

ENTSO-E Ten Year Network Development Plan 2012

Regional Group Continental South West (RG CSW) Adequacy and market studies methodology

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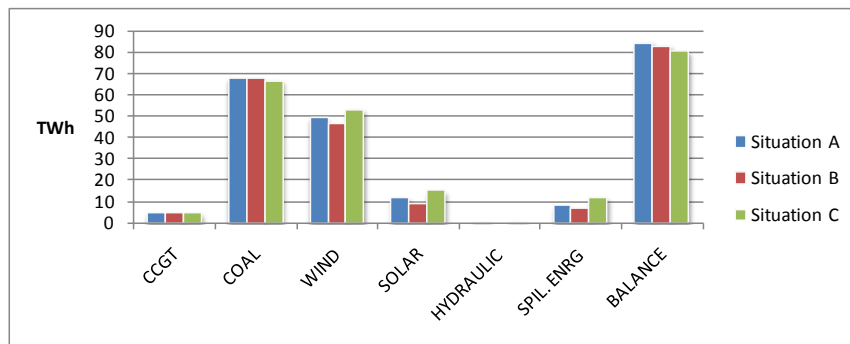


Market studies: purpose

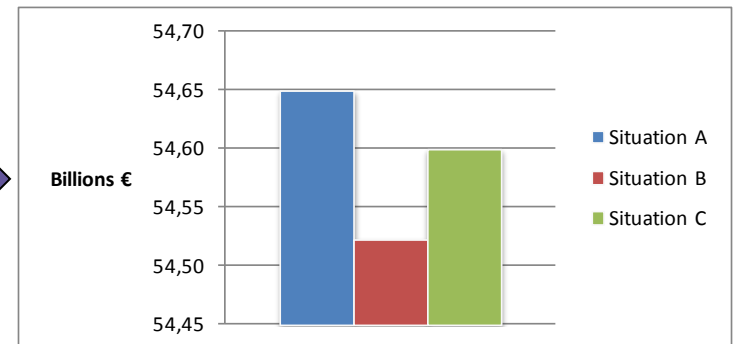
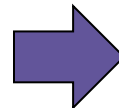
Purpose of market studies:

To assess the **economic efficiency** of an interconnected system

= Ability of the system to **minimize the overall variable generation cost**, according to the merit-order of generation units



Optimisation of the **generation breakdown** for configuration A, B, C ...



... results in different **variable generation costs**

Assumptions of « perfect market » (no modelling of subsidies, capacity payment, stakeholders behavior...)

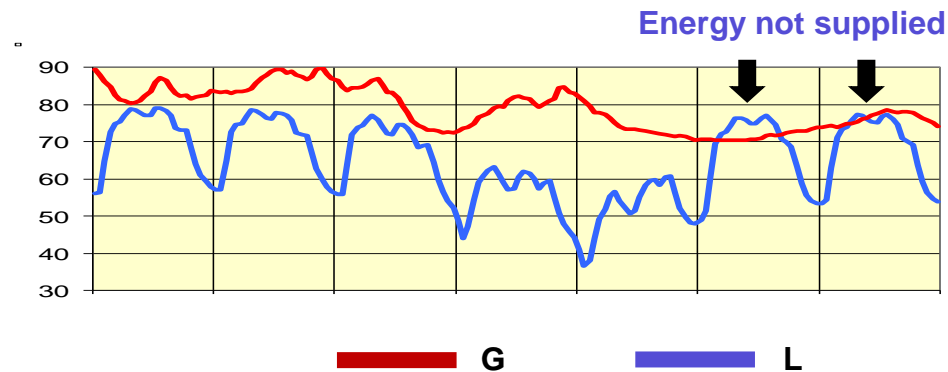


Purpose of adequacy studies:

To assess the **Security of Supply** (SoS) of an interconnected system

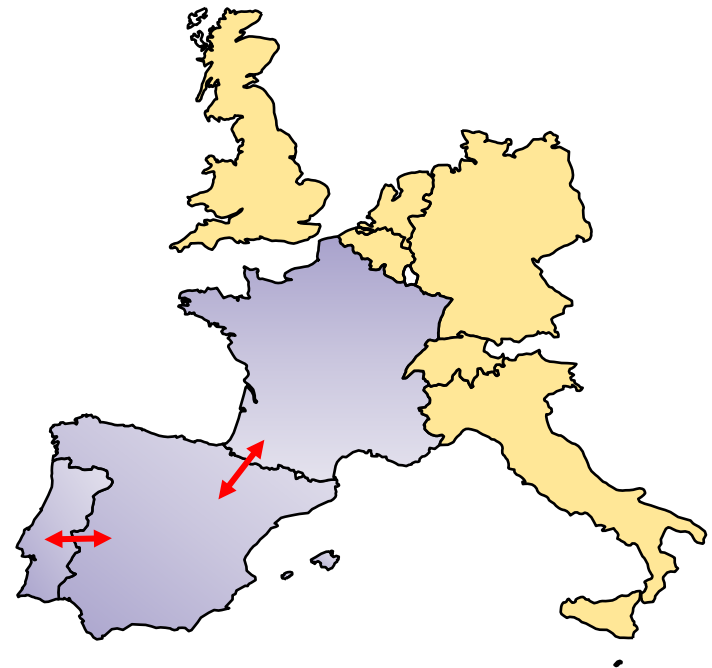
= Measurement of shortfall in any country, which may result from the conjunction of:

- demand higher than average (low temperatures for instance)
- low availability of thermal units (planned and unplanned outages)
- low levels of hydro-reservoir and low levels of wind power (unfavourable meteorological conditions)



General principles:

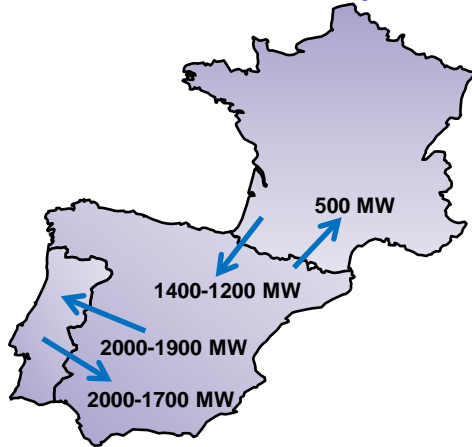
- Situations are the outcome of random events (outages, meteorological conditions...) with a very high number of possible combinations
- Yearly simulation with a 1h time step
- Multi-area (1 area = country= 1 node)
- No network constraints modelled inside an area
- Assessment performed for different :
 - generation scenarios
 - interconnections levels ↔



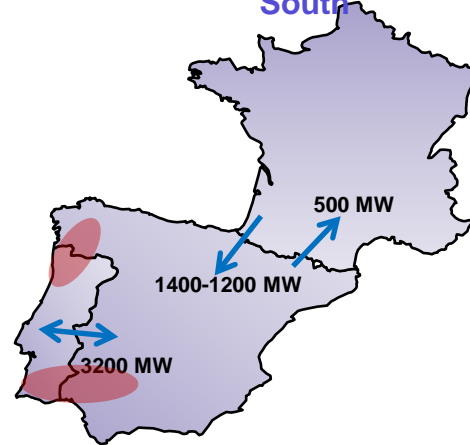
Simulations allow to analyze project by project



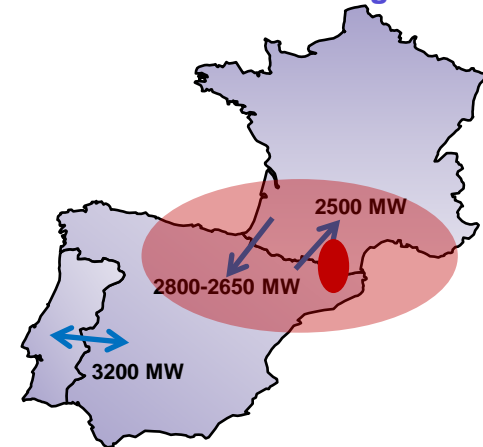
S1: NTC Today



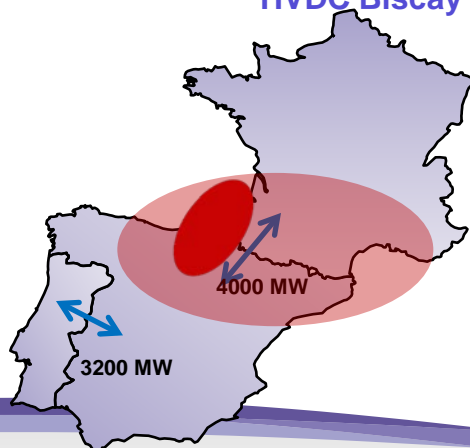
S2: Projects ES-PT North and South



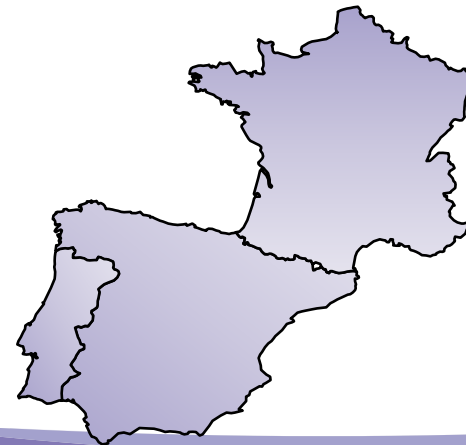
S3: Eastern Interconnection ES-FR HVDC Sta Llogaia -Baixas



S4: Western Interconnection ES-FR HVDC Biscay Gulf



S5: Copper-plate





CSW (Spain-France-Portugal)

Data exchanged in the framework of CSW, refers mainly to:

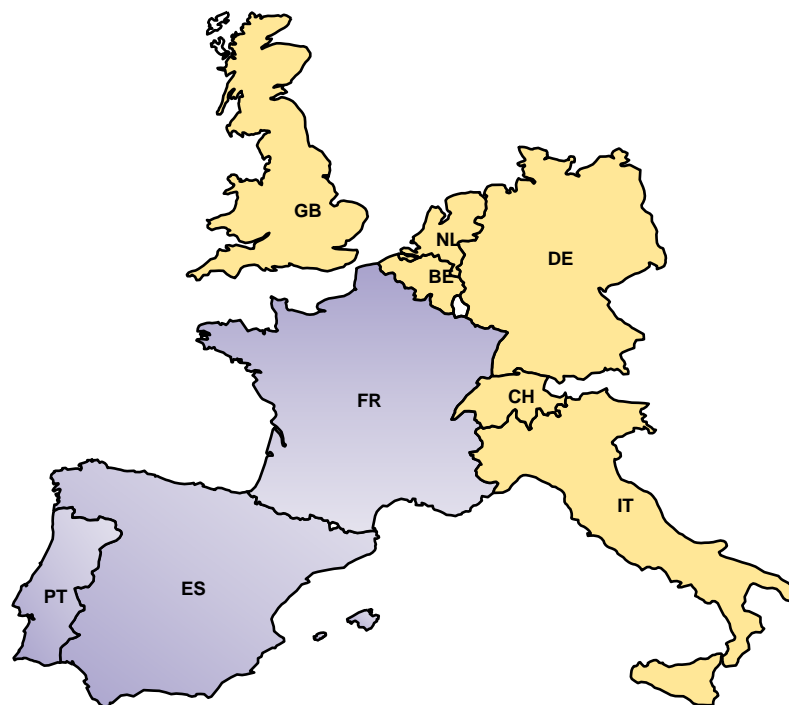
- Load (hourly profile, sensitivity to temperature...)
- Generation:
 - thermal units, with their characteristics: installed capacity, efficiency, flexibility, availability...
 - hydraulic system: run-of-river, storage, pumping capacity...
 - other renewable generation (solar...)
 - other generation (CHP, waste...)
- Transmission capacity between countries

Extended perimeter

(1st neighbours = 6 countries):

Data coming from ENTSO-E database (less detailed level)

=> *Studies take into account the interactivity of CSW with the rest of ENTSO-E*



System modeling: limit conditions

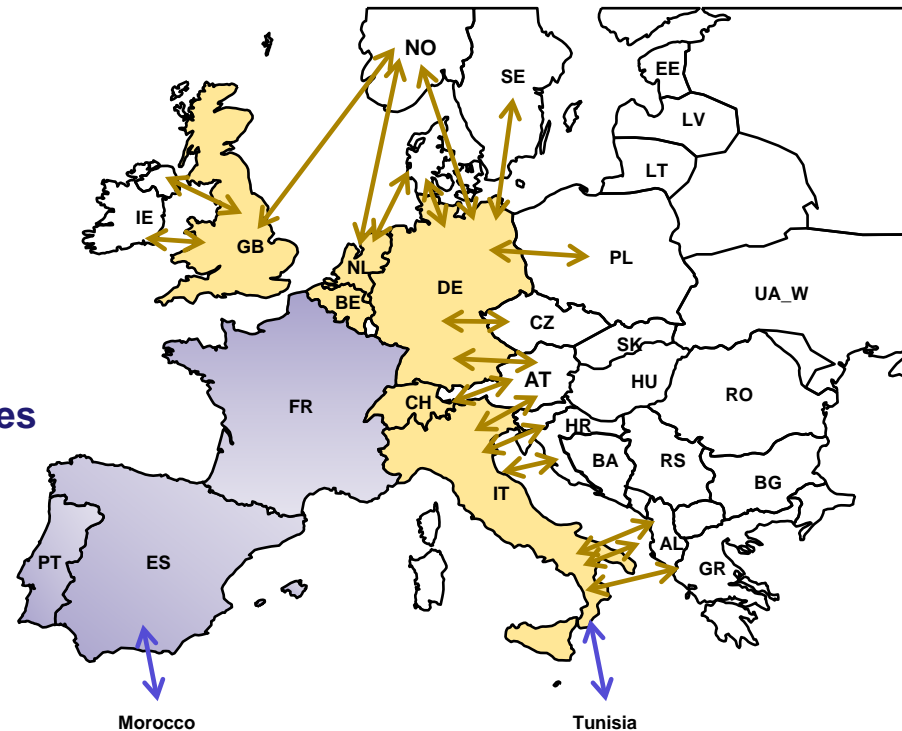
Exchanges with the rest of ENTSO-E ↔

Pan-European simulation made by RG CCE;
based on data coming from ENTSO-E database

Hourly profiles

Assumption of exchanges with non-ENTSO-E countries (Morocco & Tunisia) ↔

Hourly profiles

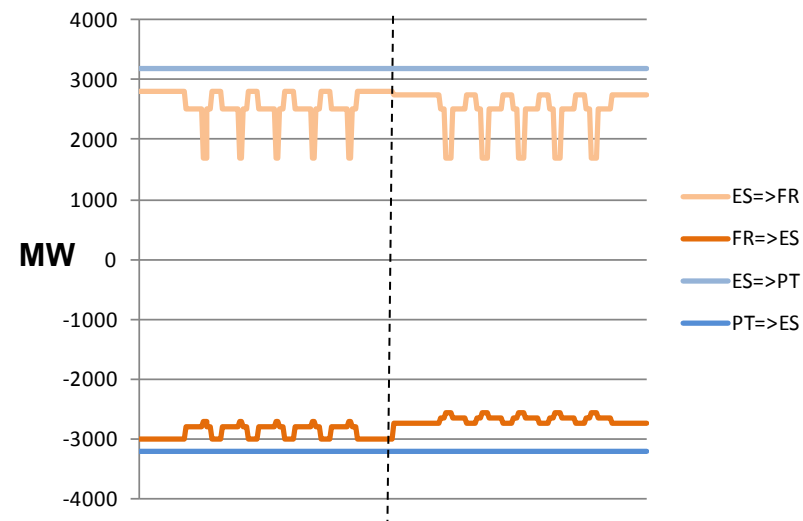
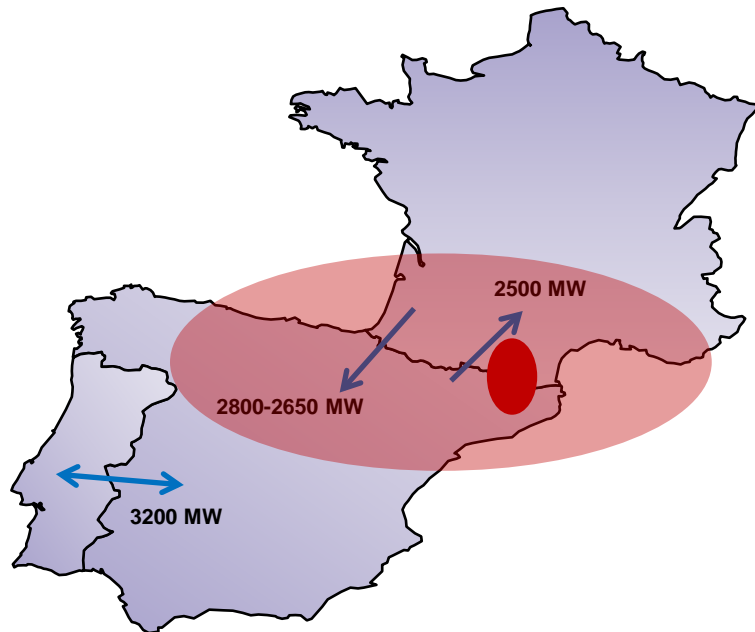


System modeling: focus on transmission capacity

- NTC within CSW are defined **on an hourly basis**, depending on:
- hours of the day (peak, off-peak, average situations)
 - Seasons

Example S3:

Eastern Interconnection ES-FR HVDC Sta Llogaia -Baixas



*Variation of NTC during
Winter week*

*Variation of NTC during
Summer week*

Variable generation costs of thermal units:

$$\text{Variable Generation Costs [€/MWh]} = \text{Operational \& Maintenance Costs} + \text{Fuel Costs} + \text{CO}_2 \text{ emissions Costs}$$

Standard ENTSO-E values *based on the IEA World Energy Outlook 2010* *Depends on the studied scenario*

=> **resulting merit-order** for Scenario EU2020 & Scenario B:

	Sc. EU2020	Sc. B
Renewables, other non-dispatchable units and must-runs	1	1
Nuclear units	2	2
CCS (Carbon capture and storage)	3	3
CCGTs	4	6
Hard coal power plants	5	5
Lignite power plants	6	4
Oil-fired power plants and OCGTs	7	7

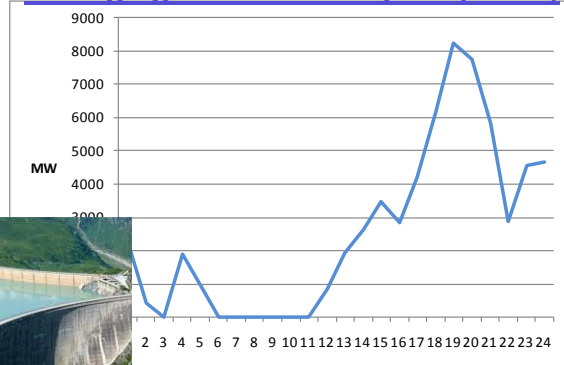
CO₂ price effect

Market studies: RES & non-dispatchable units

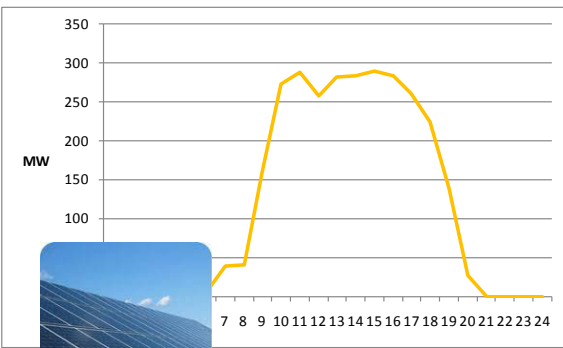
No variable cost affected to RES & non-dispatchable units

- Hydraulic systems: optimisation under constraints
Monthly energies, Max Power available, Flexibility...
- Other RES & non-dispatchable units:
predetermined hourly power with specific profiles

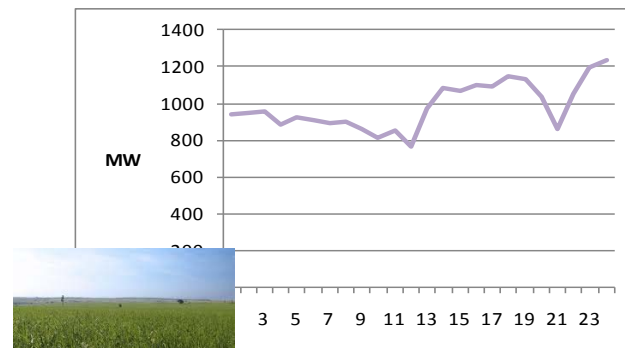
daily profile:
Storage generation in Spain (05/07)



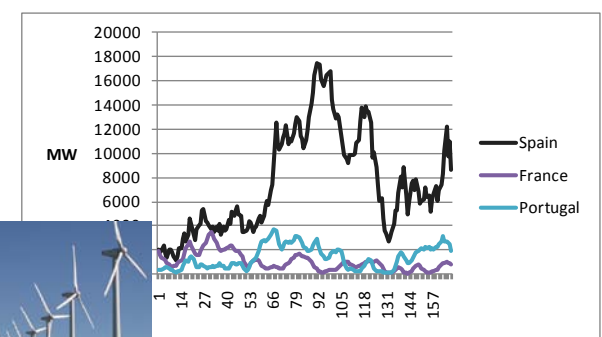
daily profile:
Solar in Portugal (05/07)



daily profile:
Biomass in Spain (05/07)



Weekly profiles:
Wind in Spain, France & Portugal (1st week of June)



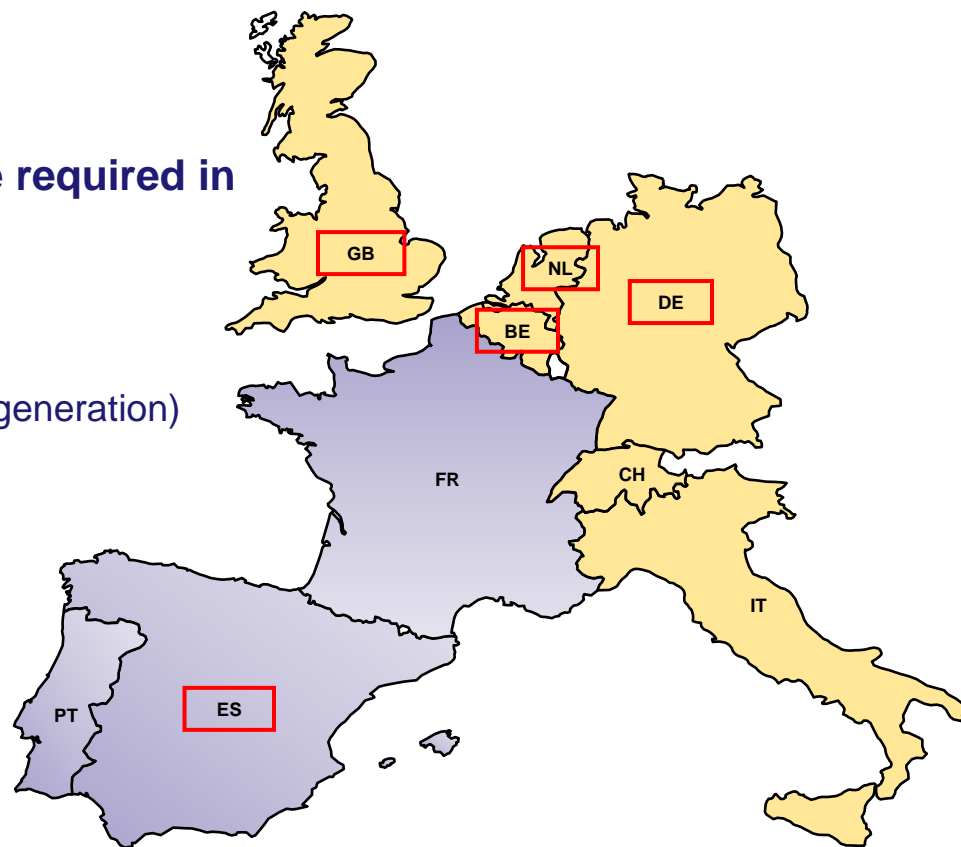
spatial correlation

Additional Must-Run obligations applied to usually dispatchable thermal units, are required in some **countries** for:

- Voltage control
- Intermittency of RES (requires minimum thermal generation)
- Specific policies (externalities, lignite mines...)
- ...



Not price-driven generation





Assessment of reinforcements benefits:

Simulations with/without reinforcement \Leftrightarrow Measure benefits of planned cross-border reinforcements

Main results coming from Market studies:

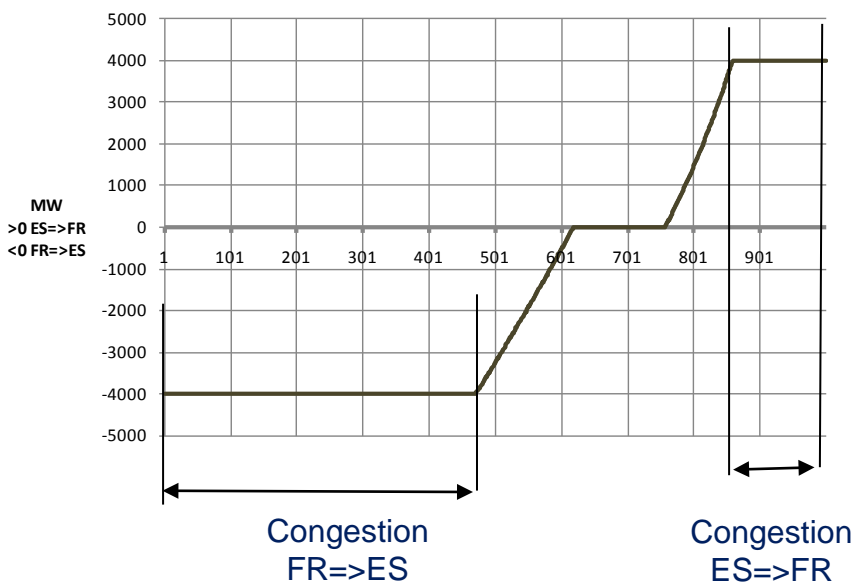
- *Variation of the generation per technology [TWh]*
- *Social Economic Welfare (variation of the variable generation costs) [M€]*
- *Variation of CO2 emissions [Mtons]*
- *RES integration (how much energy spillage avoided) [GWh]*
- *Energy exchanged [TWh] & congestions on the interconnections [%]*



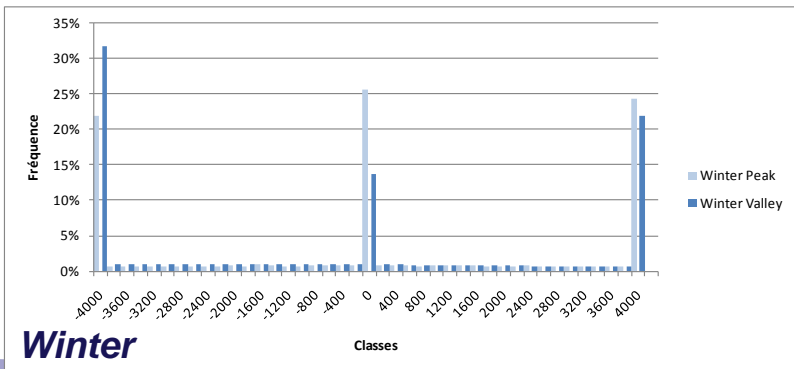
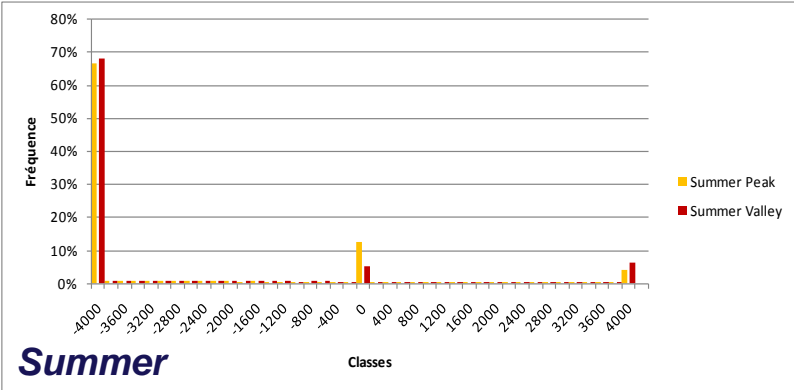
Assessment of Bulk Power Flows (BPF)

... by quantifying the probability of typical cross-border exchanges situations:

Yearly duration curves:



Seasonal exchanges probability :



Adequacy studies: valuation of reinforcements



Benefits of reinforcements:

Simulations with/without reinforcement \Leftrightarrow Measure benefits of reinforcements in terms of **energy not supplied**

Main indicators from adequacy studies:

- *How often: Loss Of Load Probability (% / year)*
- *How long: Loss of Load Expectation (hours / year)*
- *How much: Energy Not Supplied (GWh / year)*

Model used in Market & adequacy studies

Analysis were performed with 3 simulation softwares:

- **MAREA model**, for *Economy* analysis
- **RESERVAS model**, for *Adequacy* analysis
- **ANTARES model**, for both *Economy* and *Adequacy* analysis



Similar results have been obtained

- **Market results** provided are *the average of MAREA and ANTARES*
- **Adequacy results** provided are *the average of RESERVAS and ANTARES*