WORKSHOP

CONTINENTAL SOUTH WEST REGIONAL GROUP

TEN-YEAR NETWORK DEVELOPMENT PLAN

Madrid, 29 November 2011

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Agenda

09 :30	Registration and welcome coffee	
10 :00	Welcome and Introduction	David Alvira Convener Regional Group South West
10:10	General presentation on ENTSO-E, Ten Year Network Development Plan (TYNDP) and Regional Group Investment Plan (RgIP)	Irina Minciuna ENTSO-E Secretariat
10:40	TYNDP and RgIP methodology and scenarios: - Scenarios - Market and adequacy studies - Grid studies	REN representative (Ricardo Pereira) RTE representative (Gregoire Paul) REN representative (Antonio Pitarma)
12:10	Coffee break	
12:40	Preliminary results of the South West Regional Group studies	REE representative (Javier Revuelta) (Patricia Labra)
13:20	Towards TYNDP 2014 and further	David Alvira Convener Regional Group South West
13:30	Discussion	All
14:00	End of Workshop	

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General presentation on ENTSO-E, Ten Year Network Development Plan and Regional Investment Plan

Irina Minciuna
Planning Data Advisor
ENTSO-E

RG CSW Workshop

Madrid, 29 November 2011

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Content

1. ENTSO-E under the EU 3rd Energy Package

- ✓ organization
- ✓ roles and deliverables

2. Ten Year network development plan & Regional investment plans:

- ✓ Drivers
- ✓ Process
- ✓ Improvements compared to the pilot TYNDP 2010
- ✓ Expected results

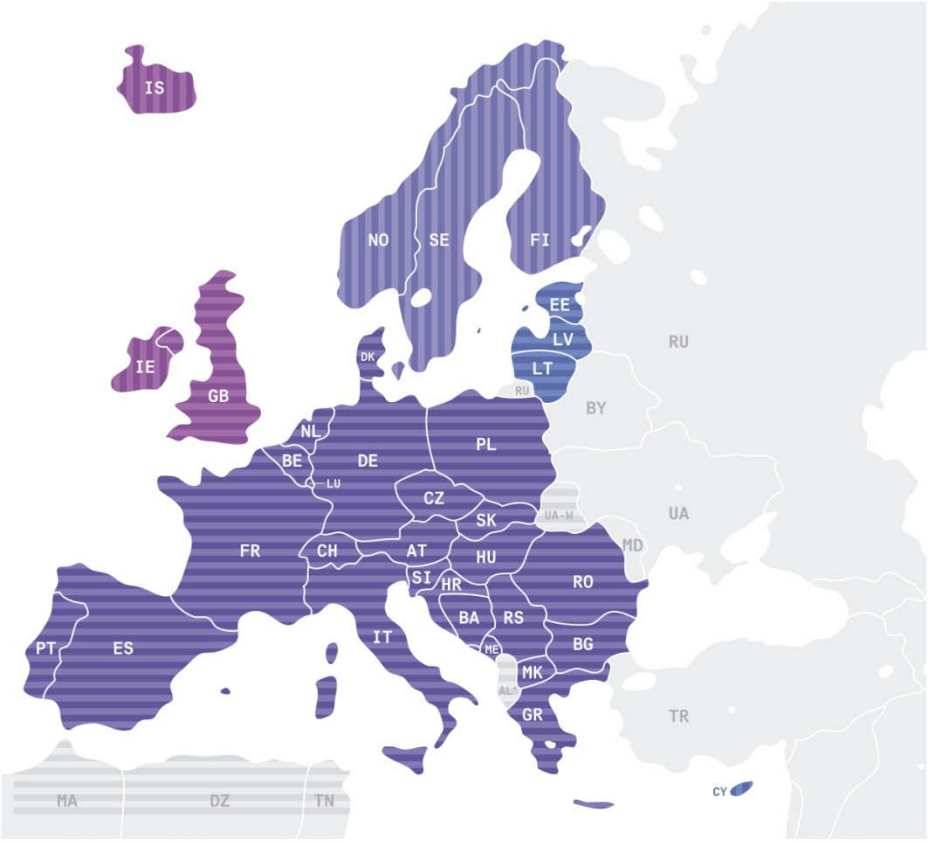
Regulation 714/2009– an important raison d'être for ENTSO-E

- **Article 4: European network of transmission system operators for electricity**
  - **Completion and functioning** of the internal market in electricity and cross-border trade
  - **Optimal management, coordinated operation and sound technical evolution** of the European electricity transmission network
- **Article 6: Establishment of network codes**
- **Article 8: Tasks of the ENTSO for Electricity**
  - **Network codes**
  - **Common network operation tools**
  - **Non-binding Community-wide 10-year network development plan**, including a European generation adequacy outlook, every two years
  - Work programme, annual report, **summer/winter outlooks, monitoring**

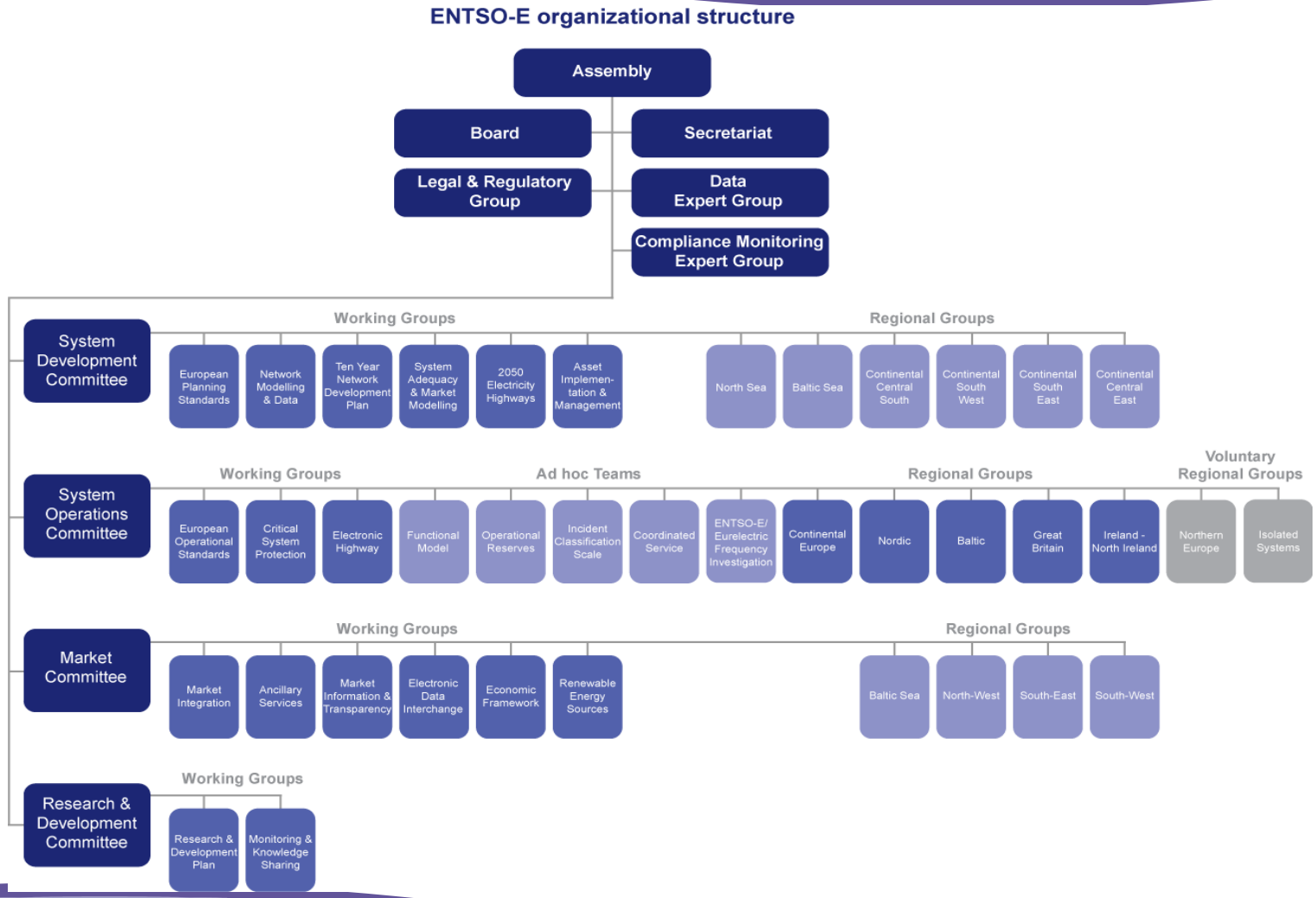
ENTSO-E operational much earlier because a fully developed IEM and the integration of RES demand urgent TSO action

ENTSO-E: a trans-European network

- Fully operational since **July 2009**
- Represents **41** TSOs from **34** countries
  - **525** million citizens served
  - **828** GW generation
  - **305,000** Km of transition lines managed by the TSOs
  - **3,400** TWh/year demand
  - **400** TWh/year exchanges
- Replaces former TSO organisations: ATSOI, BALTSO, ETSO, NORDEL, UCTE, UKTSOA



ENTSO-E structure reflects the tasks given to ENTSO-E under the 3rd Energy Package



European transmission grid – key role in reaching the EU policy goals

Energy policy goals

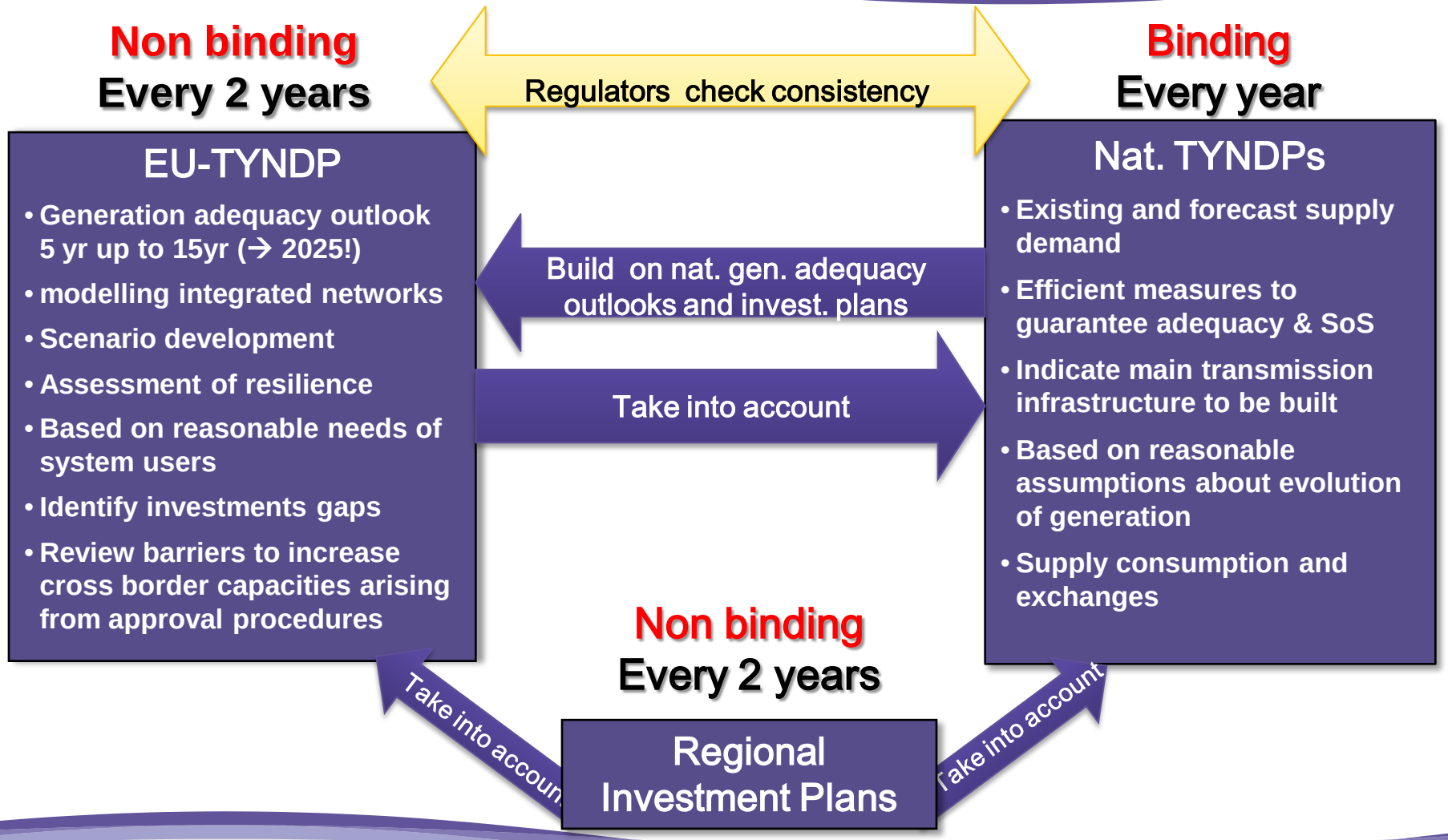
- **Sustainability/GHG**:
  - More renewables, further from the loads
  - More heating and mobility with electricity
- **Competitiveness/market integration:**
  - More long-distance flows
- **Security of supply**
  - More optimal resources sharing

all require Grid capacity !

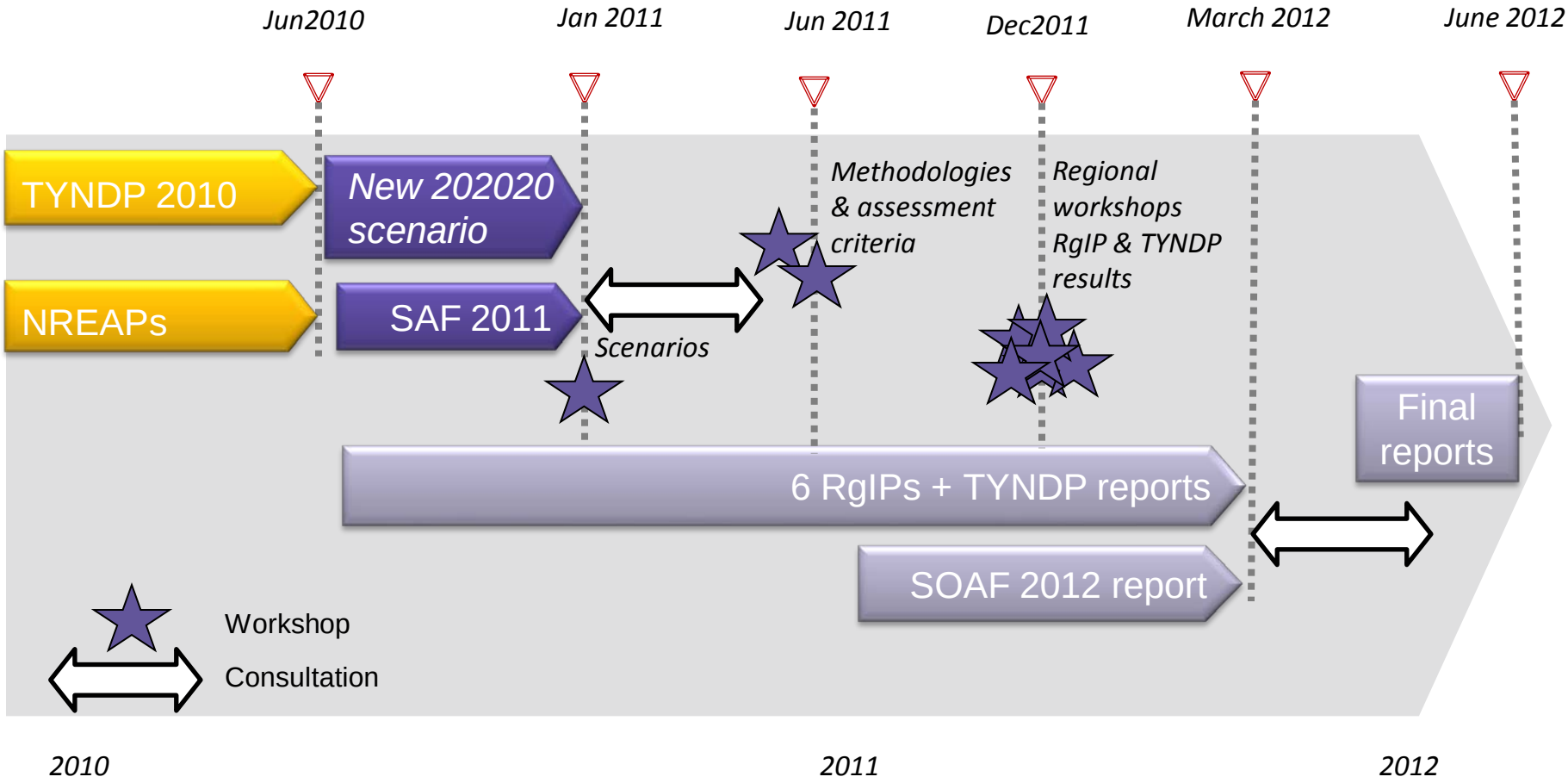
Main drivers

- **Massive integration of renewable energy sources**
  - in Northern Europe
  - in Southern Europe
- **Important East-West and North-South energy flows in South-East and Central-South regions**
- **Baltic States integration**
- **Connection of new conventional power plants**
- **Power supply of some large European cities and regions**

The 3rd Package defines the TYNDP



Overall schedule TYNDP 2012



TYNDP 2012 package improved

- **Explicit definition of projects of pan-European significance**
- **Public procedure to identify the 3rd party projects**
- **More scenarios : top down + bottom up scenarios + Nuclear phase-out sensitivity analysis**
- **Regional market & network studies – based on the common set of data**
- **Project assessment based on a set of clear indicators**
- **More compact reports easy to understand**

The TYNDP 2012 package

8 documents

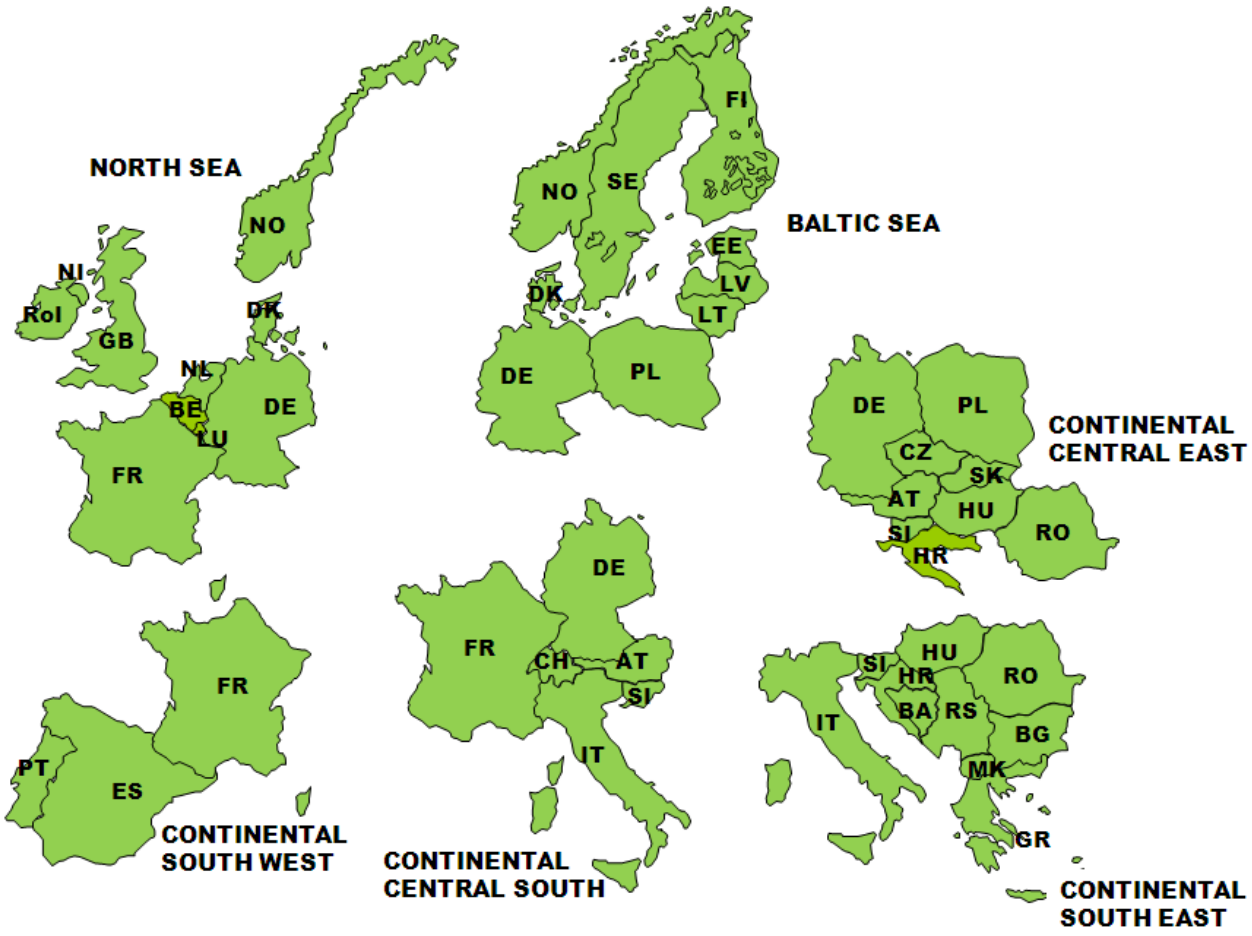
- About 50p each, complementing each other

- **Scenario outlook & adequacy forecast report (SOAF)**

- **6x Regional Investment Plans reports**
  - Detailed grid development issues, reg. level

- **10-year Network Development Plan report**
  - Synthetic compilation, pan-European level

ENTSOE Regional Groups

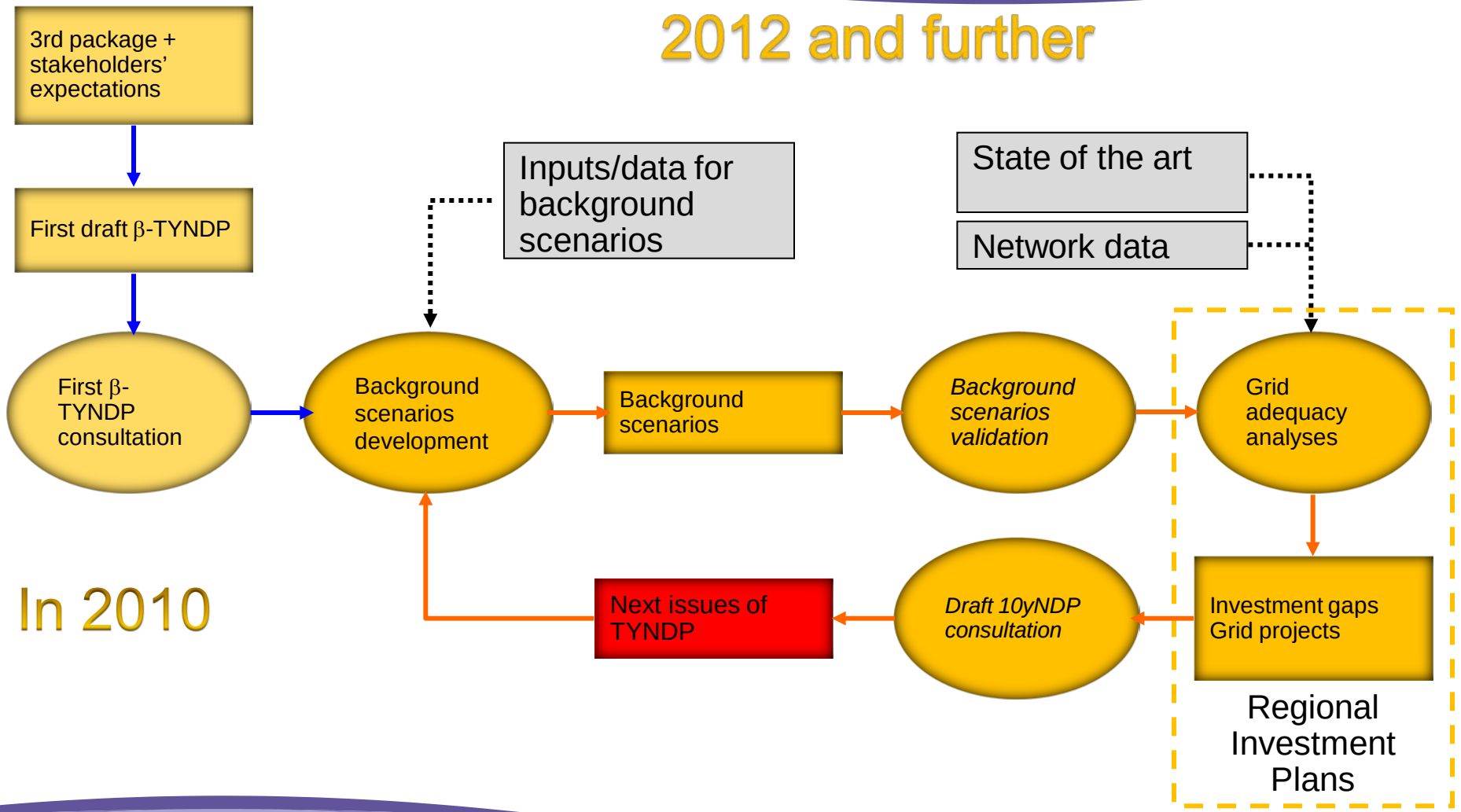


The most appropriate framework for grid development in Europe

Every RG gather countries sharing the same common concerns

Overlaping, in order to ensure overall consistency

RgIP & TYNDP 2012 elaboration process



A dense study process all over 2012

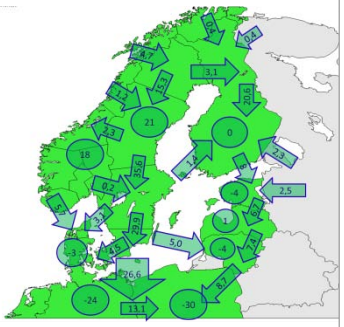
- Scenario elaboration & validation
- Market studies
- Network studies
- Project identification & valuation
- Report compilation

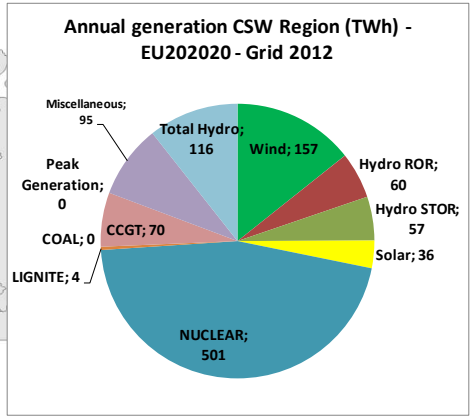
↳ at stake

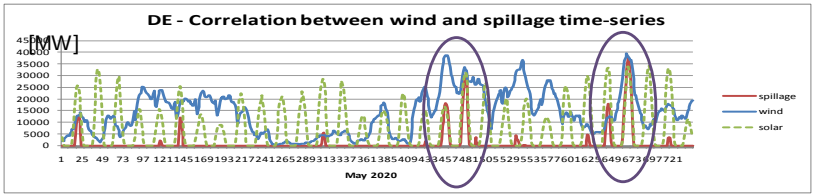
timely delivery

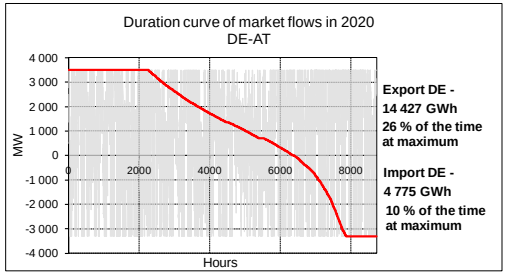
consistent results

limited resources





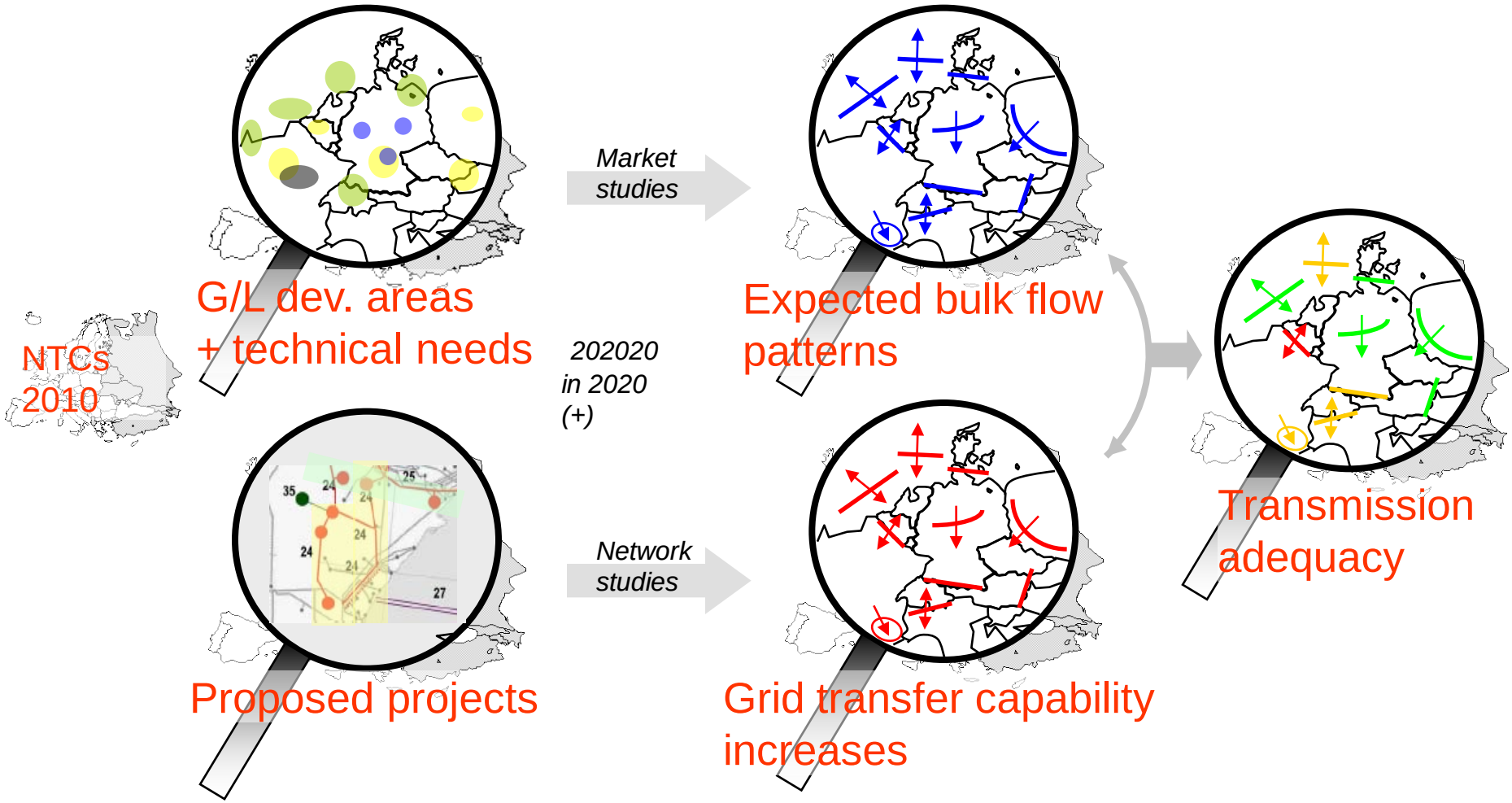




Presently being investigated

↳ Subject to adaptations &/o changes

Main deliverables TYNDP 2012



Conclusions

-The pilot TYNDP in 2010- first overview of the needs, drivers and the necessary European infrastructure

-TYNDP 2012: more comprehensive, common studies(market, network), top down approach (based on NREAPS)

-TYNDP open to the 3rd party projects

-The TYNDP as the factual and methodological basis for key policy and investment decisions.

-Coherency with longer term plans – 2050 Modular Development Plan for Electricity Highways System, North-Sea grid, Mediterranean ring, System Extension Project (Ukraine/Moldavia, ..)

Thank you for your attention

Irina Minciuna
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Projects of Pan-European significance - Definitions

- **A Project of European significance is…**
  - … a set of EHV assets (with at least one part in Europe);
  - … all contributing to a same grid transfer capability increase across a grid boundary, valuated in MW;
  - … matching the following thresholds:
    - *Main equipment > 220 kV for OHL AC and > 150 kV else*
    - *Grid Transfer Capability Increase, either*
      - *enabling > 500 MW of additional NTC; or*
      - *enabling or securing output of > 1 GW/1000 km² of generation (new and/or existing); or*
      - *securing for > 10-year load growth for an area > 3 TWh/yr.*

TYNDP and RgIP SCENARIOS

RG Continental South West

Ricardo Pereira

REN – Redes Energéticas Nacionais

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Overview of Scenarios

YEAR 2020

ENTSO-E Base Scenario (as in SO&AF 2011)

- **EU 2020:** built to meet 20-20-20 EU targets

Top-down

ENTSO-E Base Scenario (as in SO&AF 2011)

- **BEST ESTIMATE (B):** by the TSOs

Bottom-up

VARIANT Scenarios **built upon Scn B**

- **NUCLEAR PHASE-OUT:** official, assuming that most of nuclear generation units in Germany will be shut down

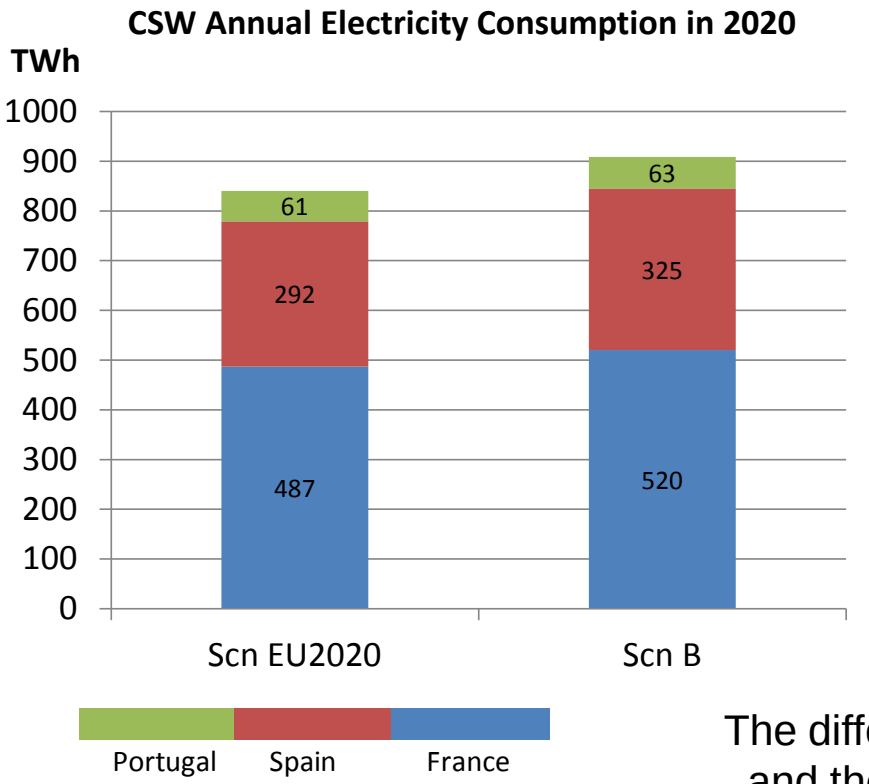
Assumptions

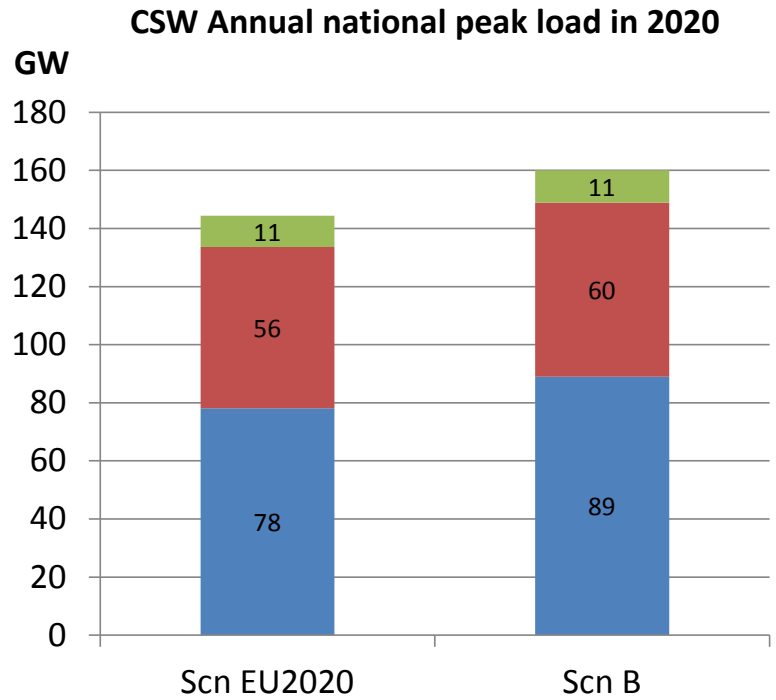
- LOAD
- THERMAL GENERATION
- HYDRO GENERATION
- WIND AND SOLAR
- OTHER MUST RUN UNITS

- MERIT ORDER

Load assumptions

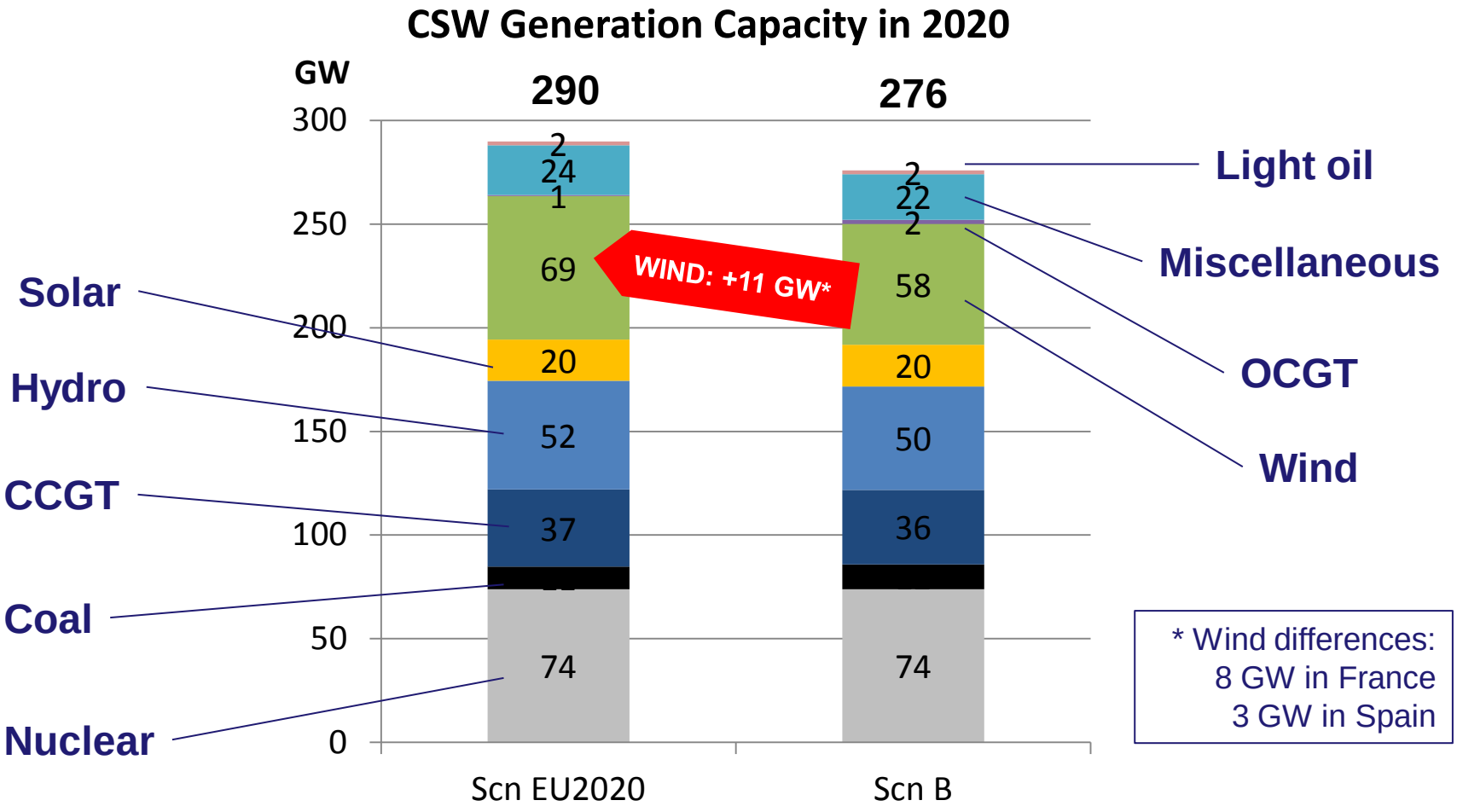
Reductions of annual electricity consumption in Scenario EU2020 (when compared to Scenario B) vary from 3% (Portugal) to 10% (Spain). In CSW annual electricity savings nearly reach 70 TWh which represent 7,5% of forecasted demand by TSO's in Scenario B.





The difference between the synchronous SW peak power and the sum of the national peak is about 1,5 to 3,5 GW

Overview of generation assumptions

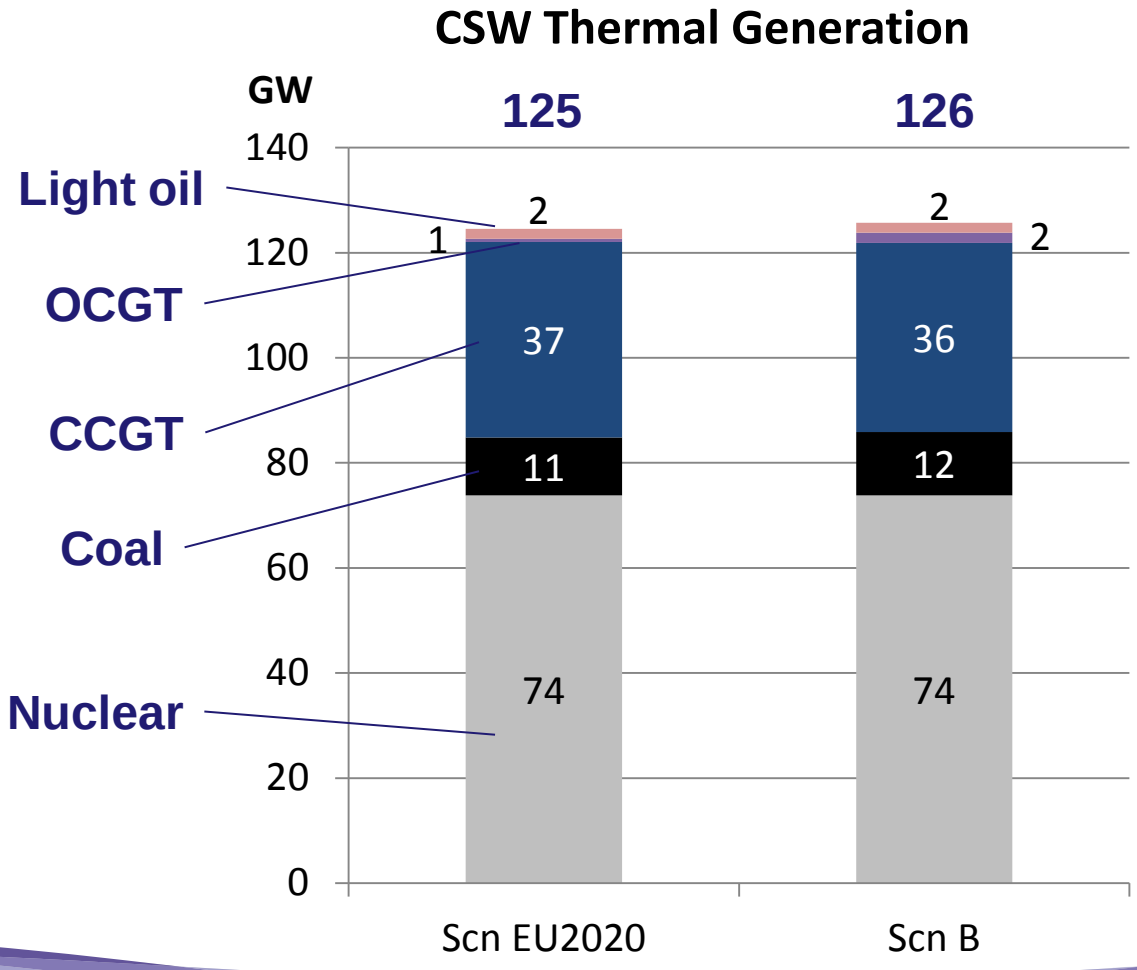


Thermal generation assumptions

The overall thermal generation capacity is nearly the same in Scenario EU202020 and Scenario B, summing up 125 GW.

Difference is just 1000 MW more of CCGT in Scenario B

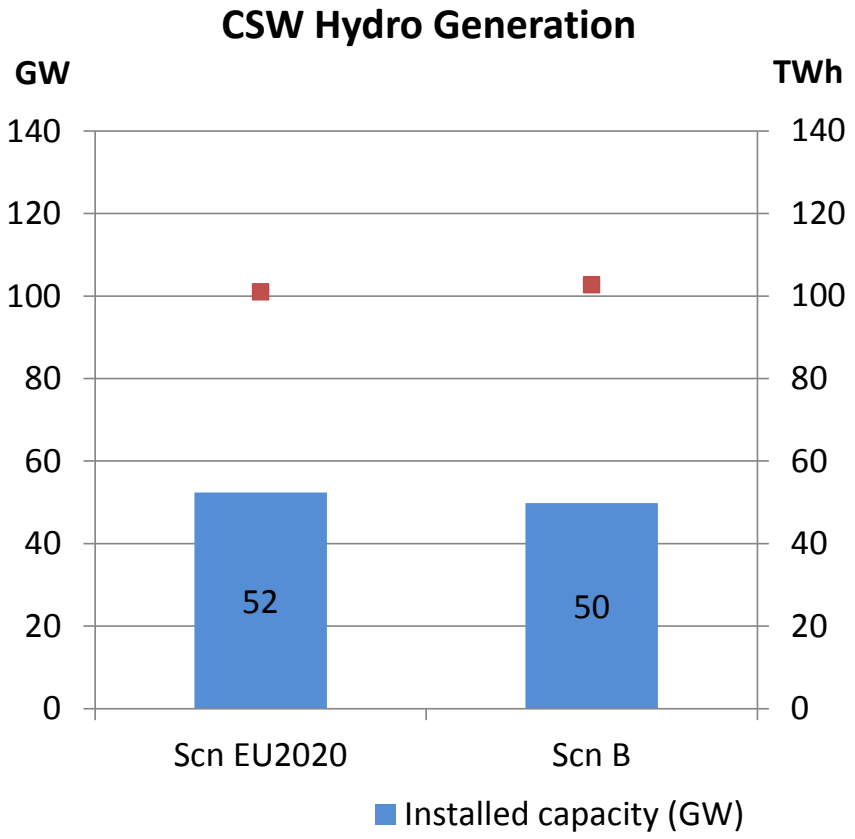
The largest share belongs to Nuclear (59%) followed by CCGT (30%) and Coal (10%).



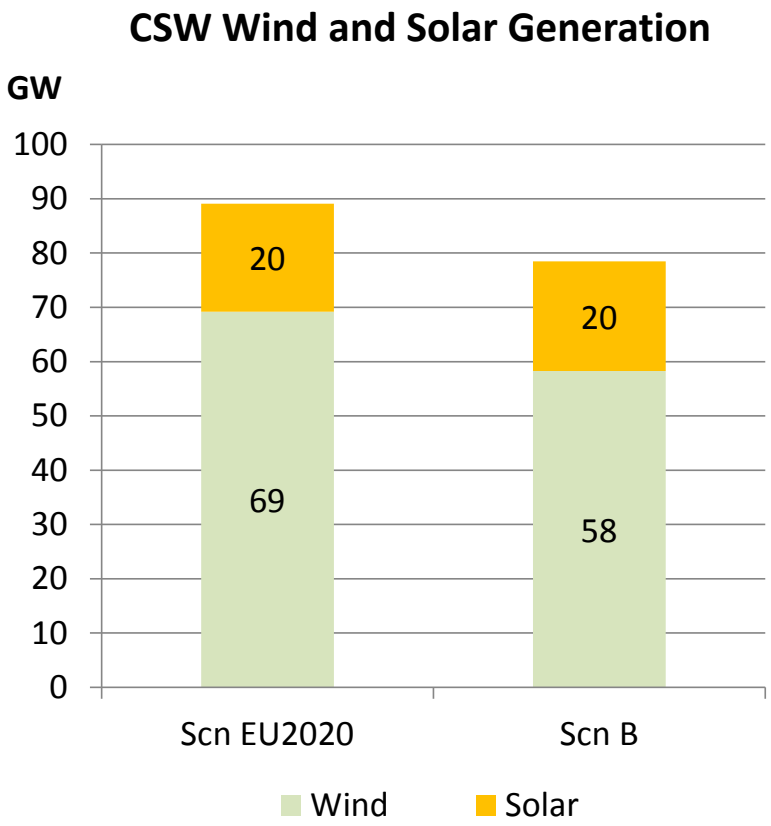
Hydro generation assumptions

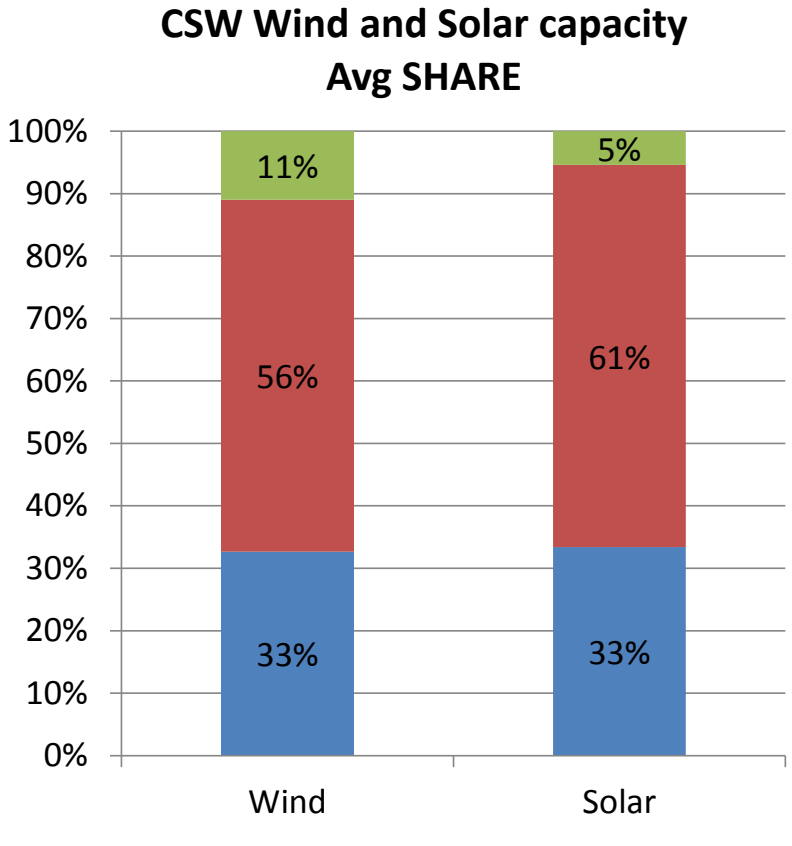
Very similar hydro generating capacity in SW in both scenarios.

Nevertheless extra new 3000 MW of hydro pumping are forecasted in Scenario EU2020.



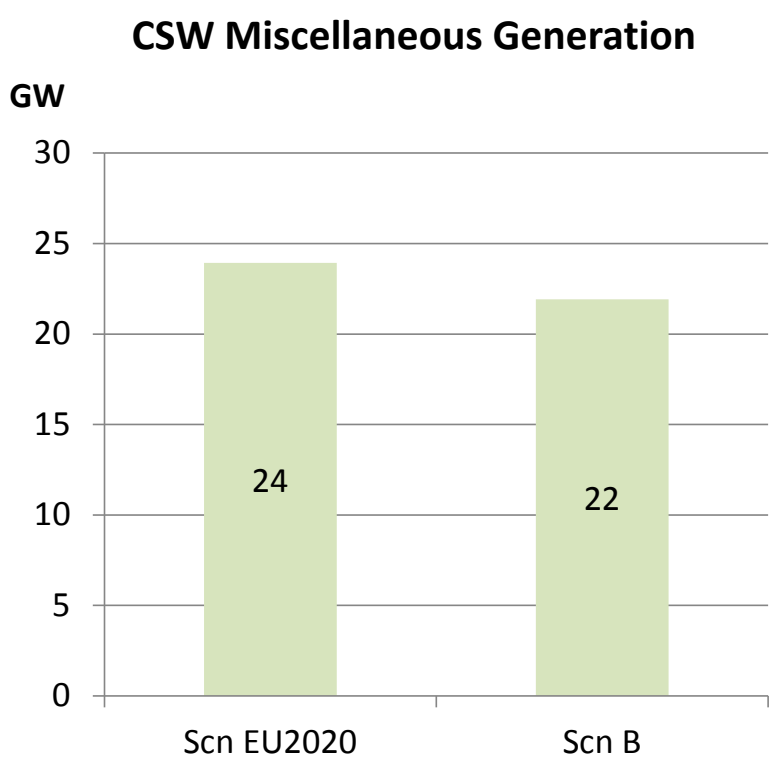
Wind and Solar generation assumptions

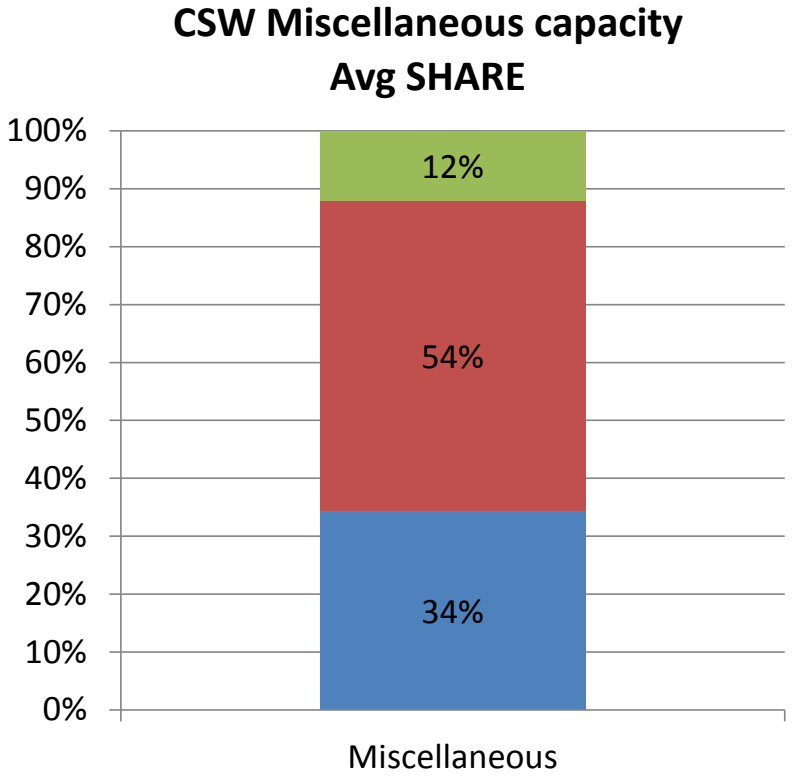




Spain concentrates more than half of both Wind and Solar capacity.
In SW, the wind average load factor is about 25% (20% for the solar generation).

Miscellaneous (non-dispatchable) generation assumptions

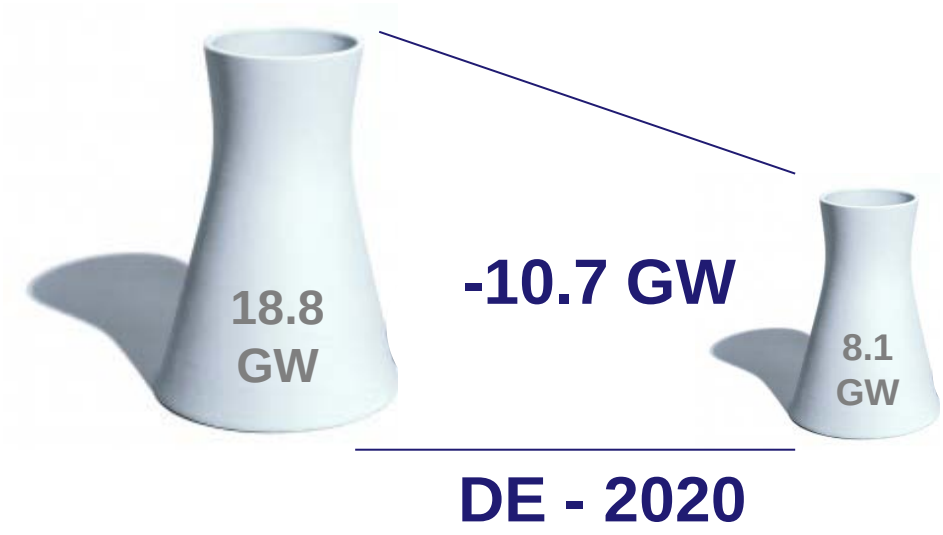




The installed capacity of miscellaneous generation do not vary much between scenarios and includes other renewables and distributed generation.
The average load factor is 45%.

Nuclear Phase-out

Following Fukushima's events + Germany's decision to permanently shutdown Nuclear power plants, ENTSO-E decided to perform a sensitive analysis of main scenarios.



Merit order assumptions

Prices of the fuels are taken from the reference scenario of the International Energy Agency in its World Energy Outlook. In Scn EU2020, CO_2 price is higher, and CCGT units are generally cheaper than coal plants, except for the coal with “must-run” conditions.

	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

CO_2 price effect

ENTSO-E Ten Year Network Development Plan 2012

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

Gregoire Paul
RTE – Réseau de Transport d'Electricité

ENTSOE RG CSW workshop
Madrid, 29 November 2011

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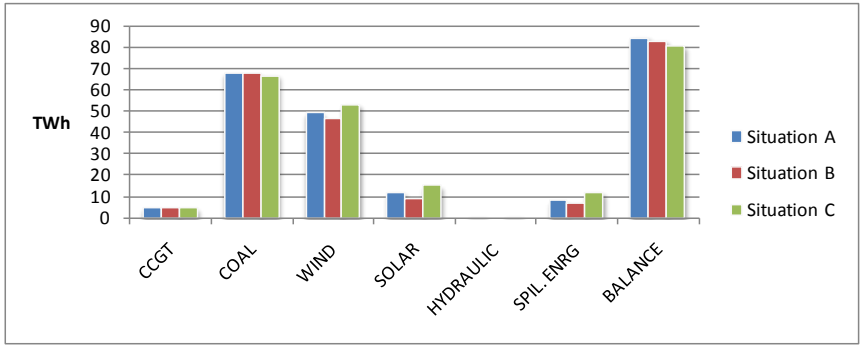
Market studies: purpose

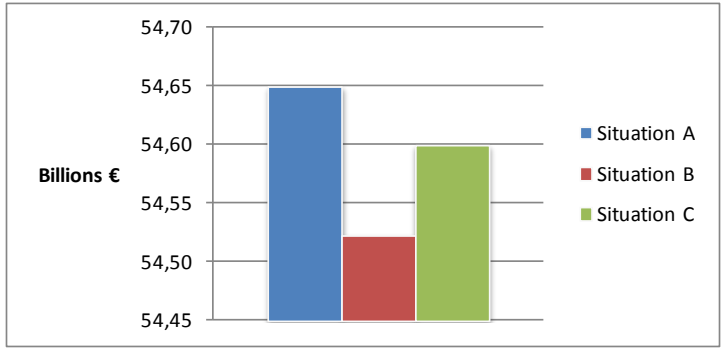
Purpose of market studies:

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…)

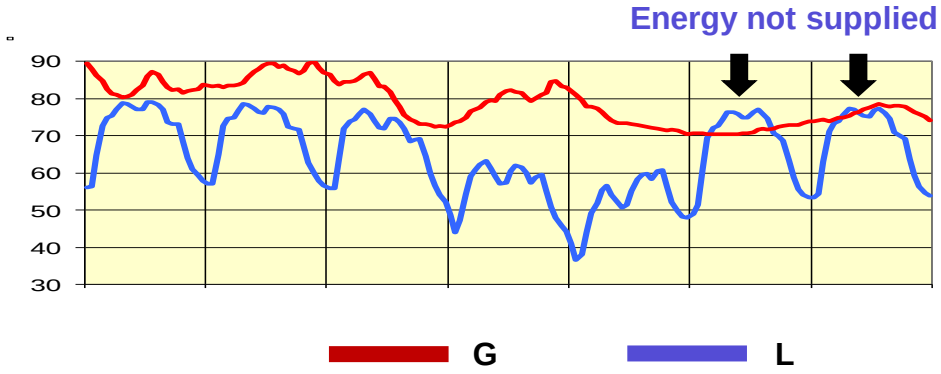
Adequacy studies: purpose

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:

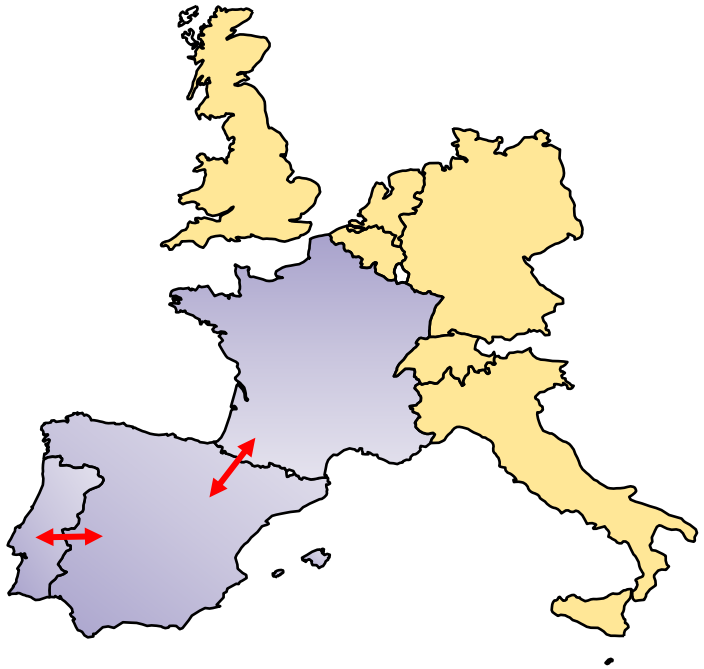
- demand higher than average (low temperatures for instance)
- low availability of thermal units (planned and unplanned outages)
- low levels of hydro-reservoir and low levels of wind power (unfavourable meteorological conditions)



Market & adequacy studies: general principles

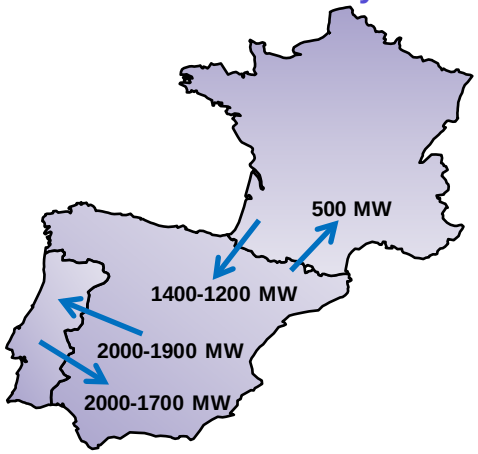
General principles:

- 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 ⟷

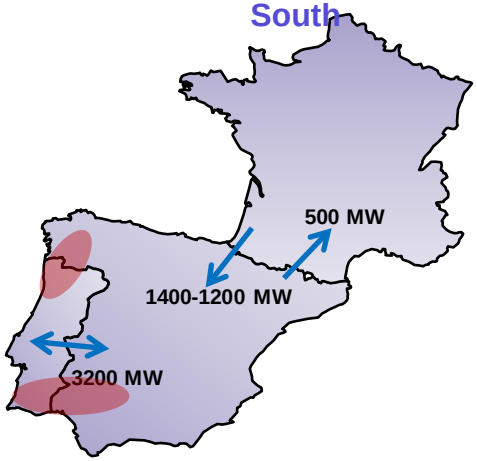


Simulations allow to analyze project by project

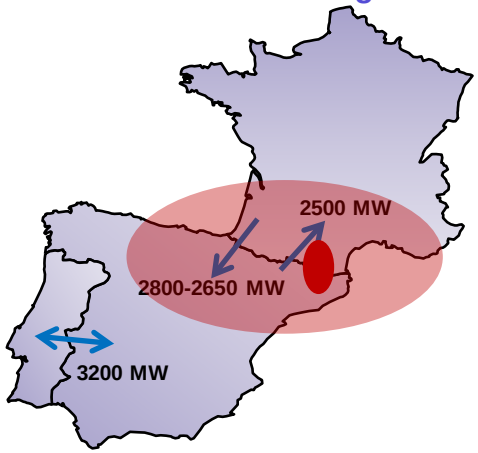
S1: NTC Today



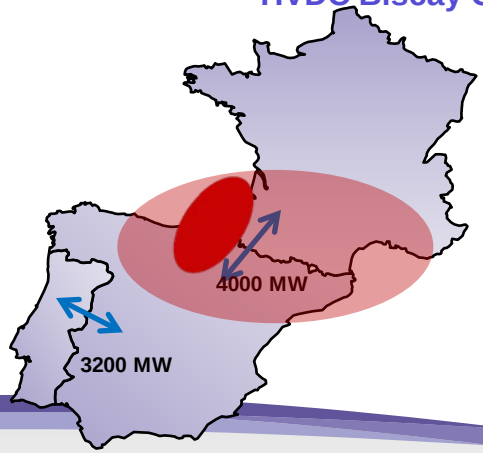
S2: Projects ES-PT North and South



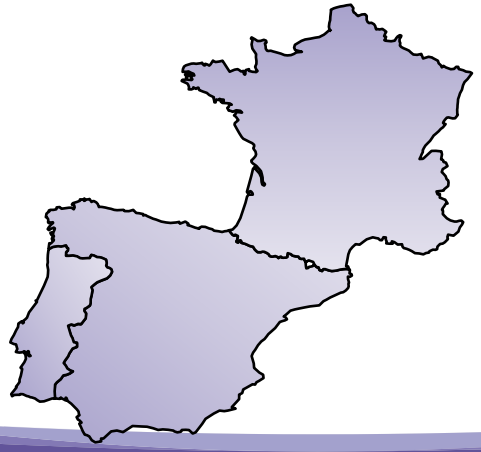
S3: Eastern Interconnection ES-FR HVDC Sta Llogaia -Baixas



S4: Western Interconnection ES-FR HVDC Biscay Gulf



S5: Copper-plate



System modeling: CSW + extended perimeter

CSW (Spain-France-Portugal)

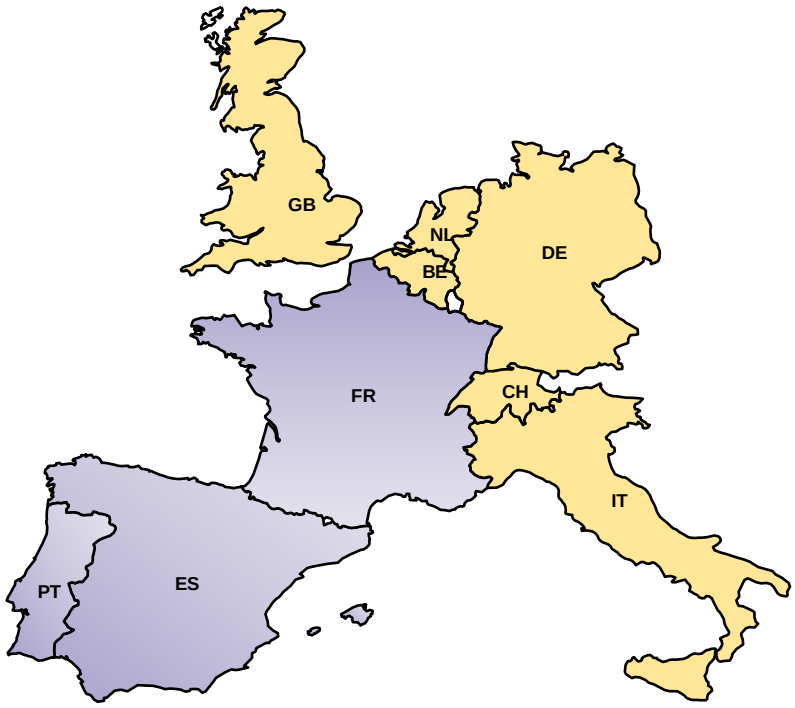
Data exchanged in the framework of CSW, refers mainly to:

- •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)

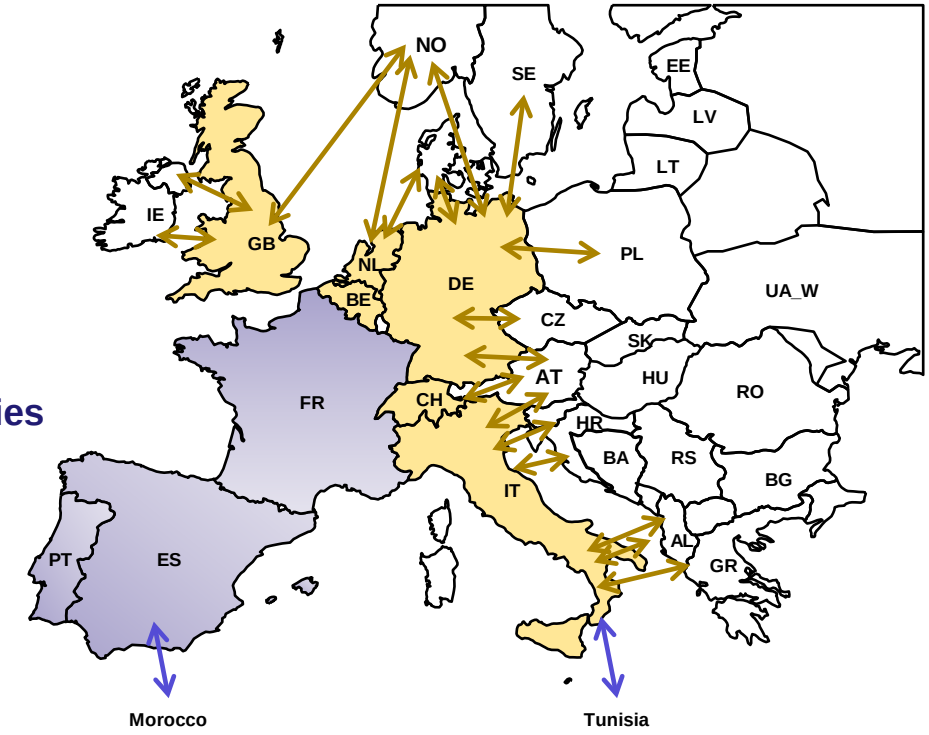
=> Studies take into account the interactivity of CSW with the rest of ENTSO-E



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



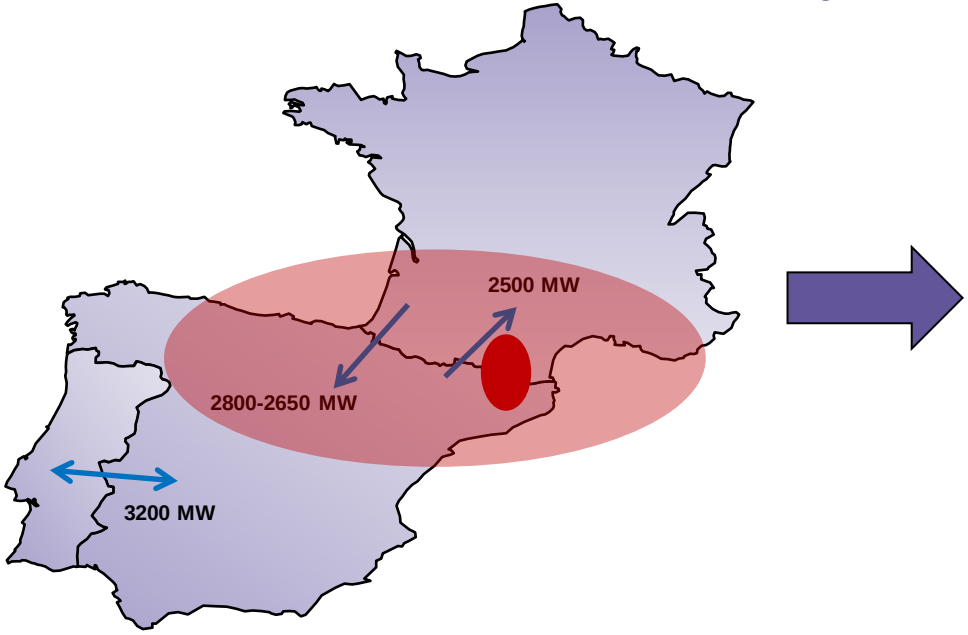
System modeling: focus on transmission capacity

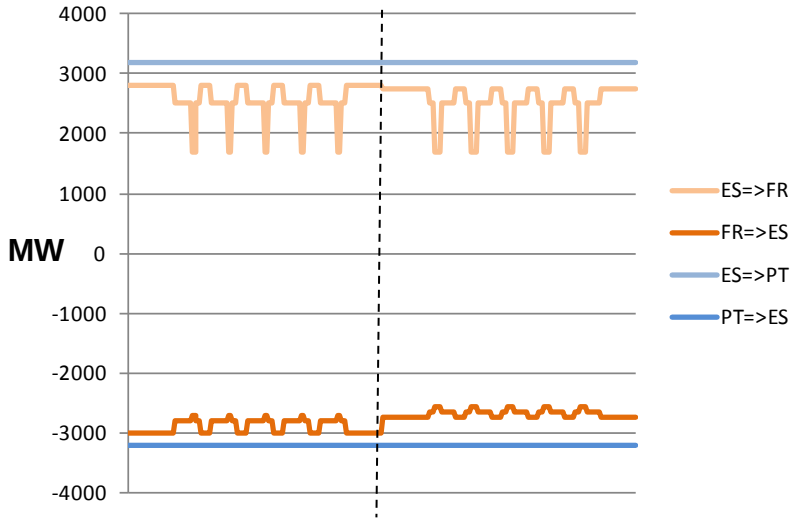
NTC within CSW are defined **on an hourly basis,** depending on:

- 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

Market studies: dispatchable units

Variable generation costs of thermal units:

Variable Generation Costs [€/MWh] = Operational & Maintenance Costs + Fuel Costs + CO2 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
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Oil-fired power plants and OCGTs	7	7

CO_2 price effect

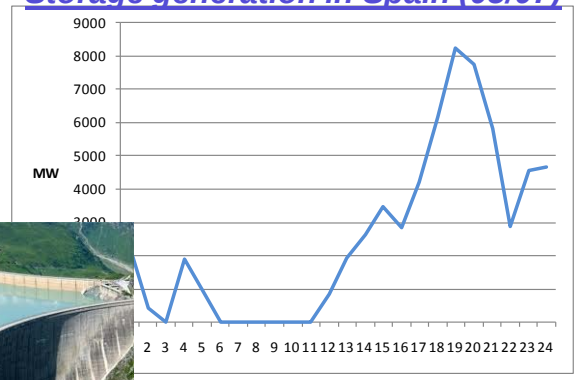
Market studies: RES & non-dispatchable units

No variable cost affected to RES & non-dispatchable units

- Hydaulic systems: optimisation under constraints
  Monthly energies, Max Power available, Flexibility...

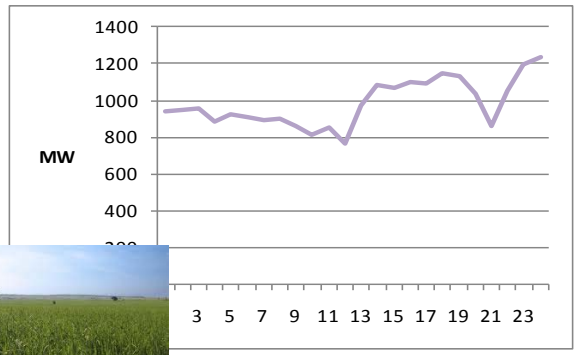
- Other RES & non-dispatchable units:
predetermined hourly power with specific profiles

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

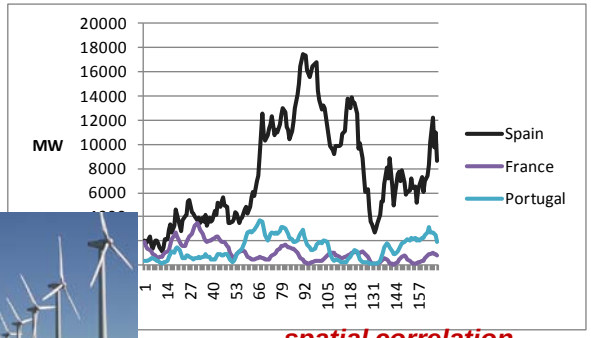


daily profile:
Solar in Portugal (05/07)

daily profile:
Biomass in Spain (05/07)



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

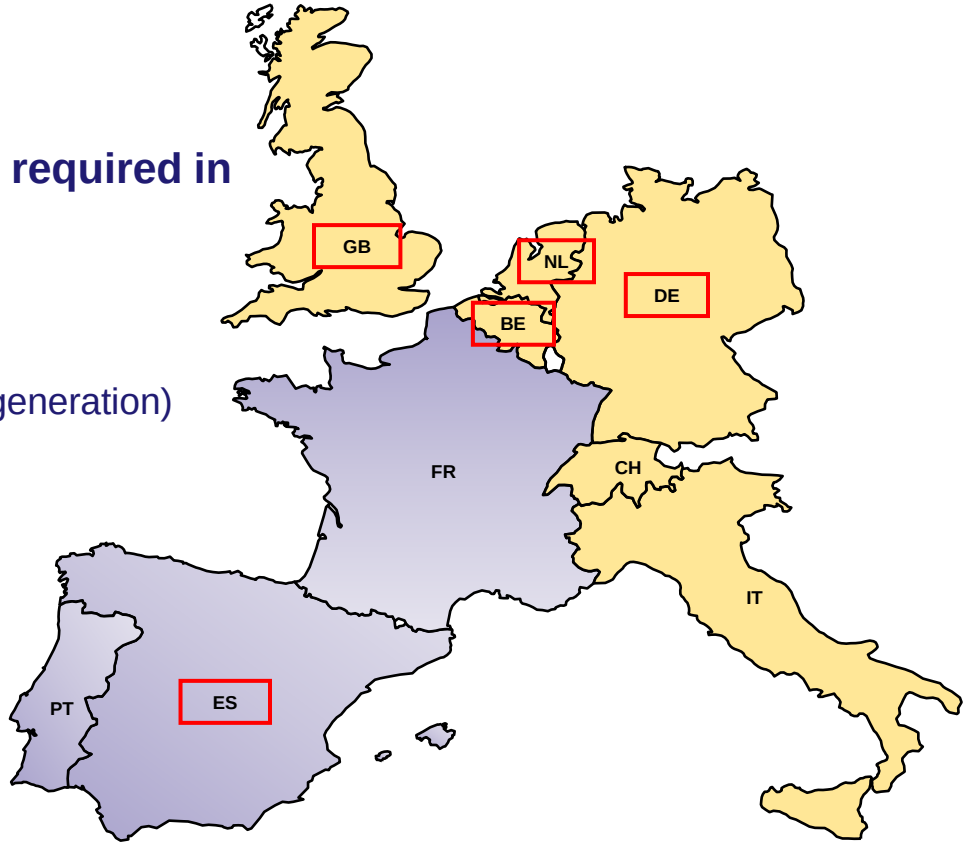


spatial correlation

Market studies: Must-run units

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

Market studies: valuation of reinforcements

Assessment of reinforcements benefits:

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

Main results coming from Market studies:

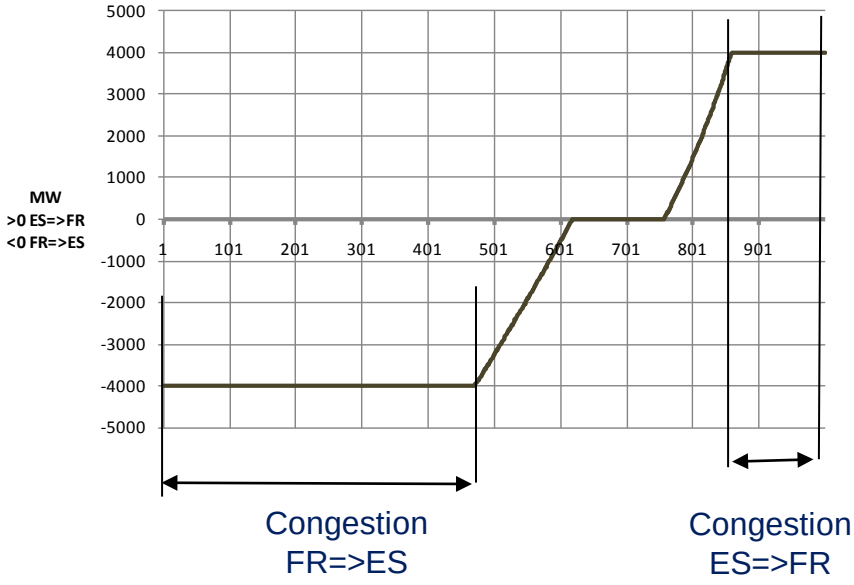
- *Variation of the generation per technology [TWh]*
- *Social Economic Welfare (variation of the variable generation costs) [M€]*
- *Variation of CO2 emissions [Mtons]*
- *RES integration (how much energy spillage avoided) [GWh]*
- *Energy exchanged [TWh] & congestions on the interconnections [%]*

Market studies: Exchanges analysis

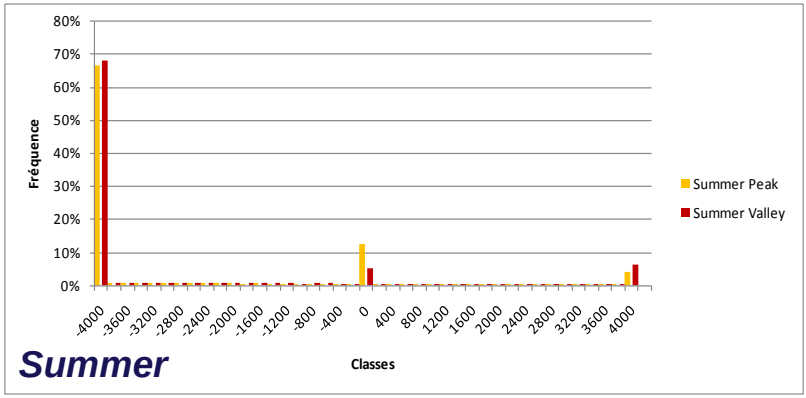
Assessment of Bulk Power Flows (BPF)

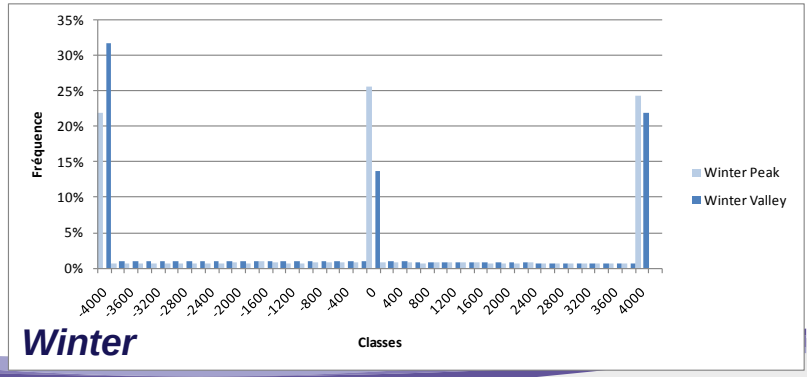
… by quantifying the probability of typical cross-border exchanges situations:

Yearly duration curves:



Seasonal exchanges probability :





Adequacy studies: valuation of reinforcements

Benefits of reinforcements:

Simulations with/without reinforcement ⇔ 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*

ENTSO-E Ten Year Network Development Plan 2012

Regional Group Continental South West (RG CSW)

Network studies and project assessment methodology

Antonio Pitarma
REN

ENTSOE RG CSW workshop
Madrid, 29 November 2011

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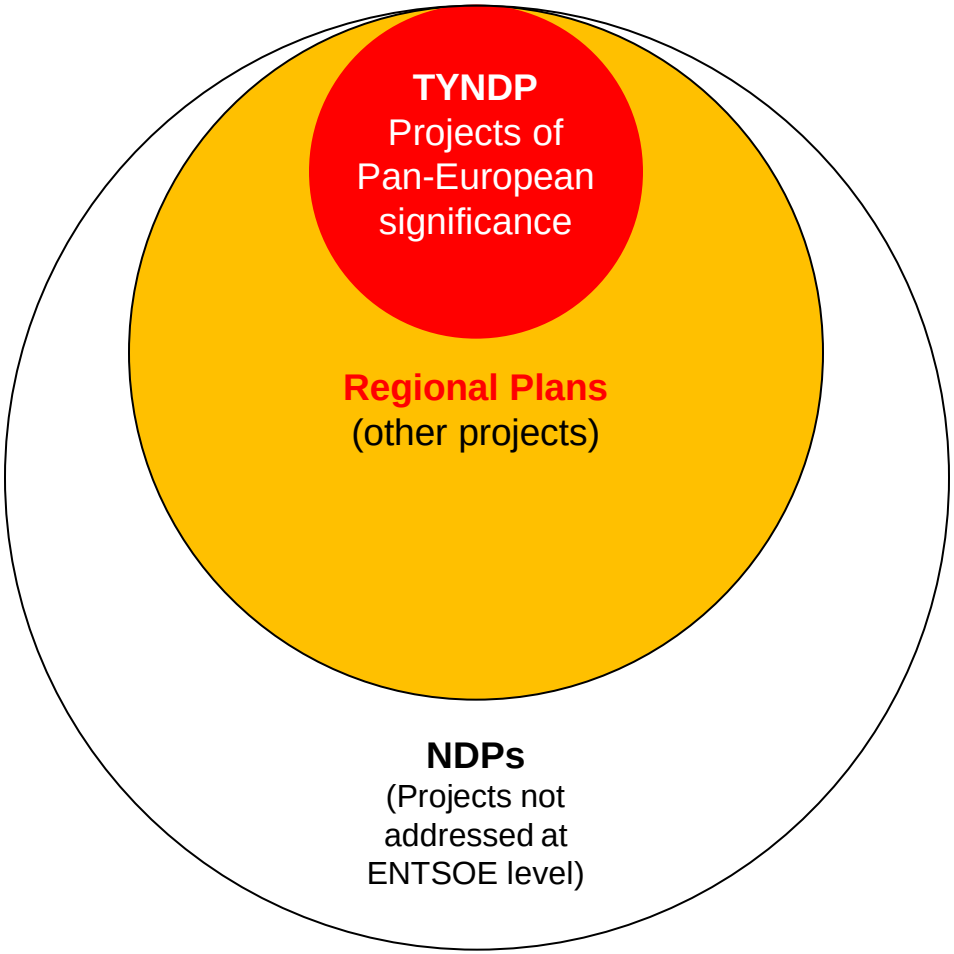
Reliable Sustainable Connected

Projects of Pan-European significance



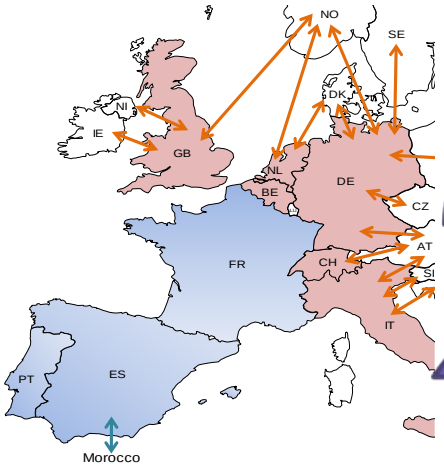
- Projects of Pan-European Significance
  - Meeting the EU energy targets: RES (20-20-20 objectives), SoS, Internal Energy Market (IEM).
- Projects can be from TSOs & 3rd parties
- Basis for further selection of Projects of Common interest

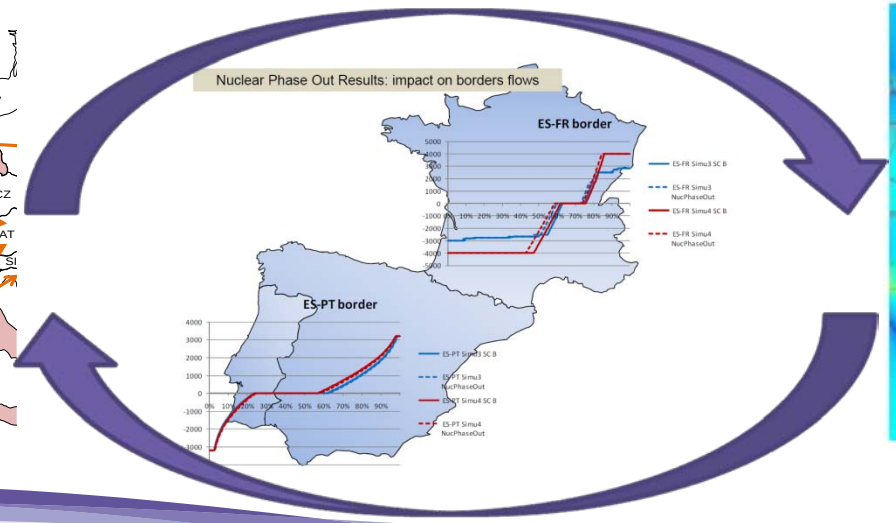
Projects of Pan-European significance - Definitions

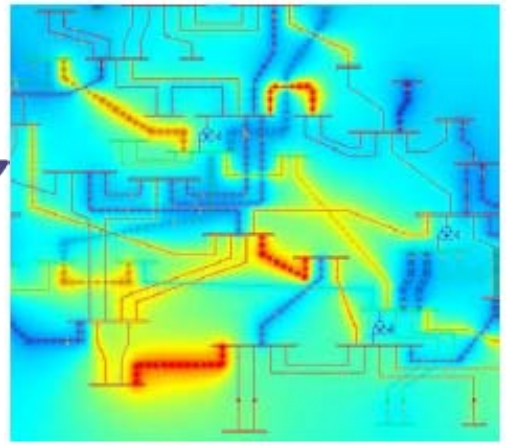
- **A Project of European significance is…**
  - … a set of EHV assets (with at least one part in Europe);
  - … all contributing to a same grid transfer capability increase across a grid boundary, valuated in MW;
  - … matching the following thresholds:
    - *Main equipment > 220 kV for OHL AC and > 150 kV else*
    - *Grid Transfer Capability Increase, either*
      - *enabling > 500 MW of additional NTC; or*
      - *enabling or securing output of > 1 GW/1000 km² of generation (new and/or existing); or*
      - *securing for > 10-year load growth for an area > 3 TWh/yr.*

From Market Studies to Network Studies (1/3)

- **Scenario elaboration & validation**
- **Market studies**
- **Network Studies**
- **Project identification & valuation**

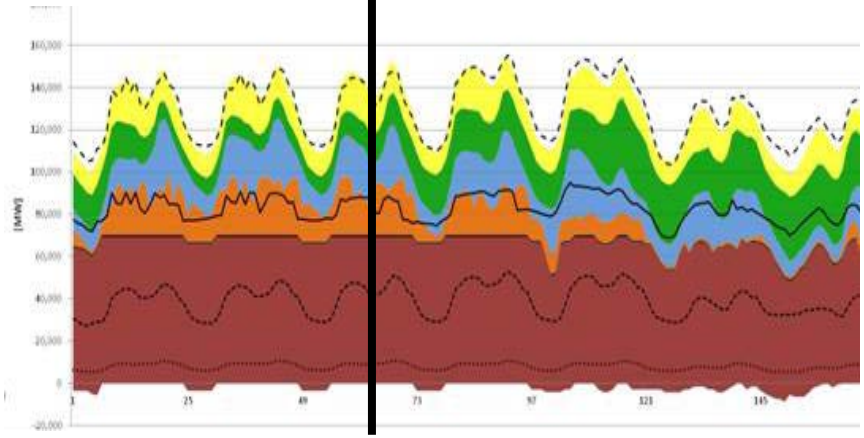






From Market Studies to Network Studies (2/3)

Point in time



Market studies give statistical information, used to choose the most representative **reference planning cases in the region**.

- Generation mix : MW by technology & country
- Demand in each country
- Possible power exchanges between countries in the Regional Group and with ROW

Network studies allocate power output to particular generators in the grid in each snapshot.

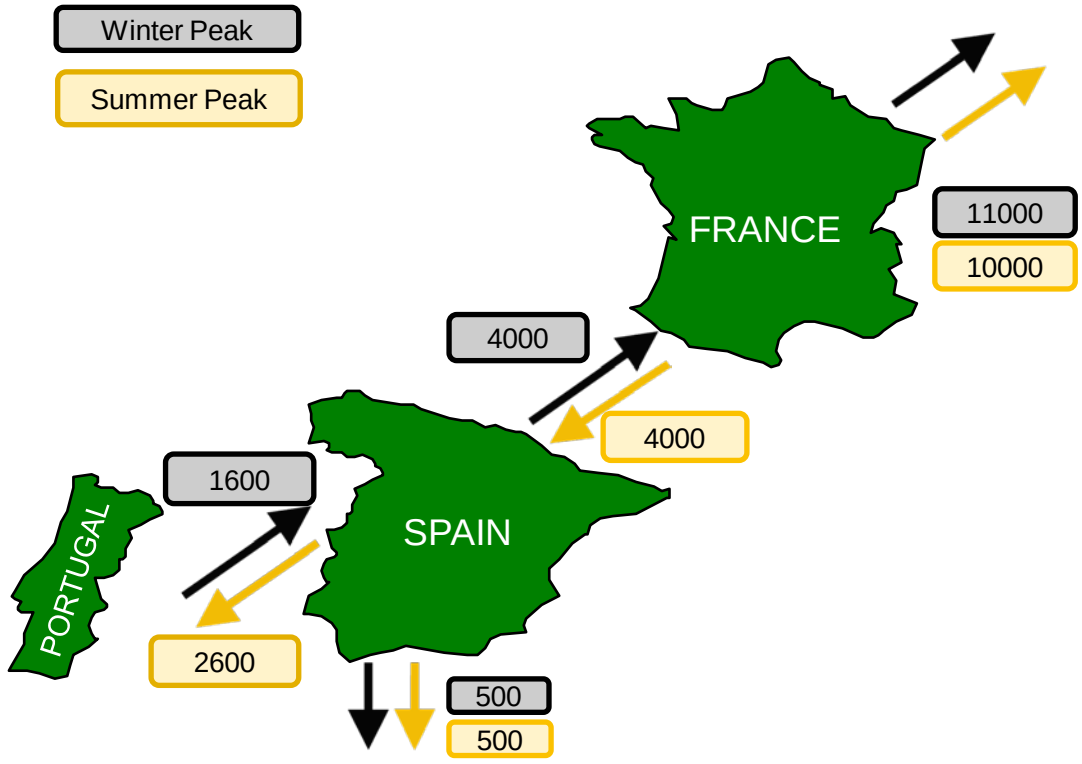
From Market Studies to Network Studies (3/3)

Reference cases (1 winter peak and 1 summer peak) with ROW simulated with panEU network models

	Case	Season	Peak or Valley	RES Iberia	PT-SP exchange	SP-FR exchange
probable	**1**	**Winter**	**Peak**	**High**	**1600 PT>SP**	**4000 SP>FR**
extreme	2	Winter	Peak	High	3000 PT>SP	4000 SP>FR
extreme	3	Winter	Peak	Low	2800 SP>PT	4000 FR>SP
probable	**4**	**Summer**	**Peak**	**Low**	**2600 SP>PT**	**4000 FR>SP**
extreme	5	Summer	Peak	High	2200 PT>SP	4000 SP>FR
extreme	6	Summer	Valley	High	1400 PT>SP	4000 SP>FR

Additional cases for analysis of interconnections

Models for network studies (1/2)



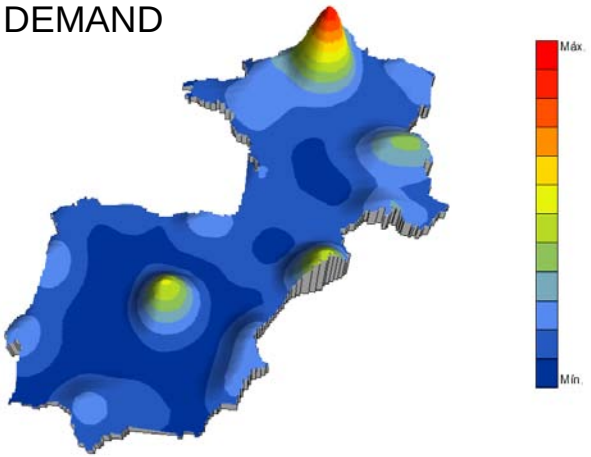
MW	Gen	Load
FR	98000	91000
SP	52800	49900
PT	11900	10300

MW	Gen	Load
FR	79000	65000
SP	47300	48200
PT	5900	8500

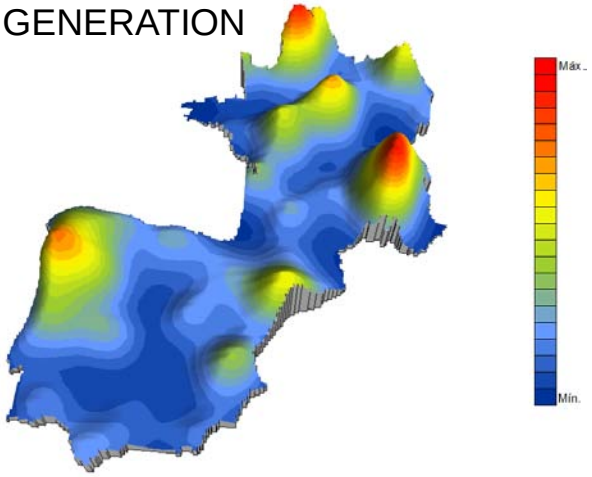
Models for network studies (2/2)

Snapshot of Winter Peak 2020 Scenario 3x20

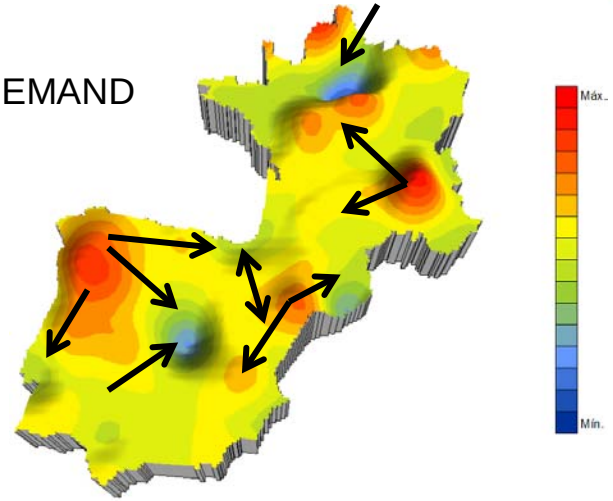
DEMAND



GENERATION



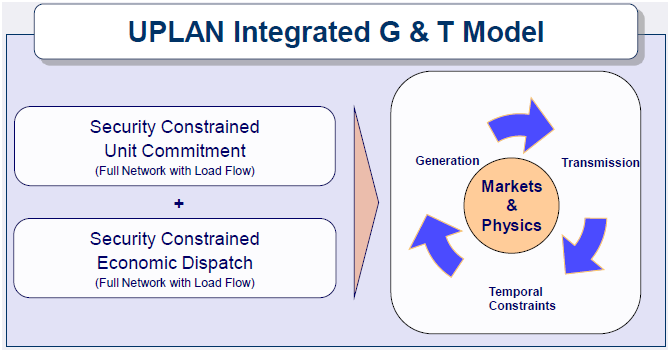
GENERATION - DEMAND



Simulation Tools

Analysis performed with 3 simulation software's:

- **CONVERGENCE model**, developed by RTE, used for load flow analysis
- **PSSE model**, commercial model used by REE and REN, used for load flow analysis.
- **UPLAN model,** commercial model used by REE, used for a joint market and load flow analysis for internal network



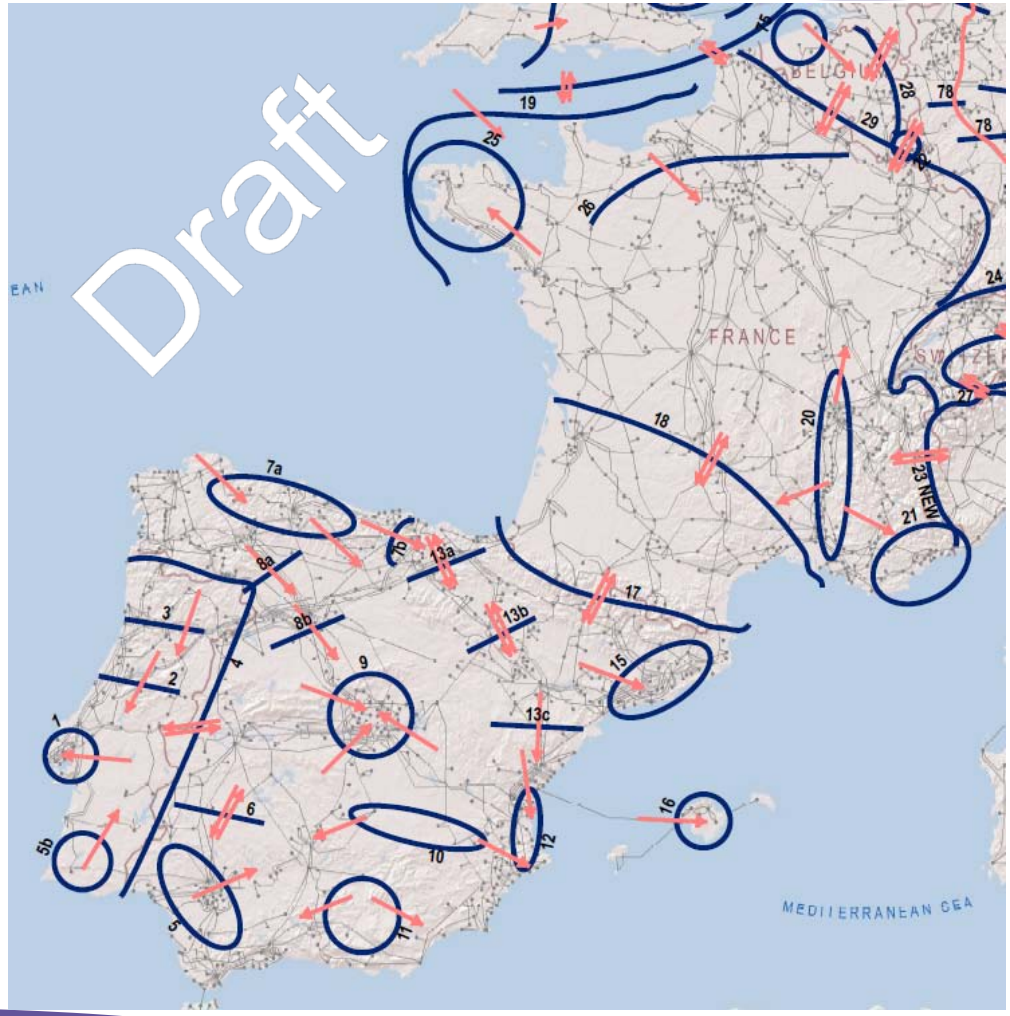
Project Assessment

The goal of project assessment is to characterise the impact of transmission projects, both in terms of added value for society (increase of capacity for trading of energy and balancing services between price zones, RES integration, increased security of supply….), and in terms of costs.

- Grid Transfer Capability Increase (GTC)
- Social Economic Welfare (SEW)
- RES integration
- Security of Supply (SOS)
- Losses variation
- CO2 emissions
- Technical Resilience
- Flexibility
- Social and Environmental impact

Assessment done with/without each project in a 2020 planned situation

Project Assessment - Boundaries



Project Assessment – GTC Increase / SEW

- **Grid Transfer Capability (GTC)** is the ability of the grid to transport electricity across a boundary, i.e. from one area (price zone, area within a country or a TSO) to another.

  - Maximum grid transfer capability across a boundary between two areas is found, in a certain direction, assuming that the flow is to be maximised in the direction of the net flow across the boundary in the reference condition.

- **Social Economic Welfare (SEW)** on electricity markets is characterised by the ability of a power system to reduce congestions and thus providing an adequate grid transfer capability, reflecting to the needs and willingness to pay of market players and consumers

  - The social and economic welfare benefit is calculated from the reduction in total variable generation costs associated with the GTC variation that the project allows.

Project Assessment – Res integration / SOS

- **RES integration** is defined as the ability of the system to allow the connection of new RES and unlock existing “green” generation, while minimising curtailments.
  - RES integration is facilitated by increasing the GTC between an area with excess of RES generation and another area where this production can be consumed by reducing other type of generation.

- **Security of Supply (SOS)** is the ability of a power system to provide an adequate and secure supply of electricity in normal conditions.
  - Benefit is evaluated by the reduction of proportion of time that the system is at risk due to constraints in transmission system following ENTSO-E standards.

Project Assessment – Losses variation/ CO2 emissions

- **Losses variation** has been considered as the ability of a transmission grid to minimise thermal losses in the power system.
  - The energy efficiency benefit of a project is measured through the reduction of thermal losses (MW) in the system.

- **CO2 emissions** is a result of **SEW** (unlock of generation with lower carbon content) and **losses variation**.
  - CO2 emissions are calculated using standard emission rates (CO2 emission) for each power plant given in the Pan European Market Data Base.

Project Assessment – Technical Resilience / Flexibility

- **Technical Resilience** is the ability of the system to withstand extreme system conditions (rare contingencies).

- **Flexibility** is the ability of the proposed reinforcement to be adequate in different possible future development paths or scenarios.

- **Social and Environmental impact** characterises the project impact as perceived by the local population, and as such, gives a measure of probability that the project will be built at the planned commissioning date.

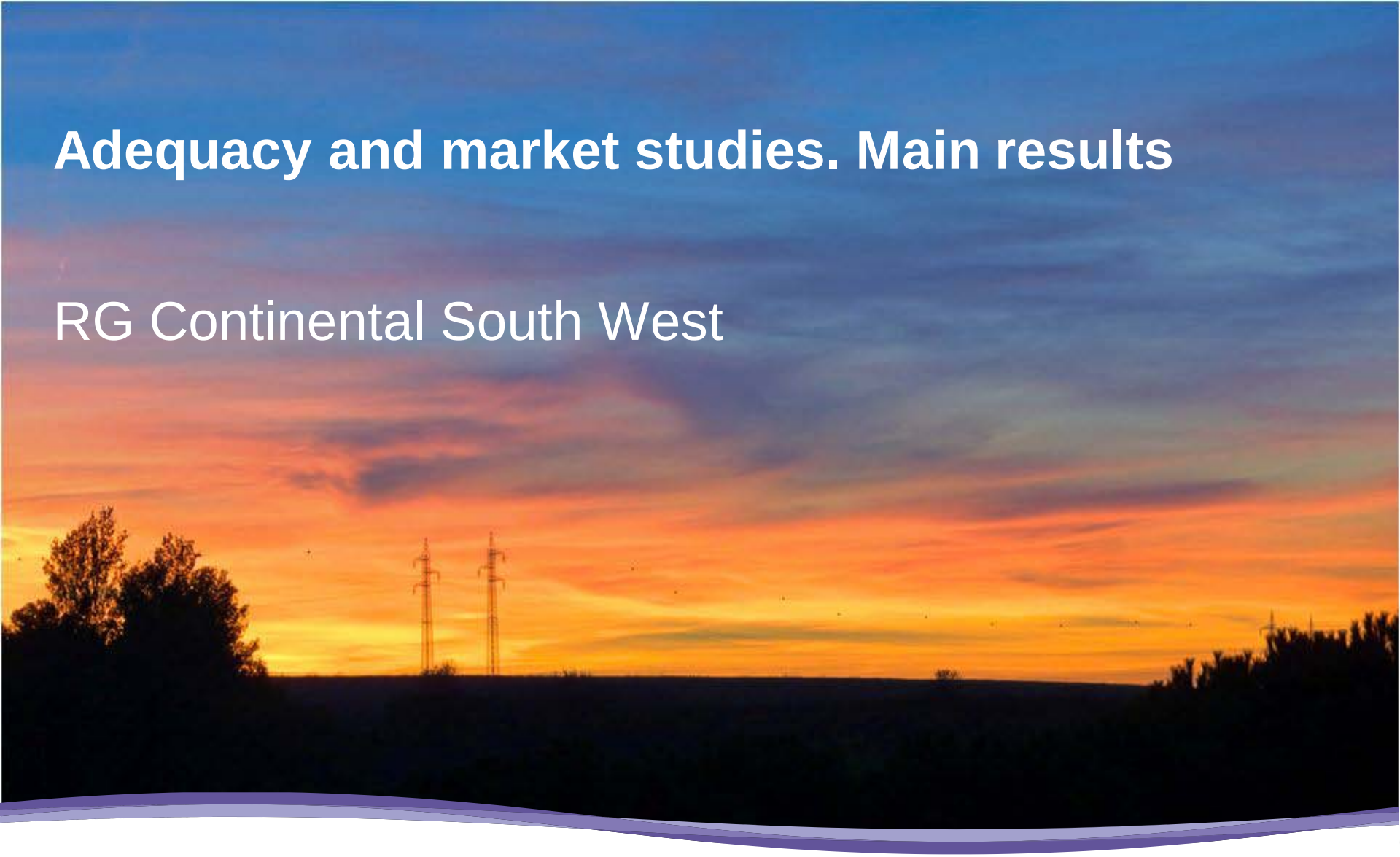
Project Assessment – Example of results

Project/ cluster	GTC	Social and Economic Welfare	RES	SOS	Losses variation	CO2	Technical Resilience	Flexibility	Social & Environmental
Project A, Name, description…	…. MW								
Project B, Name, description…	…. MW								

Thank You!

Adequacy and market studies. Main results

RG Continental South West



REE-REN-RTE
Network Planning Department of REE

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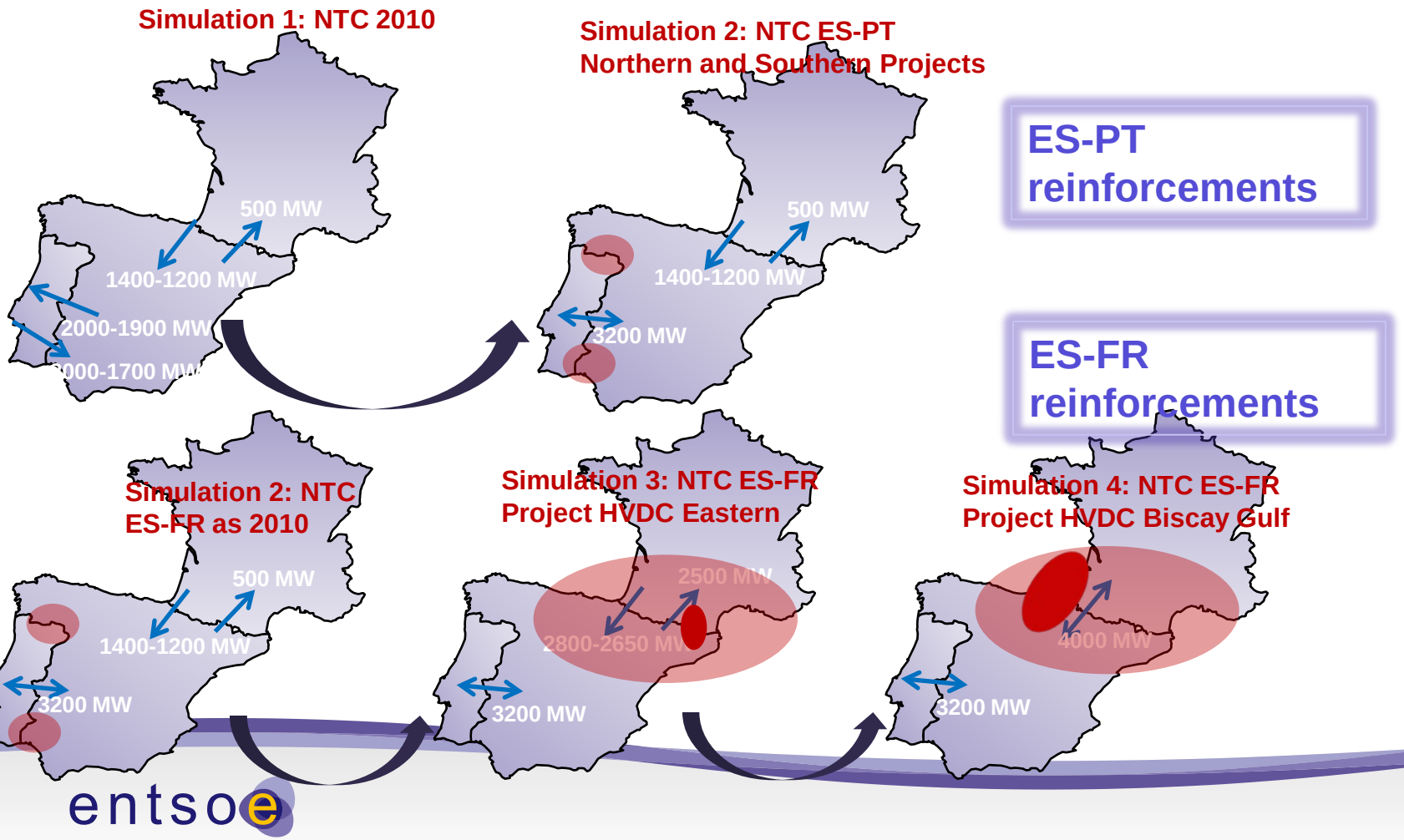
Reliable Sustainable Connected

Market studies: Main results

Assessment of reinforcements benefits:

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



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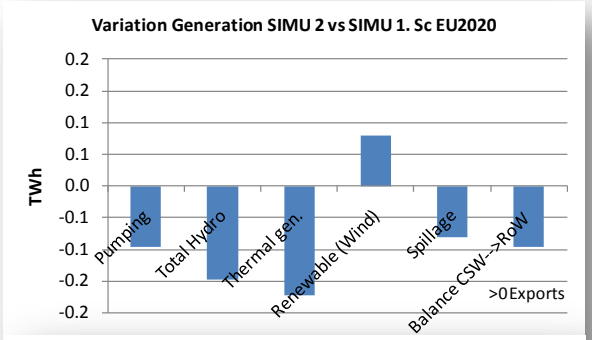
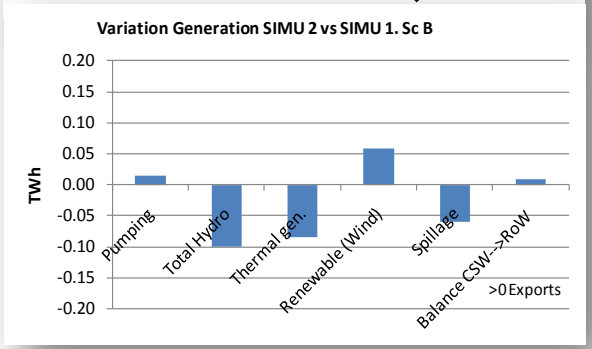
Market studies: Main Results

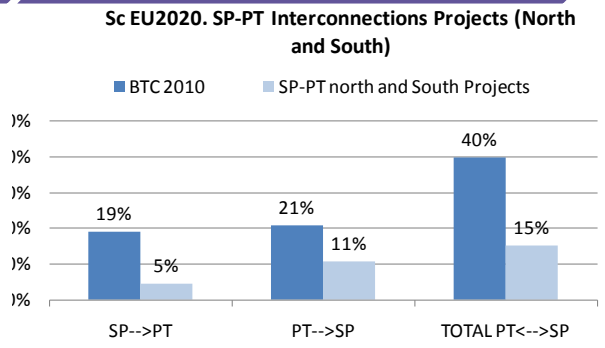
Spain-Portugal Interconnections Projects (Northern and Southern Projects)
Sc EU2020/Sc B. Main indicators

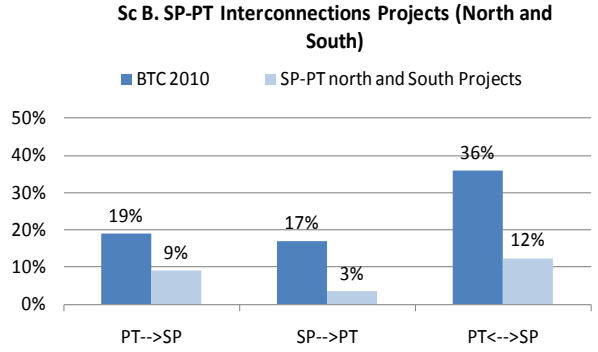
Generation | **RES Integration (Spillage avoided)** | **Congestion**





Low impact in generation breakdown.





% Hours of congestion is reduced 25%
Energy exchange increases aprox 22%
(Average of both scenarios)

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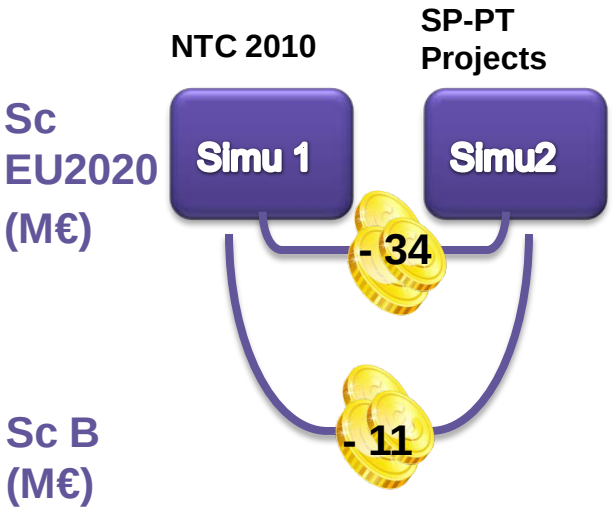
Market studies: Main Results

Spain-Portugal Interconnections Projects (Northern and Southern Projects) Sc EU2020/Sc B. Main indicators

Social Economic Welfare (*) | CO2 emissions | Conclusions



Moderate reductions of CO2 emissions (<<1%) with respect to NTC 2010, because of low impact in generation breakdown and moderate spillage avoided

Interconnection projects Spain-Portugal provide:

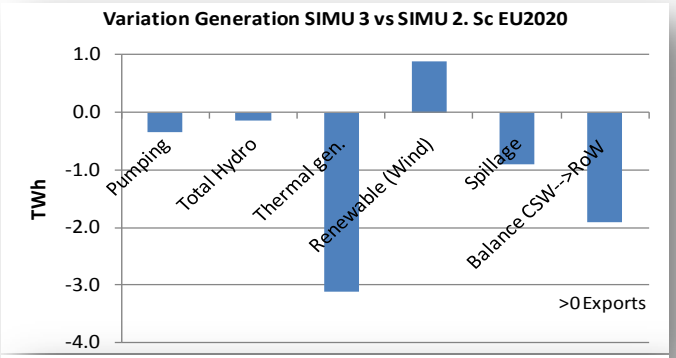
- ***some integration of renewable and reduction of their spillage***
- ***savings between 11 and 34 M€***
- ***lower congestion in the interconnection and the energy flow increases***

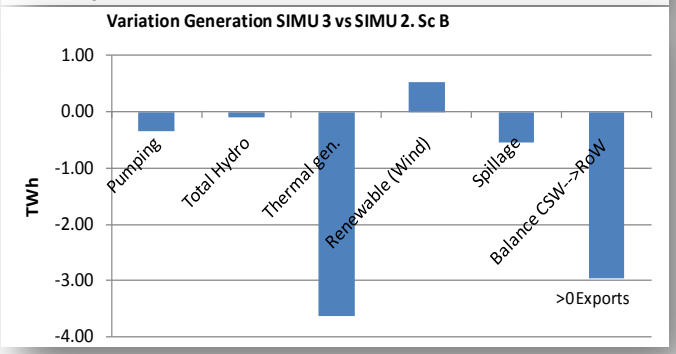
***** *Variation of the variable generation costs*

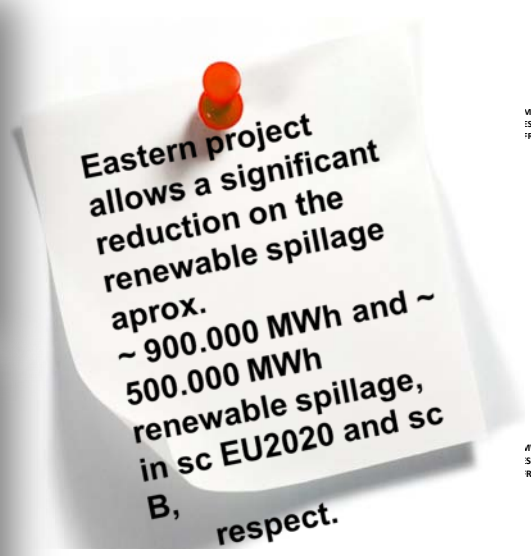
Market studies: Main Results

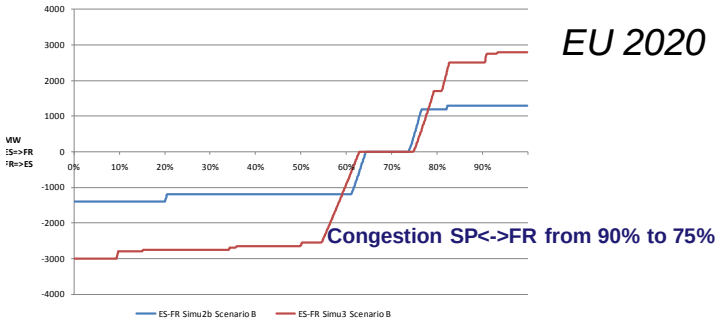
Spain-France Interconnections Projects (Eastern Project)
Sc EU2020/Sc B. Main indicators

Generation | **RES Integration (Spillage avoided)** | **Congestion**



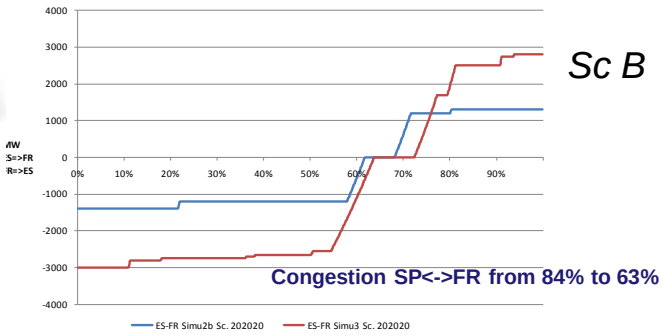






EU 2020

Congestion SP<->FR from 90% to 75%



Sc B

Congestion SP<->FR from 84% to 63%

The Eastern project implies a great impact in generation breakdown

The congestion decreases
The energy exchange increases almost twice in both scenarios

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Market studies: Main Results

Spain-France Interconnections Projects (Eastern Project)
Sc EU2020/Sc B. Main indicators

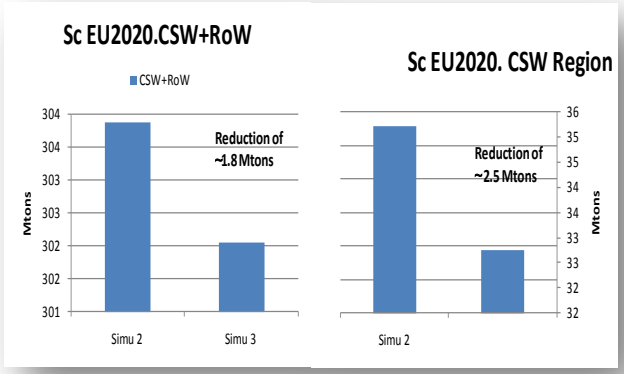
Social Economic Welfare (*) | CO2 emissions | Conclusions

Sc EU2020 (M€)

Sc B (M€)

* *Variation of the variable generation costs*

Reductions of CO2 emissions in comparison to simulation 2



In Sc B → the CO2 reductions in CSW +RoW are lower than in Sc EU2020 . For CSW Region the CO2 reduction are similar than in sc EU2020

Interconnection Eastern project Spain-France provide:

- ***Great integration of renewable and reduction of their spillage***
- ***Effects in the gen. breakdown***
- ***Important savings***
- ***Great reduction of congestion in the interconnection and the energy flow increases***
- ***Still congestion expected in 2020 with planned projects***

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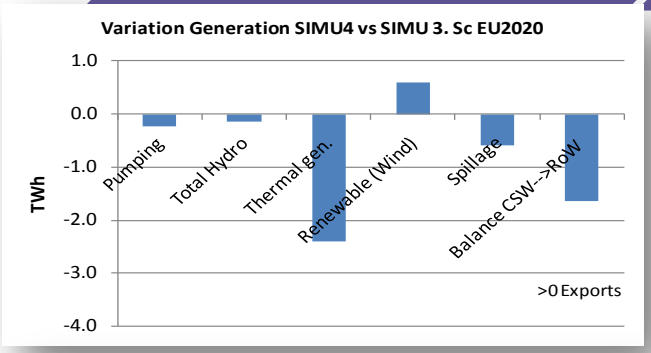
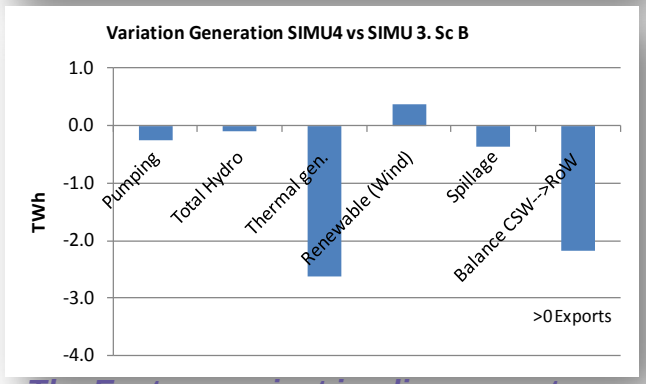
Market studies: Main Results

Spain-France Interconnections Projects (Western Project)
Sc EU2020/Sc B. Main indicators

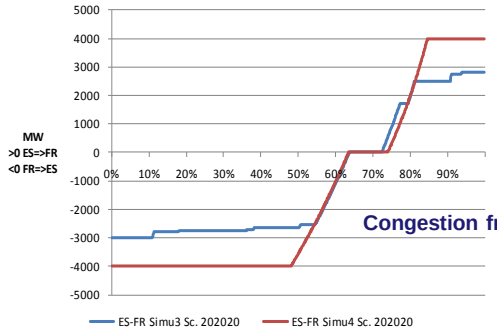
Generation | **RES Integration (Spillage avoided)** | **Congestion**





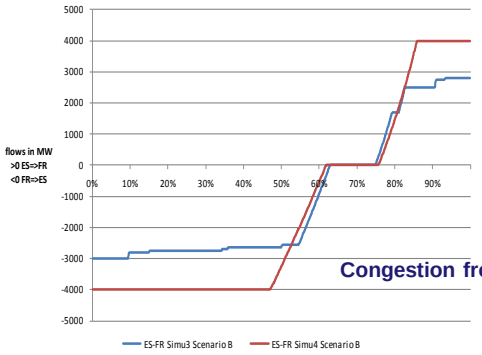
The Eastern project implies a great impact in generation breakdown

EU 2020



Congestion from 77% to 64%

Sc B



Congestion from 63% to 53%

% Hours of congestion is reduced 11% and the energy exchange increases aprox 35% (average of both scenarios)

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Market studies: Main Results

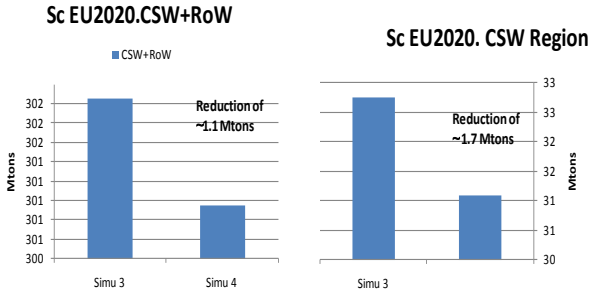
Spain-France Interconnections Projects (Western Project)
Sc EU2020/Sc B. Main indicators

Social Economic Welfare (*) | CO2 emissions | Conclusions

Sc EU2020 (M€)

Sc B (M€)

Sc UE2020 → Great reductions of CO2 emissions in comparison to simulation 3



In Sc B → the CO2 reductions in CSW + RoW region are almost neutral

Interconnection Western project Spain-France provide:

- ***Great integration of renewable and reduction of their spillage***
- ***Effects in the gen. breakdown***
- ***Important savings***
- ***Great reduction of congestion in the interconnection and the energy flow increases***
- ***Still congestion expected in 2020 with planned projects***

***** *Variation of the variable generation costs*

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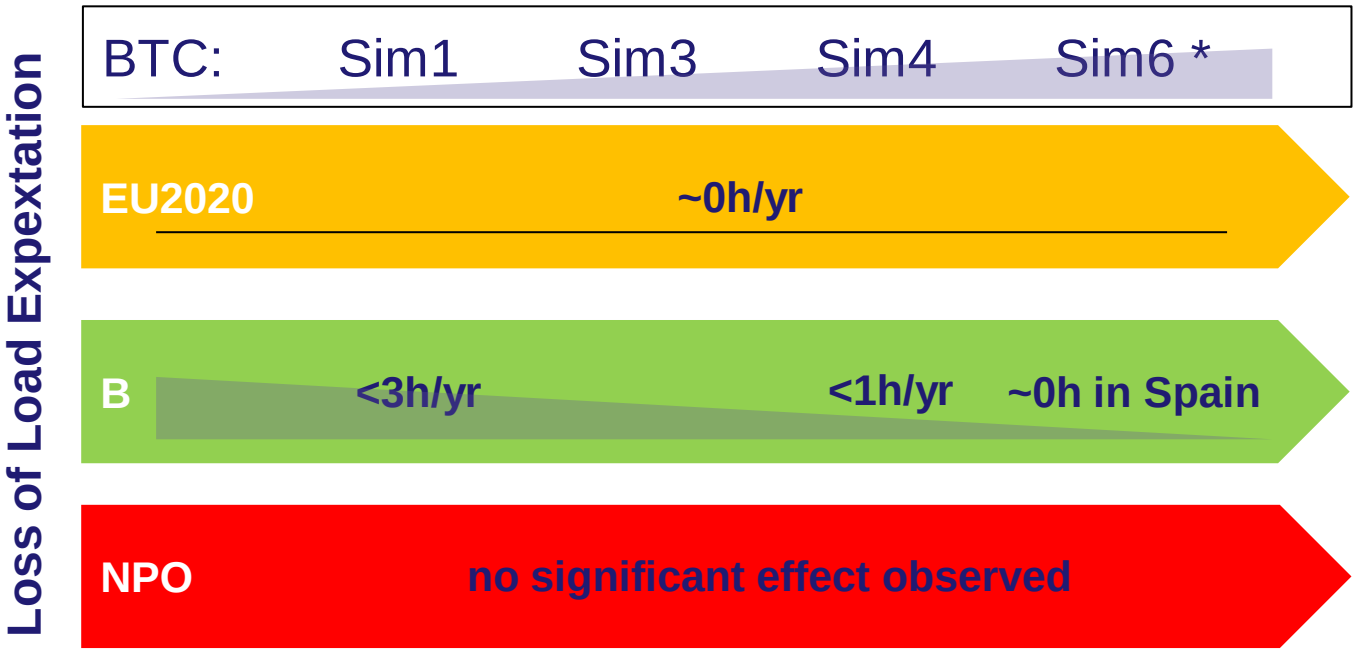
Adequacy studies: Main Results

The generation adequacy indicators in the CSW region are in general low or very low in all scenarios, even with low interconnection capacities as of 2010. Simulations were performed considering the probabilistic support of the neighbor systems.



*Simu6: NTC SP-FR: 6 GW

Tools

- RESERVAS
- ANTARES

Results

- LOLE (h/yr)
- LOLP (%)
- EENS (GWh/yr)

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Market and Adequacy studies: General conclusions

Interconnections within the region allow **higher exchanges** of energy in both directions

Seasonal behaviour of flows have been detected

The CSW region always will be an **exporting region** to the rest of Europe (very rare hourly exceptions), 80 to 110 TWh.**Spain and Portugal will be net importing systems** (low relative values)

Scenario EU2020 provides higher benefits, higher congestions, higher spillages, and higher exchange of flows

CBA shows that all planned **interconnections could be profitable for the system in less than 10 years**, and Eastern Reinforcement ES-FR even in **less than 5 years**

Interconnections within the region reduce around **4.0 MtonsCO2/y in CSW RG** (average of both scenarios), and a lower value for the whole EU: 3.1 MtonsCO2/y in Scen EU2020 and almost neutral in Scen B (NTC 2010 vs NTC2020)

Market and Adequacy studies: General conclusions

The **new interconnection projects have a significant impact on the congestion** of the borders.

- ES-PT projects will reduce congestion in 2015 from 36-40% (without) to 10-15% (with)
- ES-FR projects will reduce congestion in 2020 from 84-94% (without) to 45-64%(with)
- ES-PT projects don't affect ES-FR border, but ES-FR projects increase slightly ES-PT congestion

The copper plate analysis shows that

- 0% congestion in the borders gives **310-550 M€ increase in Socio-Economic Welfare over NTC 2020 situation,** almost half of it could be obtained with 6GW ES-FR (+2GW over 2020 planned value), however congestion would still be 28-45%
- 0% congestion is not cost effective as the cost of the reinforcement vs the benefit obtained would not be profitable
- **Qualitative assessment : 10% congestion on FR-ES could be obtained with 8-10 GW ; economic viability of such a project not proven**

Sensitivity analysis: The **Nuclear phase out** implies higher imports of Germany. This simulation **has a low impact in the CSW region**, slightly affecting congestion and energy flows, and slightly reducing the benefits of interconnection projects in our region.

The generation adequacy indicators in the CSW region are in general low or very low in all scenarios, even with low interconnection capacities as of 2010.

ENTSO-E Ten-Year Network Development Plan 2012

Regional Group Continental South West (RG CSW) Results

Patricia Labra
REE

ENTSOE RG CSW workshop
Madrid, 29 November 2011

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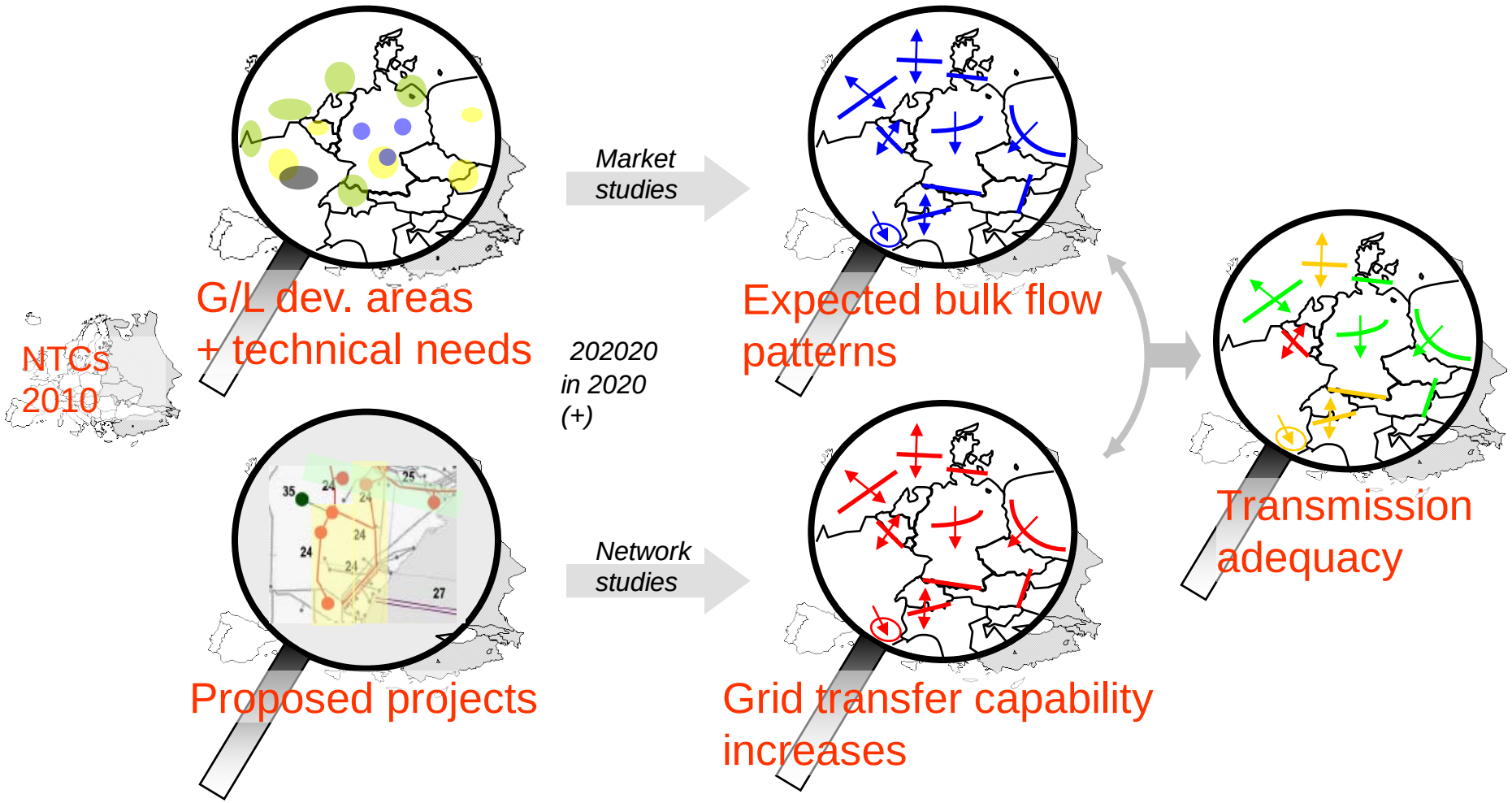
Reliable Sustainable Connected

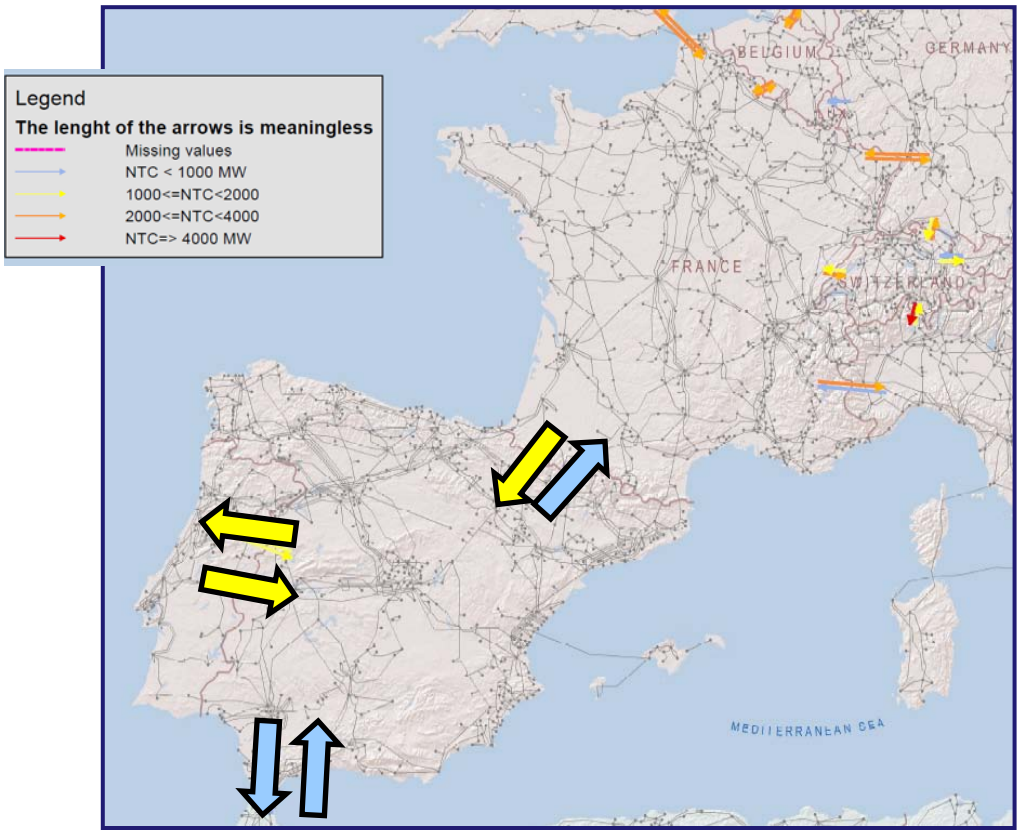
Main Deliverables



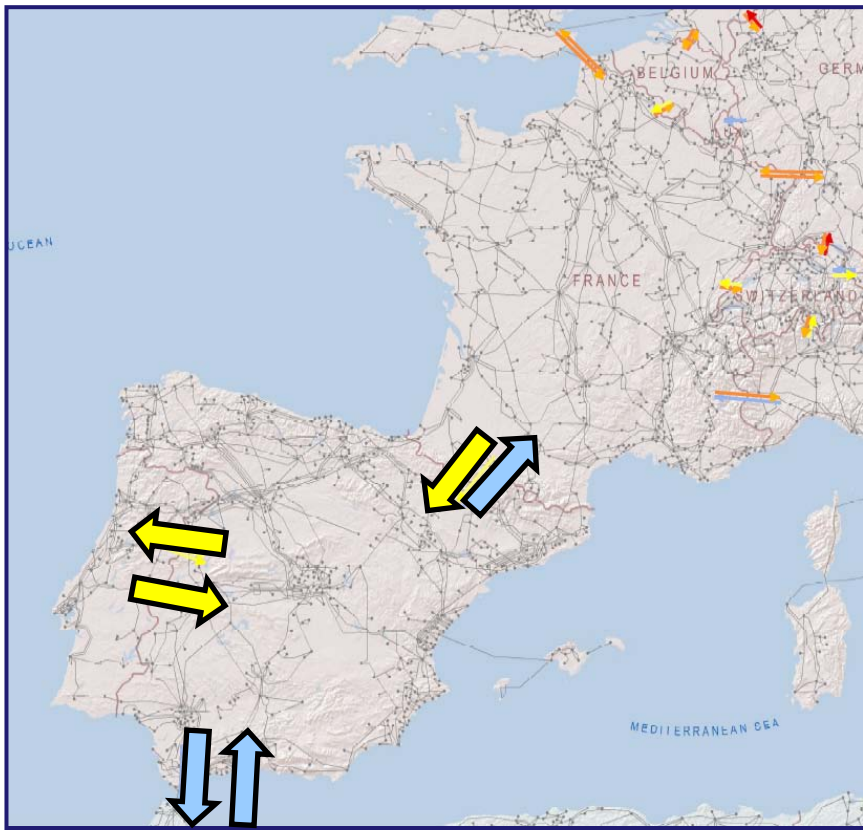
Starting point :Net Transfer Capacity 2011

Situation today

Winter 2011



Summer 2011



Interconnection ratio objective set in EC Council Barcelona 2002 =10%

Portugal	Spain	France
11%	4%	9%

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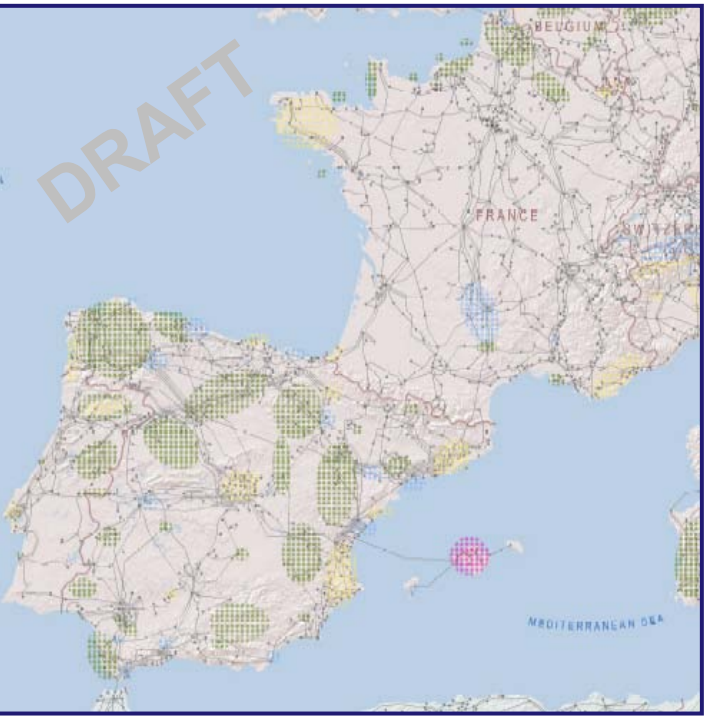
Map of drivers-CSW

Where will problems arise?

Midterm = 2012-2016



Legend

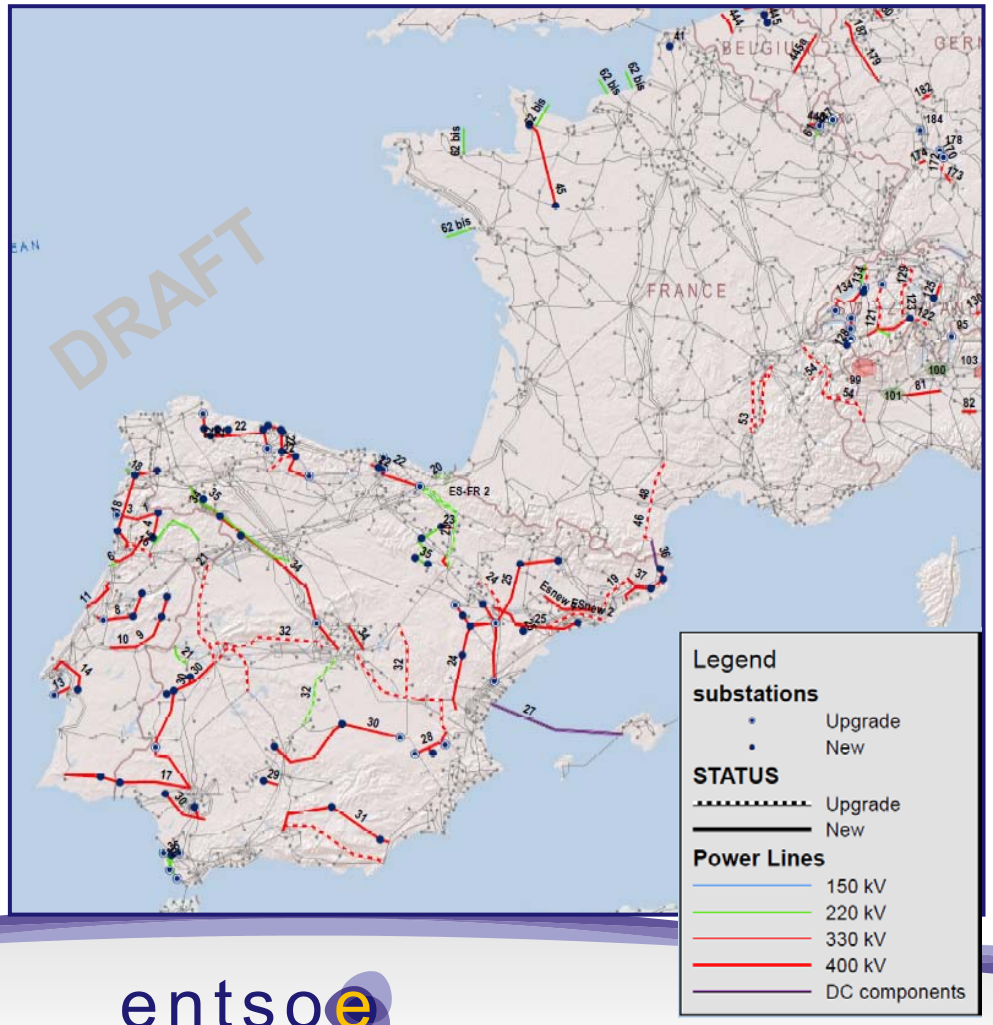
- Existing generation evacuation
- Future generation evacuation
- Reliable grid operations issues
- Aging/obsolescence of network equipement
- Generation decomissioning
- Isolated systems to be connected
- Growth demand

Longterm = 2017-2022

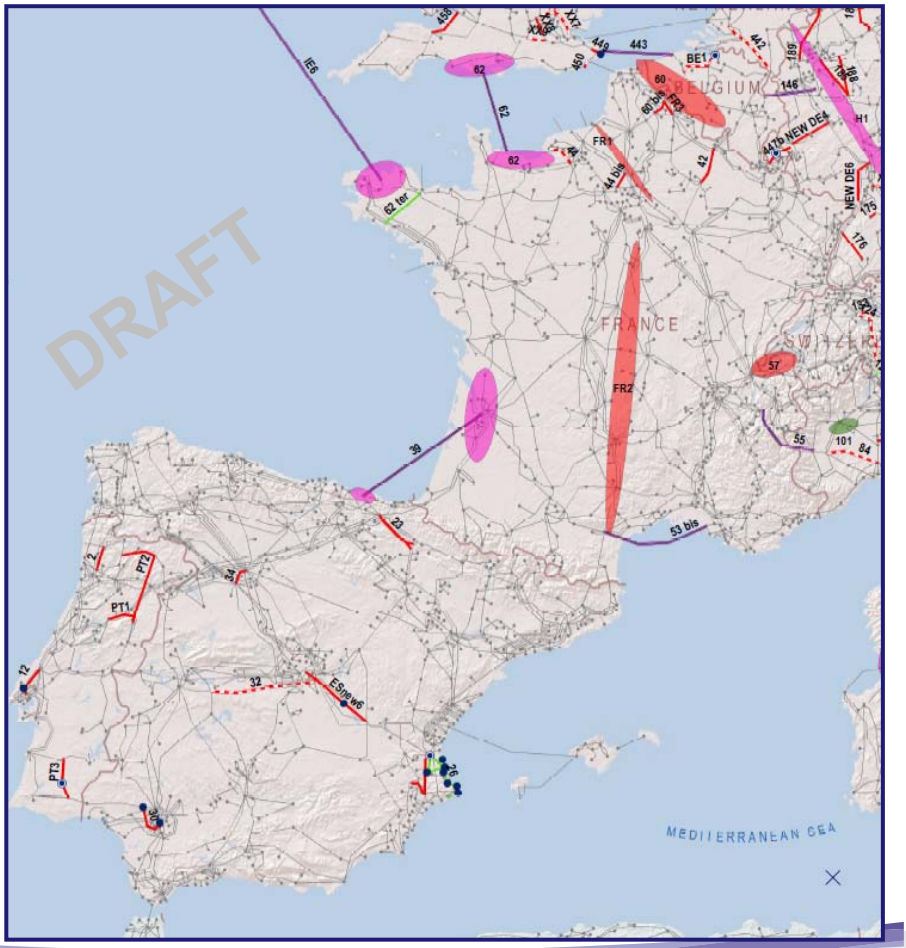
Transmission investments -CSW

Which investments are required?

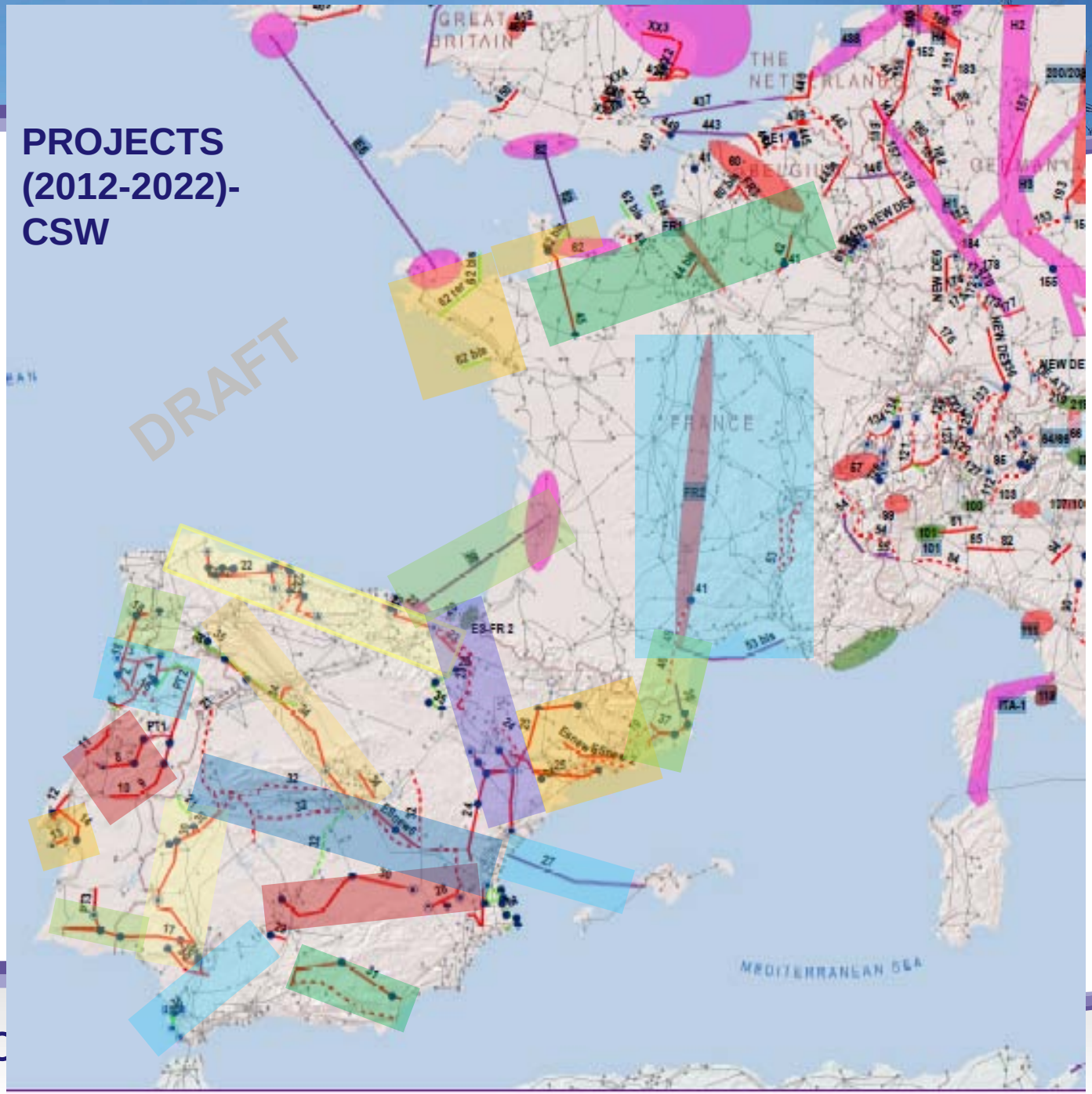
Midterm = 2012-2016



Longterm = 2017-2022



PROJECTS (2012-2022)- CSW



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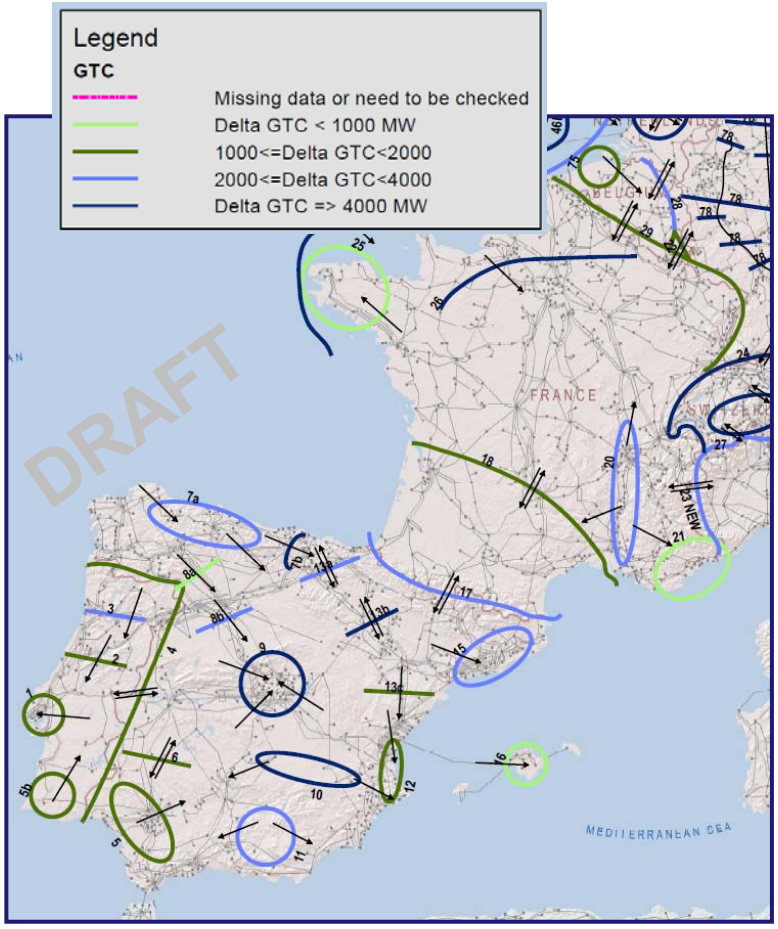
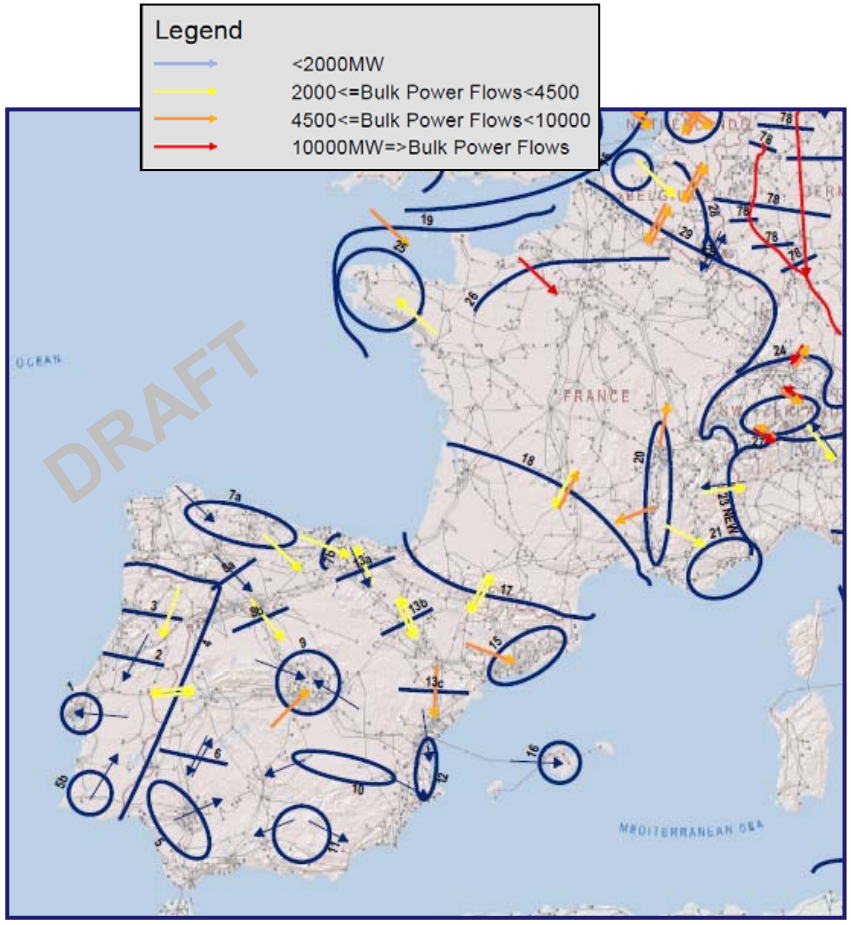
GTC Increase & Bulk Power Flows by 2020 horizon

2020 Situation

GTC increase (MW)



Bulk power flows (MW)



	Portugal	Spain	France
Interconnection ratio	12%	6.5%	12%

Transmission Adequacy Indicator-CSW

In the analyzed scenarios, with all projets in the plan…

GREEN

No further investment will be reported to this boundary in the next 5 years

YELLOW

Problems are solved in most cases but some situation or adverse future can cause some problems

RED

Additional investments will be needed to cope congestion on this boundary

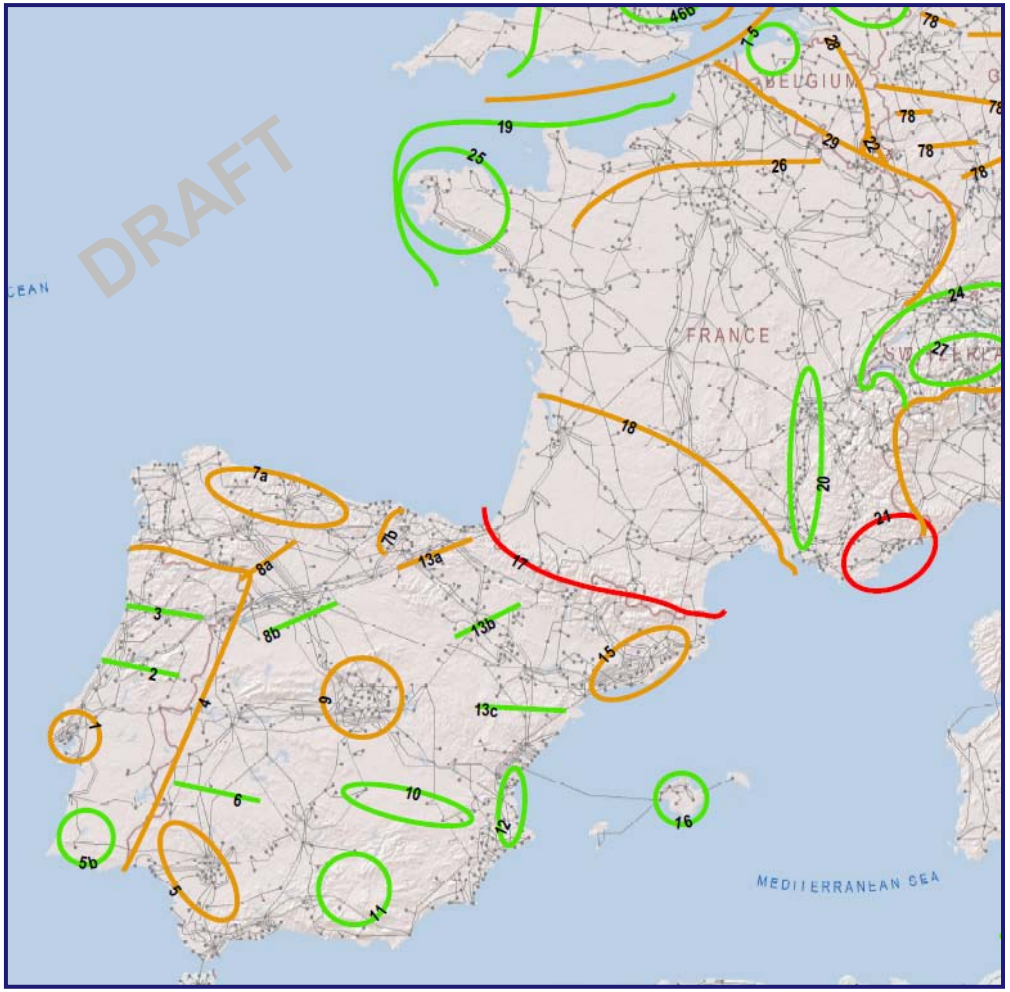
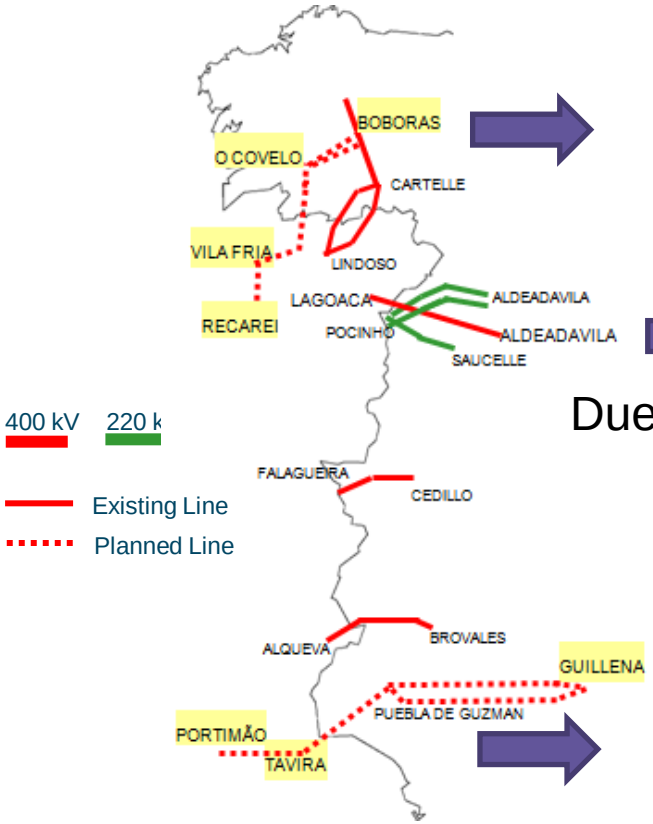


Table of projects of European Significance

Project n°	TYNDP-2010-investmt index	RG	TSO/TSOs in charge	Brief description of the project	Grid Transfer Capability increase MW	SEW	RES indicator	SoS	Losses variation	CO2 indicator	technical resilience	flexibility	Social and environmental indicator	Present status TYNDP 2012	Update 2012 date of comissioning
1					1800										
2					P>E 1700 E>P 1400										
3					Up to 1200										
4					2400										
5					1840										
6					2600										

PT-ES project



New Northern interconnection : 2014

Status: Permitting

Duero interconnection 2010

New Southern interconnection : 2012-2013

Partly in operation

Cross Section Status: Permitting/Under construction

Project Assessment

ΔGTC	SEW	RES	SoS	Lossses variation	CO2	Technic. resilienc	Flexibility
P>E 1700 E>P 1400							

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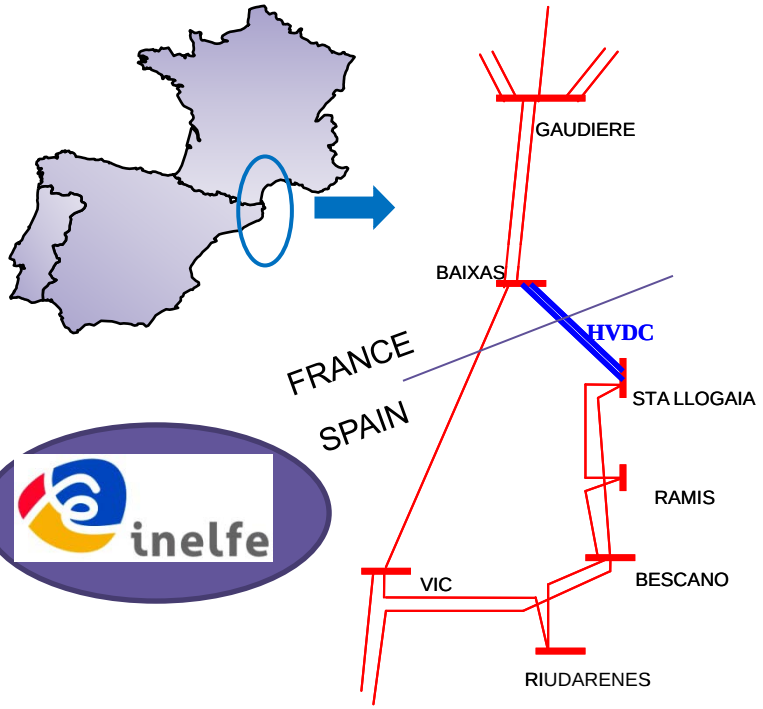
FR-ES projects : Eastern reinforcement (I)

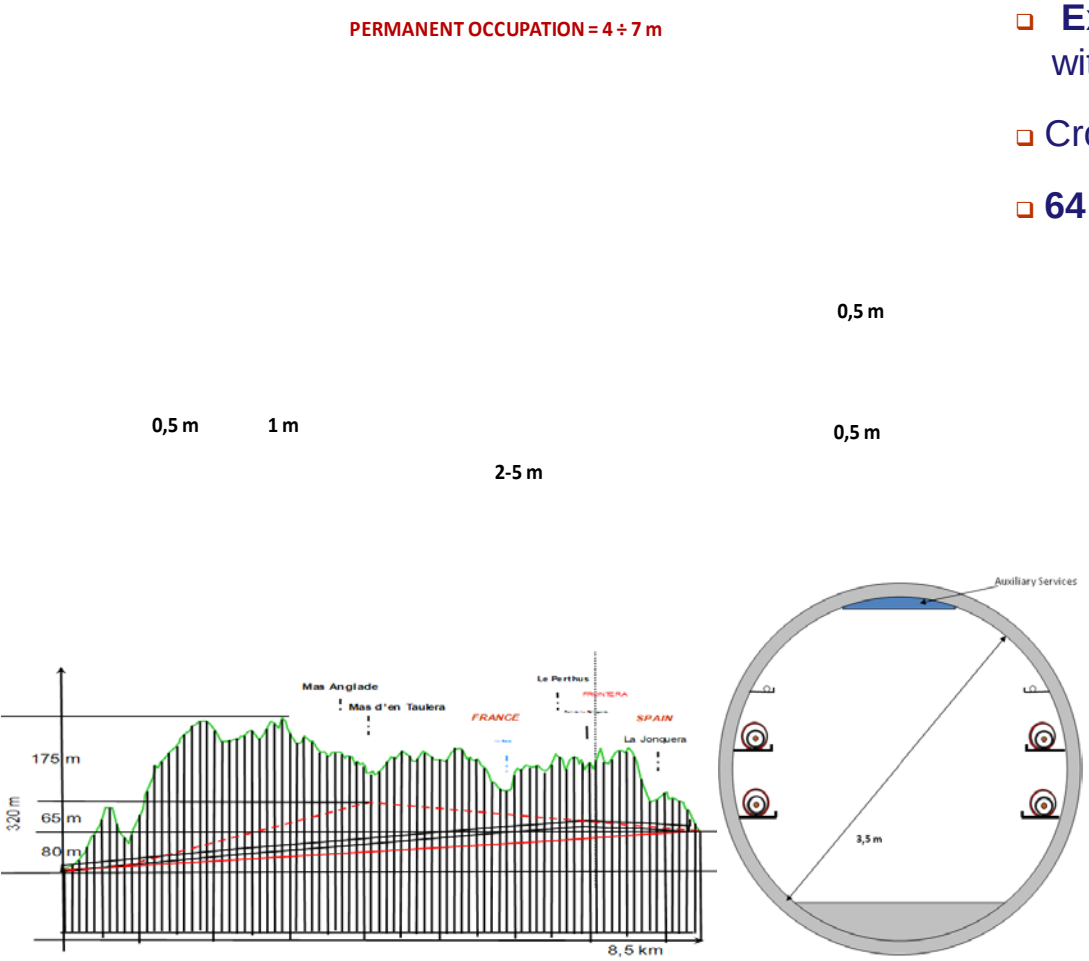


Governmental agreement since 2001: 2.600 MW exchange capacity in the short term and 4.000 MW in the long term

After being blocked during many years, the project was boosted in 2007 with the intervention of the European Coordinator (Prof. Mario Monti) under the TEN-E Guidelines regulation

- **2 HVDC bipoles**
  - 2 x 1000 MW
  - 2 x (± 300 Mvar)
  - 2 independent bipoles ± 320 kVdc
  - Maximum failure: 1000 MW
- **Converter stations (AC/DC)**
  - Baixas 400kV (FR) & Sta.Llogaia 400kV (SP)
  - VSC with MMC (Modular Multilevel Converter) technology

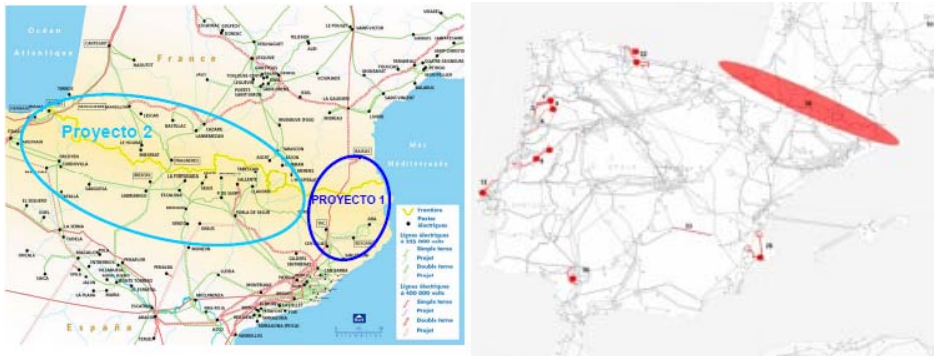
FR-ES projects : Eastern reinforcement (I)



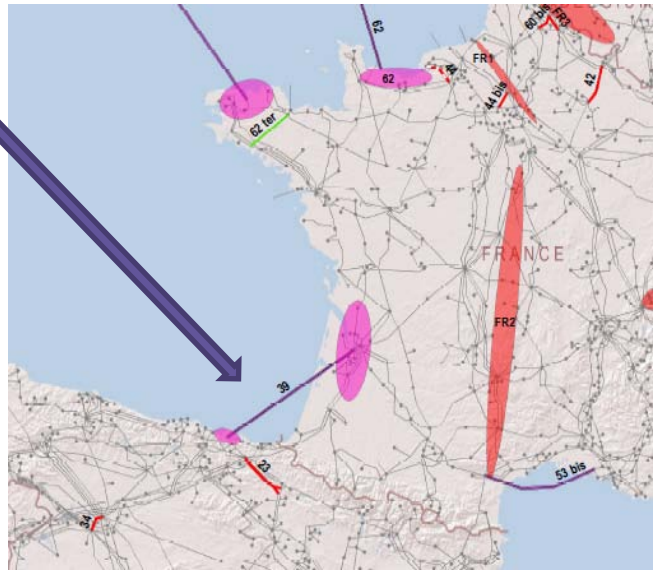
- **Extruded cables.** Dry insulation copper cable with aluminium tube screen.
- Cross section=2500 mm2
- **64 km** length (32 km Spain + 32 km France)
  - **Tunnel:** 8.5 km length, 3.5 m diameter and [80, 300]m depth
  - **Trenches:** 55.5 km length

FR-ES projects

The long term reinforcement for the long term objective exchange capacity is in TYNDP 2012 better defined after joint studies
A Submarine option in Biscay Gulf is being considered



European Coordinator Master Plan 2008 and ENTSOE TYNDP 2010



Long term TYNDP 2012

Project Assessment

	ΔGTC	SEW	RES	SoS	Losses variation	CO2	Technic. resilienc	Flexibility
ES-FR Eastern	1200-1400							
ES-FR Western	FR>ES 1200 ES>FR 2000							

DRAFT

The support to EU202020 policy: 202020 objectives

Renewable Energy Sources:

- More than 70% of the projects contribute to integrate RES
- Projects of EU significance integrate **~30.000 MW of new RES** in the region

  Not all the National Master Plans are included in RegIP,

  Not all RESNational plans are attached to projects of EU significance.

Security of Supply: SoS is enhanced with projects of EU significance.

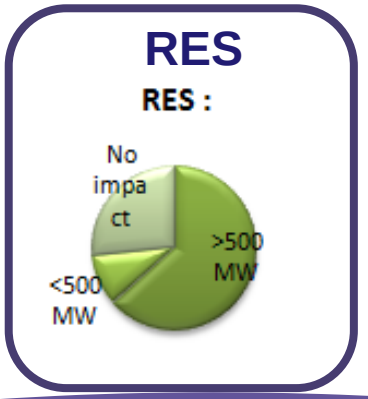
However in general, local investment of national relevance are required

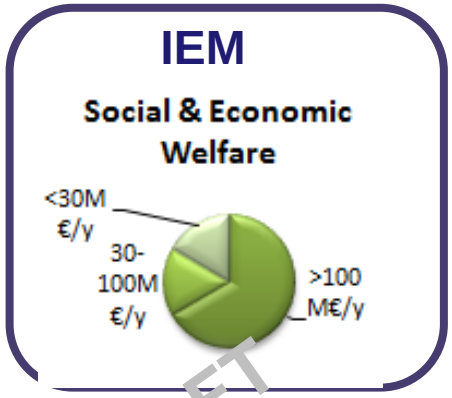
Contribution to Internal Electricity Market

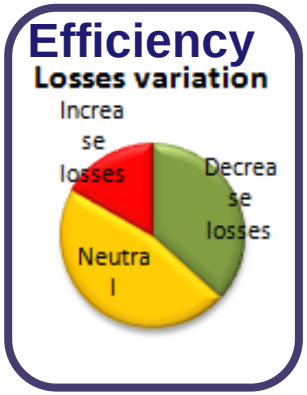
- More than 60% of the projects have important effect in variable generation savings

Losses variation: Effect in losses is not allways positive:

Long distances between RES location and load centers





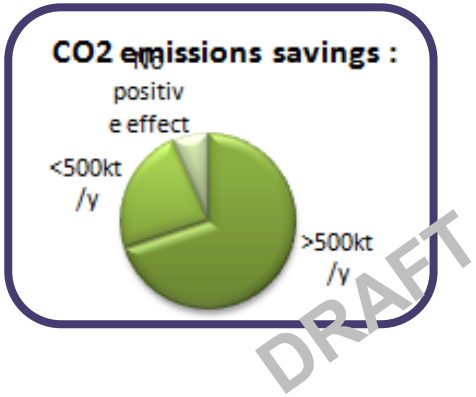


The support to EU202020 policy: Environment affection

CO2 emissions savings : 35 MtonCO2/y =annual emissions of 15 millions cars (85% of cars in Spain)

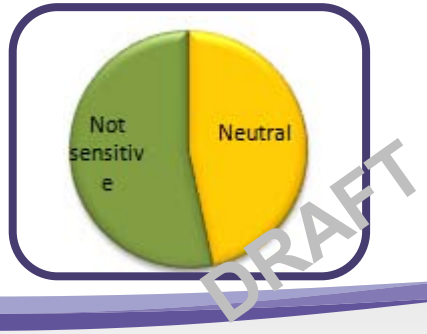
Right Of Way :

- 13700 km of projects.
- uprates and new : **34% are uprates** and 66% new routes
- AC projects: **89%**
- Midterm projects : 55%



Social & Environmental indicator

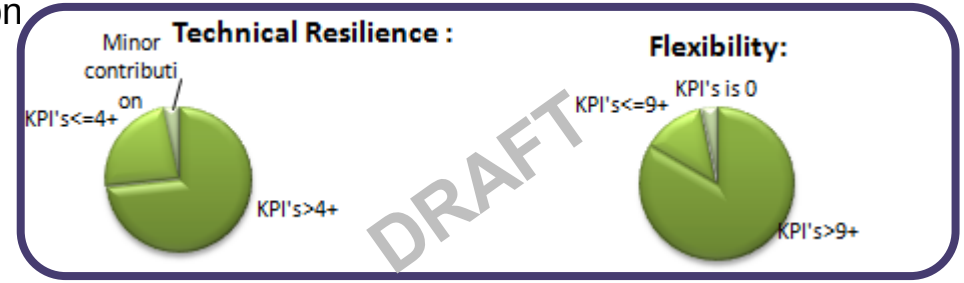
- 55% project has high probability of being commissioned at planned date, 45% are realistic but have some uncertainty
- There is no project considered that affects heavily to the environment
- Projects pass a prefeasibility study and national SEA in the NDP framework..



Assessment of Resilience

Technical Resilience and Flexibility indicator:

Proposed projects fulfill highly the network codes and are able to be adapted to different future situation



- **Economic performance justified by market & network studies**
- **Security of Operation and Supply guaranteed**
  - According to grid studies all the operational requirements are fulfilled in normal operation and under contingencies
  - TSO use special security criteria where necessary
- **Big effort to make the best of existing assets in order to minimize grid extension**
  - High enhancement of existing infrastructures (uprating, upgrading, HTC) 34% of projects
  - FACTS: CRSS and SSSC in Spain
  - Phase Shifters: 1 in Spain, 1 in FR-ES
- **New/efficient technologies applied**
  - HVDC projects (connection to Balearic islands, projects FR-ES, internal project in FR)
- **Compatibility with longer run challenges**
  - Although new investments will be required

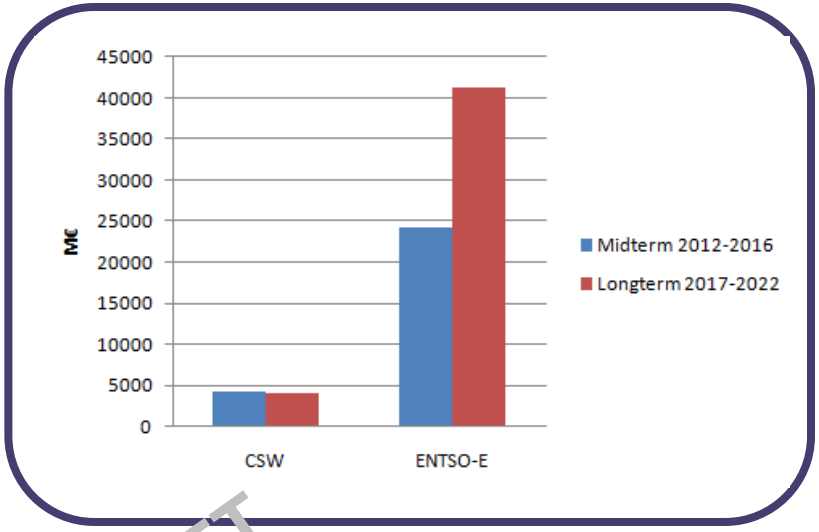
Costs and monitoring

COSTS

~8400 M€ investment in CSWRG

~25% just for interconnections

National Development plans include much more infrastructure and have higher costs

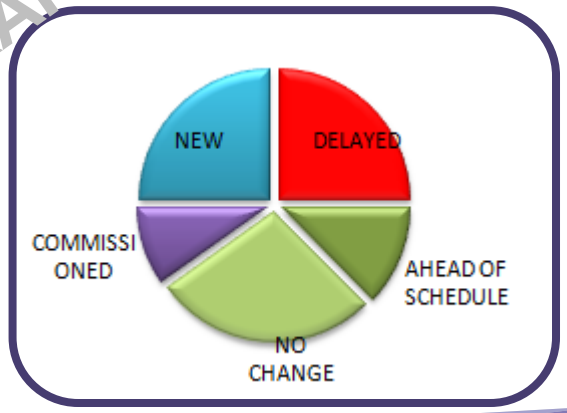


MONITORING: status in 2012 compared to planned 2010

1400 km **commissioned**

27% of projects in TYNDP 2010 have been delayed

27% of projects are new



Key Drivers and Challenges

Massive renewable integration

- Onshore wind and solar in the Iberian Peninsula → investments in Midterm
- New hydro generation including pumping storage (north of Portugal, and different areas in Spain)
- CertainOffshore mainly in France → investments in Longterm

- More flexible conventional generation is needed

Security of Supply

- Reinforcements will be needed and could become an issue for some cities or areas in the region

- Increasing of cross-border capacity enhances national security of supply while it increases mutual support possibilities

Market Integration

- Increasing of cross border capacity to accomodate predominant power flows: 3 projects within CSW RG, 5 projects with other RG
- Integration of MIBEL with continental Europe is one of the main keys for the region

- Internal projects that allow a lower total variable generation cost

Key Drivers and Challenges

Increasing complexity of Grid Operation

- Large number of decentralised RES requires monitoring and control requirements (CECRE)
- New equipments of active control of power flows (HVDC, FACTS, PSTs…)
- More complex studies
- More coordination at every level

Permitting Procedures and social acceptance

- Required grid may not be in time if there are delays in permitting procedures and RES targets are met as scheduled

→ EIP proposals are welcome (onestop shop, deadline of 3 years for authorization…)

Uncertainties

- Uncertainties regarding decommissioning, and materialization of agents portfoleo (volume, type and location) is a challenge for grid development

→ Bidirectional information and more consultations with stakeholders

Conclusions

- High development of RES (mainly onshore in Iberia) is the main driver of 400kV reinforcements
- Similar Scen B and Scen 2020 regarding RES in Iberian Peninsula, as RES plans have started to be set several years ago
- Iberian Peninsula has more investments in MT than in LT and that a big % has been already commissioned since last TYNDP2010
- Proposed investments fulfill requirements of both Scen B and Scen 202020, including also SoS
- Interconnections mainly but also internal projects enhances Market Integration, and have a big social welfare as allows the production with more sustainable and cheaper power plants
- Priority in the region is the reinforcement of FR-ES border, which is the main bottleneck in any scenario
- Proposed projects will be an input for PCIs in the North-South West Iniciative (EIP)

Thank you for your attention

Towards Ten year Network Development Plan 2014

and further

David Alvira
Convener RG CSW

RG CSW Workshop

Madrid, 29 November 2011

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Reliable Sustainable Connected

TYNDP and the 3rd Energy package

TYNDP must deliver:

- Generation adequacy outlook 5 yr up to 15yr (→ 2025!)
- Modelling integrated networks
- Scenario development
- Assessment of resilience
- Based on reasonable needs of system users
- Identify investments gaps
- Review barriers to increase cross border capacities arising from approval procedures

TYNDP 2012 a big step further

TYNDP 2012 improvements compared to pilot TYNDP 2010:

- Explicit definition of projects of pan-European significance
- Public procedure to identify the 3rd party projects
- More scenarios : top down + bottom up scenarios + Nuclear phase-out sensitivity analysis
- Regional market & network studies – based on the common set of data
- Project assessment based on a set of clear indicators
- More compact reports easy to understand

Energy Infrastructure Package and TYNDP

EIP mandates ENTSO-E to:

- Develop the TYNDP list of projects that are to be the base for the PCI list. The first list of PCI is expected July 2013.
- Assess the projects based on the appropriate indicators.
- Elaborate a EU wide cost and benefit analysis – methodology expected 1 month after entry into force of the legislation
- Create the common market and network data at European level.

TYNDP 2014 and further – continuously increasing quality

1. Developing visions that have a larger spam than 10 years (e.g. vision 2030)

2. Creating the methodology for the European CBA

3. Updating and improving the network model for the pan- Europe and regional network studies

4. Updating and improving the existing pan-European market data base (PEMD) – base for the Regional market studies

5. Looking for continuous coherency with longer term plans – 2050 E-HIGHWAYS, North-Sea grid, Mediterranean ring, System Extension Project (Ukraine/Moldavia, ..)

Thank your or your attention.

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