اللجنـــة المغاربيـــة للكهربـــــاء
COMITE MAGHREBIN DE L'ELECTRICITE

RED ELÉCTRICA DE ESPAÑA

5ième Conférence Générale du COMELEC

Les EnR : ressource stratégique et facteur d'intégration des systèmes électriques du Maghreb

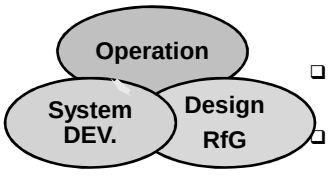
Contraintes et solutions des EnR sur le fonctionnement des systèmes électriques

Alonso García, Olivia

Tunis, 13 - 14 novembre 2012

Index

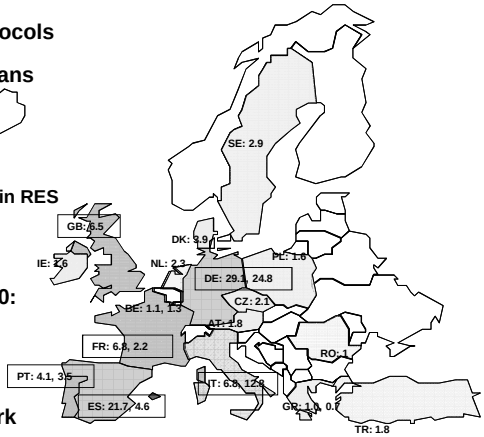
- **Context and perspectives**
- **Operational challenges and solutions**
- **System Development and RES**
- **Technical requirements for RES**
- **Conclusions**



Contraintes et solutions des EnR sur le fonctionnement des systèmes électriques

Context and perspectives

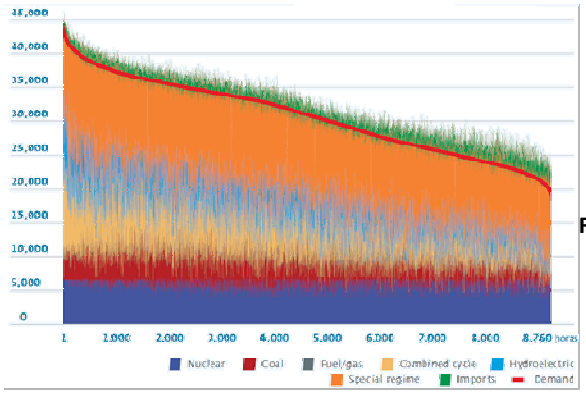
- **Climate change and Environmental protocols**
- **2009/28/EU Directive → 2020 national plans**
- **Economic importance of RES Industry**
  - **Self-sufficiency**
  - **Increase of fossil fuels prices / decrease in RES technology cost**
- **Initiatives and political views above 2050:**
  - **MSP, Desertec**
  - **Energy Infrastructure Package**
- **ENTSOE outlooks and indicative Network planning with 2030 view for Top-Down approach with high RES (TYNDP 2014)**

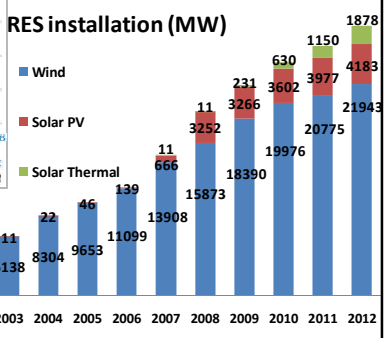


Wind, end 2011 (MW of installed wind per country > 1GW). Source: EWEA
Total Europe = 96 GW
Solar , end 2011 (MW of installed solar per country >1 GW). Source: EPIA
Total Europe = 49 GW

Contraintes et solutions des EnR sur le fonctionnement des systèmes électriques

Context and perspectives in Spain



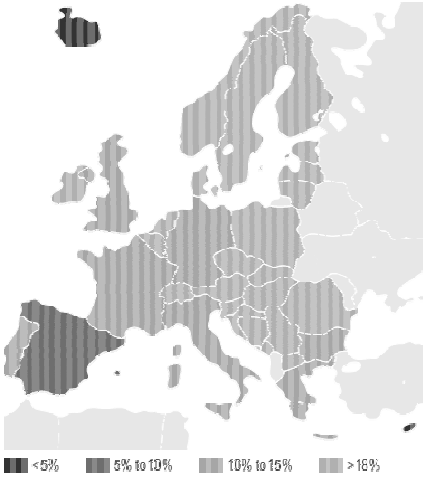


Cumulative Load curve (2011) (MW)

Context and perspectives in Spain

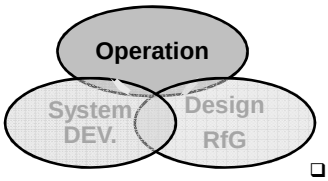
Import capacity divided by net generation capacity 2011

Import capacity divided by net generation capacity 2020



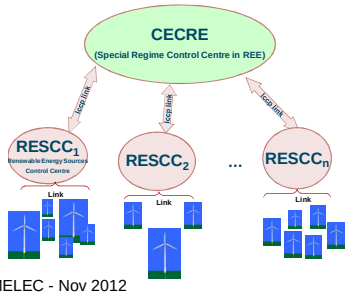
Source: ENTSOE

- **<u>Operational</u> challenges and solutions**
  - **Monitor and control**
  - **Forecast and Reserves**
  - **Flexibility in the dispatching**
- **<u>System Development</u> and RES**
- **<u>Technical requirements</u> for RES**



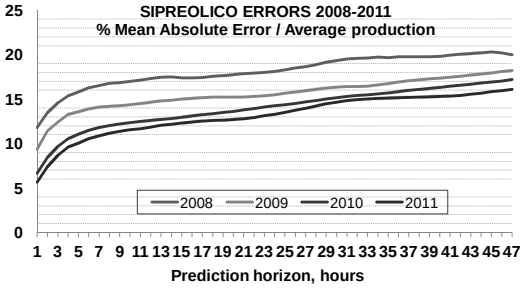
Operational challenges and solutions
1. – Observability and controllability of RES: CECRE

- **Dedicated control structure that allow the maximum integration of the intermittent generation.**
  - **Monitor and control of P and V for RES generation**
  - **Tools for analysing the operational decisions in order to maintain the system security and stability.**
- **Communication channel with the Delegated Control Centres responsible for the delivery of the set points to the generation facilities.**



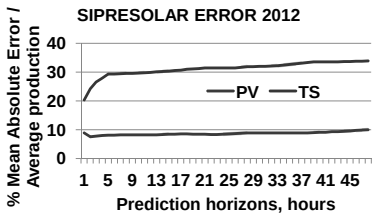
Maximiz
produc
interconnec

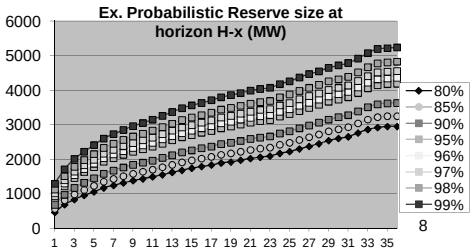
Operational challenges and solutions
2. – Predictability: Forecast and reserves



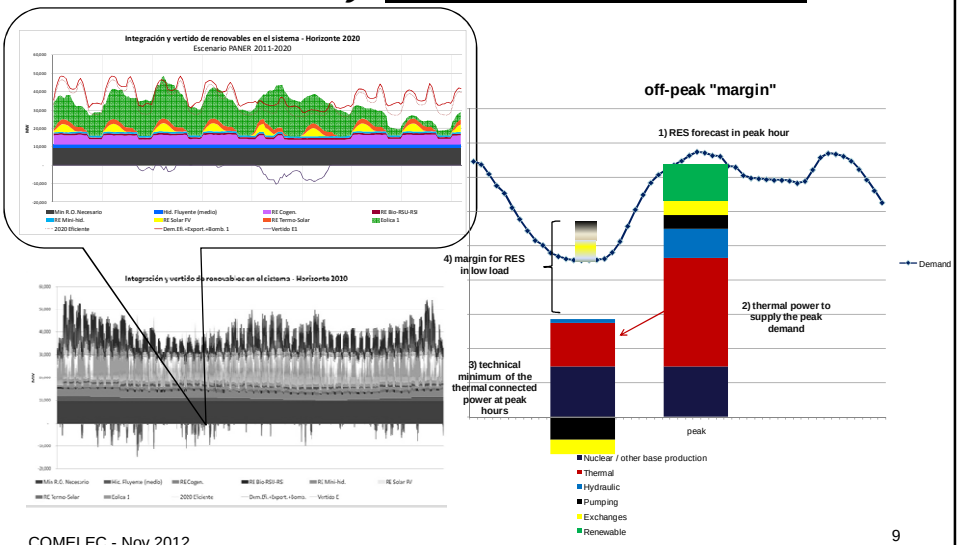
Centralised and updated with real-time measurements forecast of RES.

- **Used for the reserves calculation and management.**
- **Better prognosis that the aggregation of the commercial positions in the market (for wind and PV).**

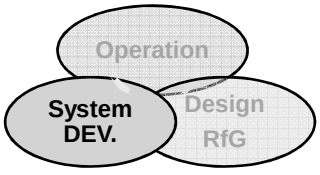




Operational challenges and solutions
3. – Variability: flexibility in the dispatching



- **Operational solutions**
- **System Development and RES**
  - **Network studies**
  - **Network planning**
  - **TYNDP and third party projects**
  - **Projects evaluation (benefits under optimal dispatch)**
- **Technical requirements for RES**



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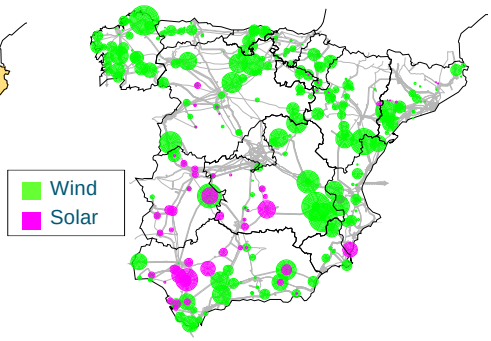
System Development and RES
1.- Network studies



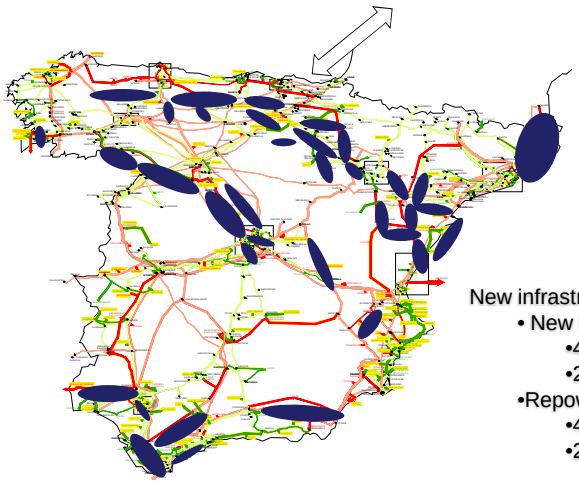
For network planning, the Spanish territory has been divided into 4 zones (ensemble of administrative Regional Authorities), defined through the statistical analysis of the simultaneity of wind production in last years

Considered wind and solar capacity distribution in the peninsular Spanish territory: in accordance with renewable plans from the Industry and the Regional Authorities

11

Contraintes et solutions des EnR sur le fonctionnement des systèmes électriques

System Development and RES
2.- Network planning



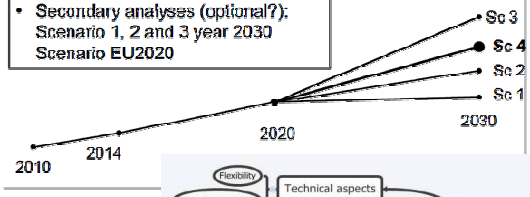
New infrastructure related to RES integration

- New lines:
  - 400 kV: > 3000 km
  - 220 kV: > 900 km
- Repowering:
  - 400 kV: > 800 km
  - 220 kV: > 900 km

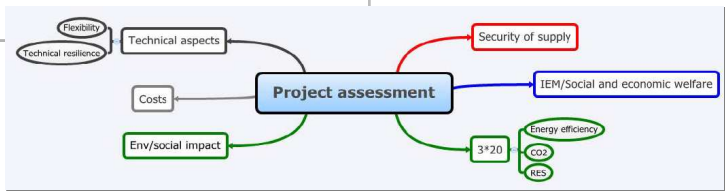
System Development and RES
3.- TYNDP and Hypothesis for evaluation of grid projects

Example: CBA for the TYNDP 2014:

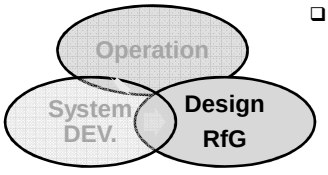
- **Primary analyses: Scenario 4 year 2030 (common)**
- Secondary analyses (optional?): Scenario 1, 2 and 3 year 2030 Scenario EU2020



- **Next TYNDP shall consider a look beyond 10 years (2030)**
- **Projects shall be assessed in accordance with the stablished methodology (including evaluation of dispatching savings for several scenarios)**



- **Operational solutions**
- **System Development and RES**
- **Technical requirements for RES**



Technical requirements for RES

- **National Network Codes and a ENTSOE NC for all generators**

  https://www.entsoe.eu/resources/network-codes/requirements-for-generators/

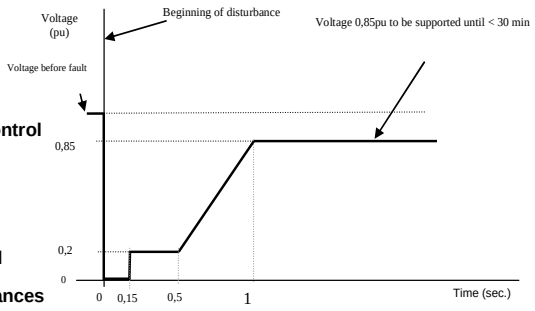
A. Not affection to wave quality

B. Steady-state

- **Respect Operational set points**
- **Voltage control**
- **Capability to perform frequency control**

C. Disturbed regime

- **Fault ride-through capability**
- **Automatic voltage dynamic control**
- **Active power behaviour in disturbances**



D. Local affection to Icc – dedicated solutions for system protections

Conclusions

- **Experience has been gained in the integration of renewable energies in electricity systems.**
- **Three main axes of work have been treated:**
  - **Related to the System Operation:**
    - **Monitor and control of RES**
    - **Forecast and reserves**
    - **Flexibility in the dispatching**
  - **System design – generation capacity and network planning**
  - **System design – technical requirements for RES technology**
- **For any of the challenges associated to renewable resource there is a solution → limits are nowadays more economical than technical.**

Thank you for your attention

Merci de votre attention

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Gracias