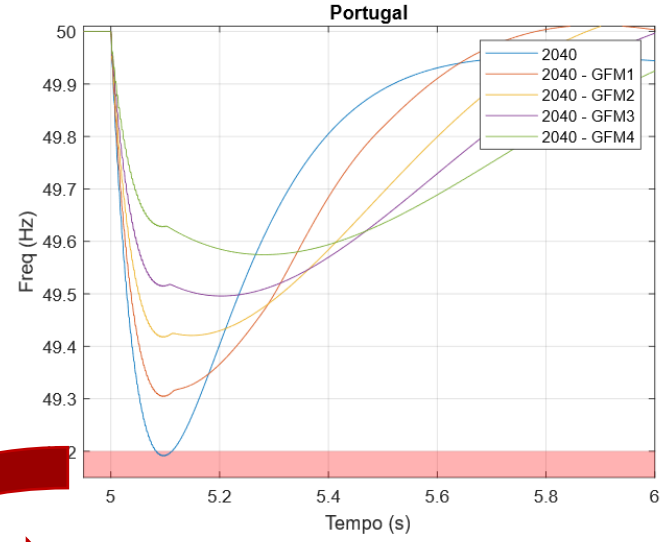
Potências requeridas

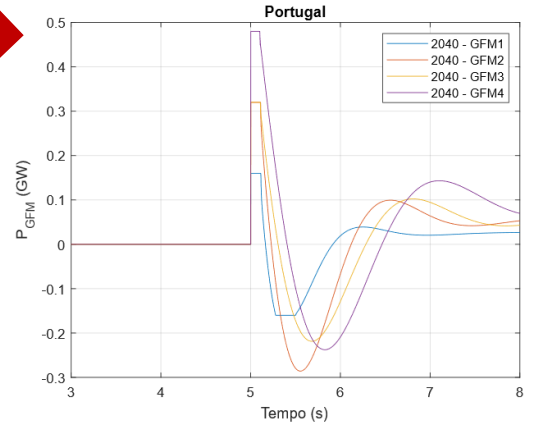
	Portugal			Espanha			
Caso	FCR-GFM (GW)	D(p.u.)	M(p.u.)	FCR-GFM (GW)	D (p.u.)	M (p.u.)	Caso SC equivalente
GFM 1	0.16	0.5	0.8	0.12	0.4	0.6	#CS ES = 2 & #CS PT =1
GFM 2	0.32	1.1	1.6	0.24	0.8	1.2	#CS ES = 4 & #CS PT =2
GFM 3	0.32	1.1	1.6	0.48	1.6	2.4	#CS ES = 8 & #CS PT =2
GFM 4	0.48	1.6	2.4	0.6	2	3	#CS ES = 10 & #CS PT =3

2040



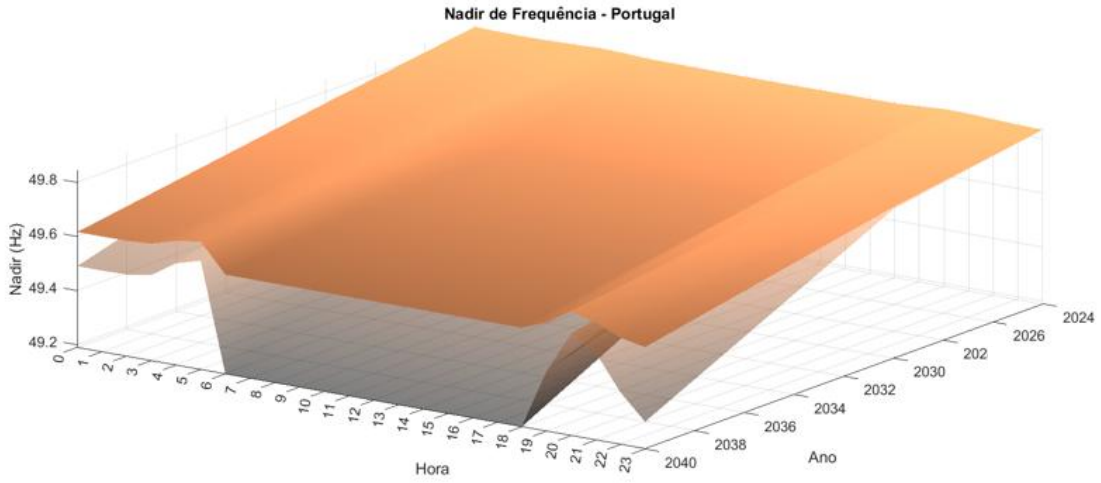


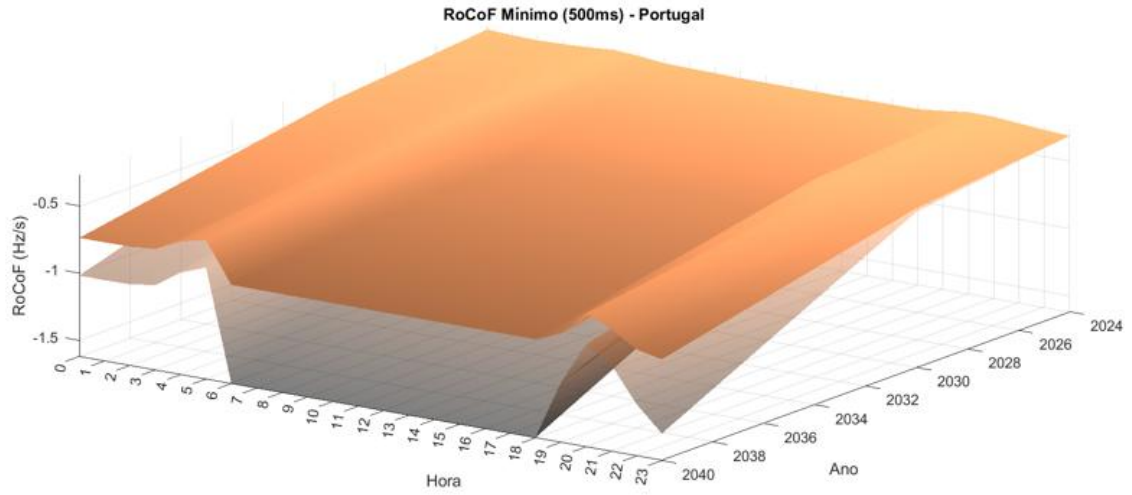




Benefits from the presence of SC

Benefits from the connection of 8 SC in Spain (250 MVA, 6 s) + 2 SC in Portugal (250 MVA, 16 s).

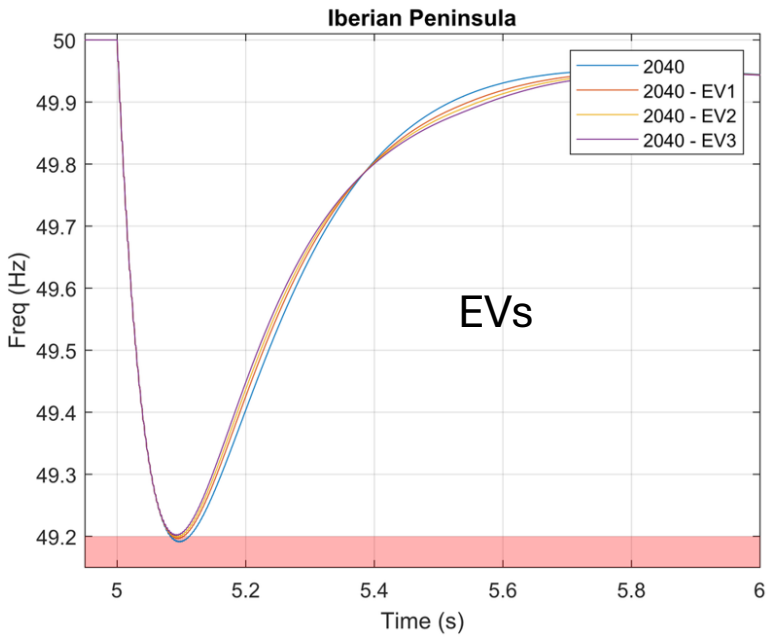


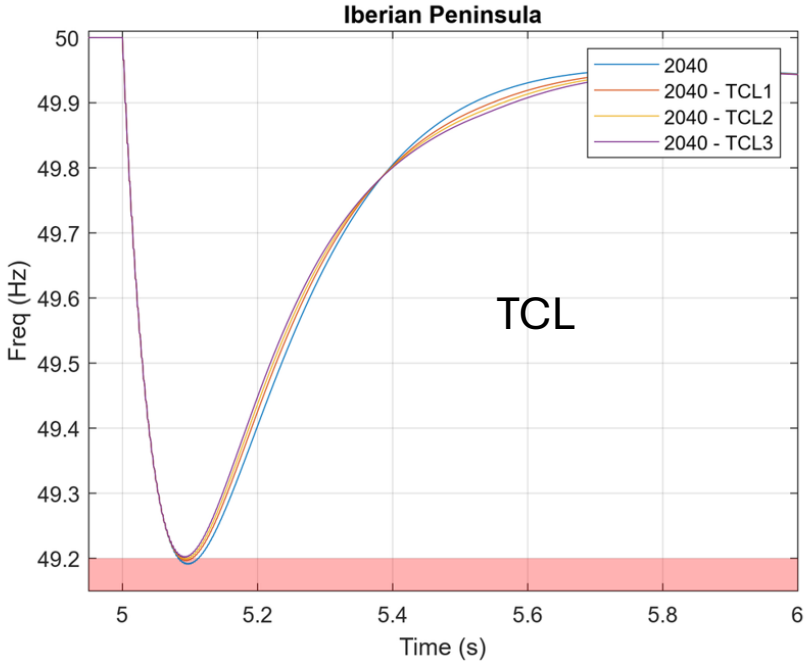


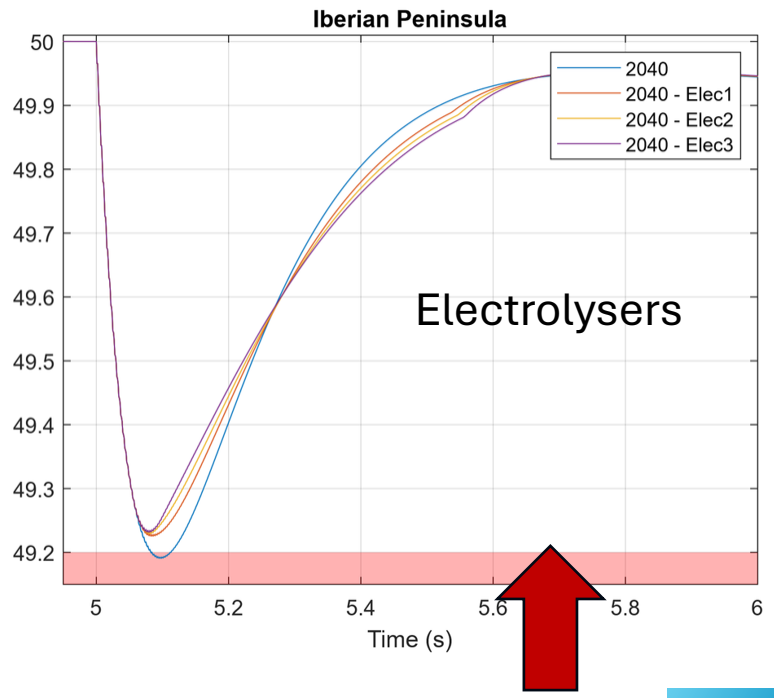
Taking profit from flexible loads for frequency ancillary services

- Electric vehicles
- Thermostatically controlled loads
- Electrolysers
- Data centers…

FCR, aFRR, mFRR







Conclusions

The success of the energy transition in Portugal involves:

- Electrification of the economy;
- Accelerate the installation of renewable power plants to support the electricity demand increase;
- Electrical grids will be reinforced and expanded;
- Increase of storage capacity;
- Increase the exploitation of demand flexibility (+ storage);
- Exploit new ancillary services (and markets …);