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Impact of the energy transition on security and quality of electric power systems

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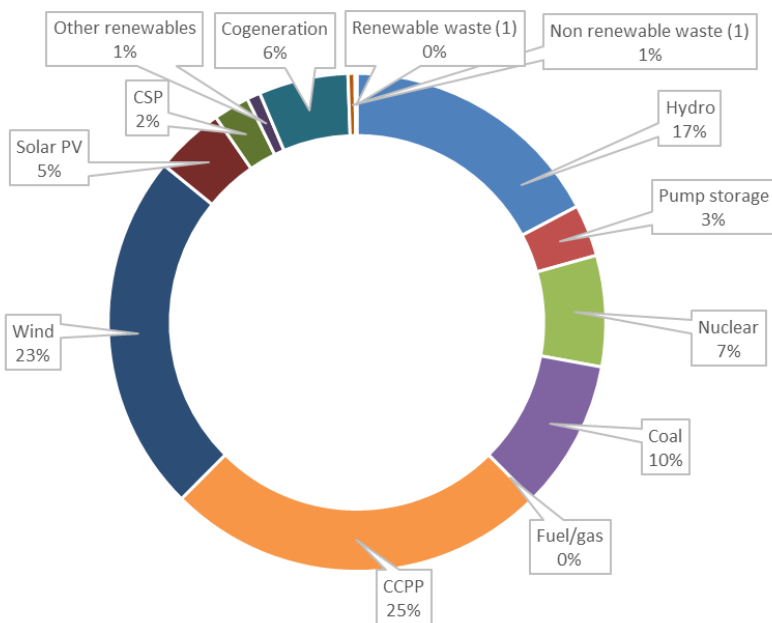
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Introduction

- Power systems are currently undergoing a transition to CO₂-emission free power systems.
- The impact of future non-synchronous RES generation on security and quality of the Spanish power system needs to be assessed.
- Dispatchable (thermal, CSP, ...) generation units could be needed to guarantee security and quality of a power system as a whole or part of it by:
 - Providing regulation reserves
 - Contributing to frequency stability
 - Contributing to transient stability
 - Providing short-circuit power
 - ...

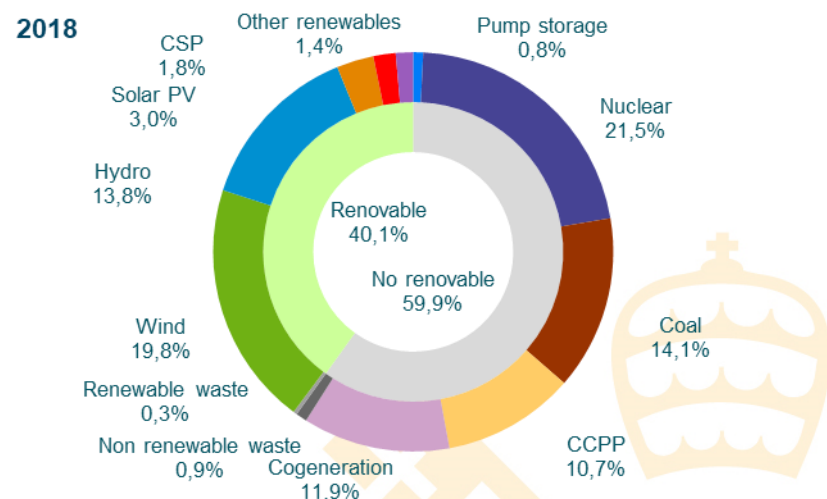
Context

- Total installed capacity in Spain: 104 GW



REE, El sistema eléctrico español, 2019

- Peak demand (2018): 40.6 GWh
- Average demand (2018): 30.7 GWh

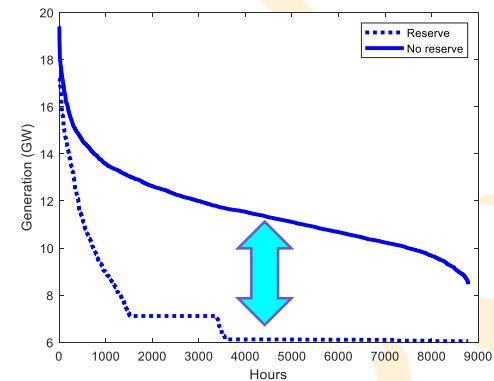
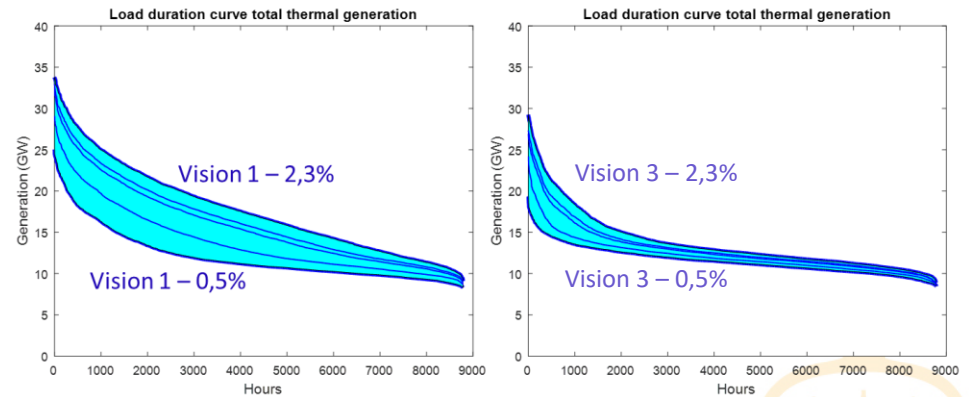


- Max. hourly RES penetration (2018): 63 %

Key conclusions (i)

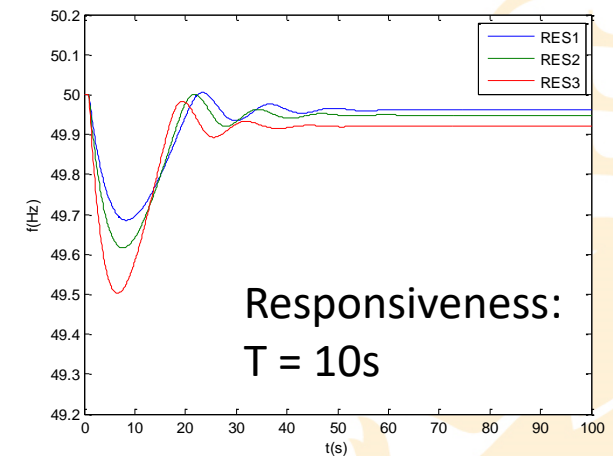
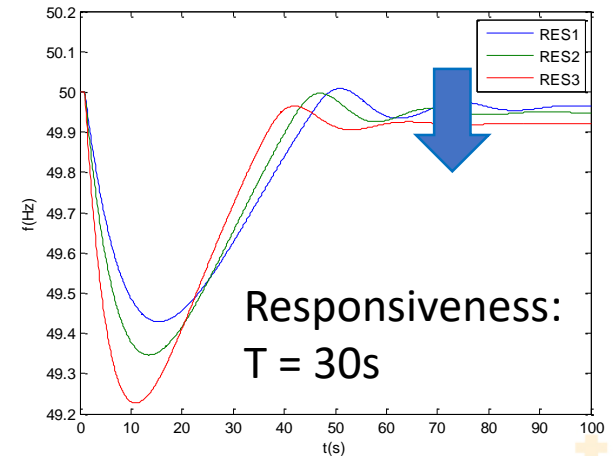
- Non-synchronous RES generation reduces thermal generation, an effect counter arrested by larger demand growth rates.
- Regulation reserve requirements favor dispatchable generation, resulting in a reserve requirement of around 6000 MW of dispatchable generation.

NS RES : V1 (+83 %) and V3 (+200 %)
Demand growth rate: 0.5%/y to 2.3%/y



Key conclusions (ii)

- Frequency dynamics are dominated by the European system.
- An increase in non-synchronous RES generation (up to 70% of the demand) does not give rise to frequency deviations that exceed maximum frequency deviations after the reference outage of 3000 MW.
- Quality of primary frequency control is fundamental to guarantee frequency stability.



Key conclusions (iii)

- Growth of non-synchronous RES increases regulation energy needs.
- Secondary frequency control requires response-compliant units.
- Active integration of RES in regulation zones mitigates new non-fulfillments and regulation energy needs. BESS could further enhance secondary regulation quality.

