Regional Market Studies for TYNDP and RgIP North Sea

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Member Regional Group North Sea

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Regional Group North Sea
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Reliable Sustainable Connected

RGNS Market Studies

1. **Overall process**
2. Market model setup
3. Main Assumptions
4. Results of reference cases
5. Project Assessment

Overall process (1)

Scenario building & PEMMDB

- process lead by WG SA&MM
- four Visions provided (2 bottom-up, 2 top-down)
- already discussed in public consultation

Regional Framework

Fine Tuning of the Model

- improvement of the model including Regional specificities
- modification of the perimeter of the study

Preliminary Market Study

- to provide the snapshots for the NS
- to check consistency between MS and main scenario hypothesis/assumptions.

Network Study

- to verify the transmission capacity between Market areas

Project Assessment by Market Study

- TOOT approach
- to provide Market indicators (Gen.cost saving,CO2 emission, Dumped energy, …..)

Overall process (2)
Main difference between PEMS and RGMS

Pan European Market Study

- ✓ Main goals:
  - ✓ To check the consistency of data provided by TSOs
  - ✓ To build top-down scenarios
  - ✓ To define the exchanges between countries (for RGMS)
- ✓ Model:
  - ✓ All ENTSO-E perimeter
  - ✓ Based only on PEMMDB
- ✓ Tools & resource:
  - ✓ Using existing TSO tools
  - ✓ Market study experts from TSOs for the expert team
- ✓ Coordination
  - ✓ By WG SAMM

Regional Group Market Study

- ✓ Main goals:
  - ✓ To provide input for Network Study
  - ✓ To provide project assessment
- ✓ Model:
  - ✓ Possibility to restrict the perimeter
  - ✓ Border flows from PE MS
  - ✓ Based on regional database
- ✓ Tools & resource:
  - ✓ Using existing TSO tools
  - ✓ Existing Regional market model groups
- ✓ Coordination:
  - ✓ Directly by RG

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Market model setup (1)
Inputs and Outputs

Inputs

- Multiple scenarios with hypotheses regarding
  - Demand profile
  - Generator characteristics
  - Other generation profile
  - Wind and Solar Profiles
  - Transfer Capacities
  - Reserve
  - Exchanges to Rest of World profile
  - Fuel and CO_2 prices

Modelling

- Chronological Unit Commitment Economic Dispatch model
- Hourly model
- Each country is a single market node
- Minimise the system cost (fuel bill/operating costs) subject to constraints such as must-run, reserve, generator capabilities.

Outputs

- National Balances
- Market Node Marginal costs
- Hourly generation pattern for each generator (UC/ED)
- System/Fuel cost
- Fuel consumption by fuel type
- CO_2 emissions
- Curtailments
- ENS
- LOLE

Market model setup (2)
Inputs and Outputs

Data for each Market node

- **Demand and Demand-Side Management Data Set (year around hour-by-hour time series)**
- **Supply data**
  - Thermal Despatchable Generation Data Set
  - Hydro Generation Data Set
  - Wind Generation Data Set
  - Solar generation
  - Other Renewables Generation Data Set
  - Other Non-Renewables Generation Data Set
- **Other System data**
  - Operational reserves Data Set
  - Exchange capacities between market nodes
  - Power Exchange Data with non ENTSO-E countries

Market model setup (3)
Key input: Climate Data

PAN European climate database: wind, solar, temperature

Renewable intermittent resources are main drivers for the necessary grid investments: reliable and correlated generation profiles are needed!

Purchase of 2 datasets from independent suppliers for correlated hourly wind , solar and temperature data by ENTSO-E

« Reference provider » + « Quality check provider »

Main input data for provider

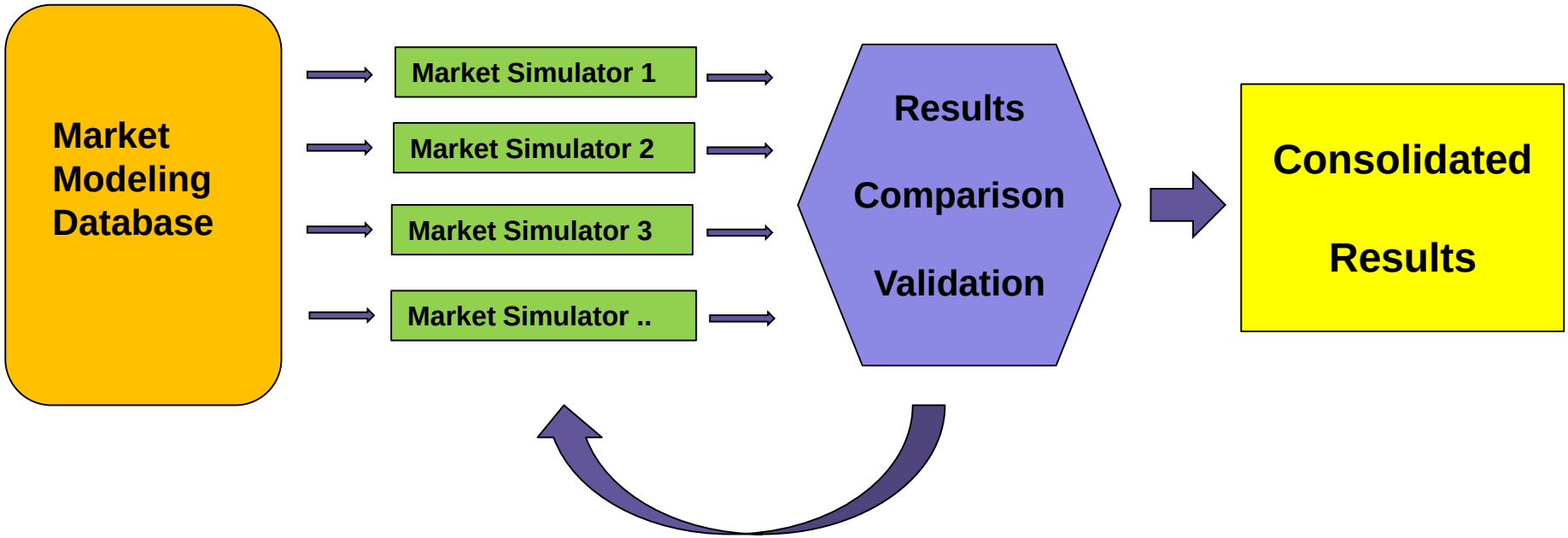
- 12 year historical weather data (wind speed and direction, radiance, temperature)
- Assumptions concerning the location of wind and solar farms in 2030
- Assumptions concerning the technology of wind and solar farms in 2030

Consistency of climate database available to TSOs

- 12 historical hourly time-series of load-factors (2000-2011), correlated between market nodes:
  - onshore wind
  - offshore wind (if relevant)
  - solar

  (applicable to a wide range of installed capacity)
- Hourly time-series of temperature also available (allow to analyze load sensitivity to temperatures for regional purposes)

Market model setup (4)
Organization



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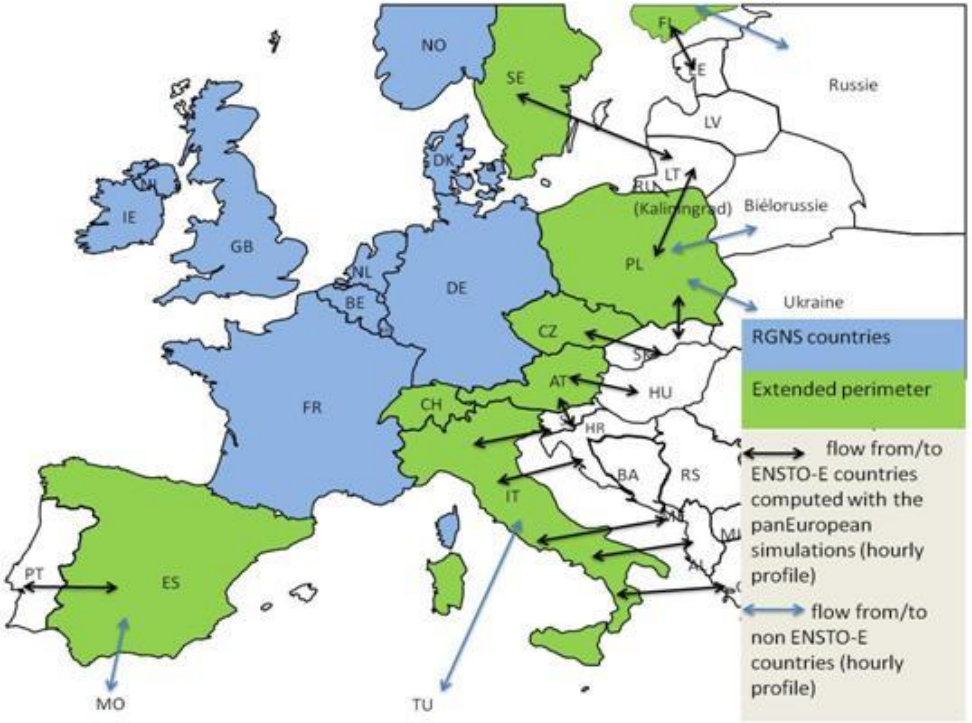
Main Assumptions (1)
Perimeter

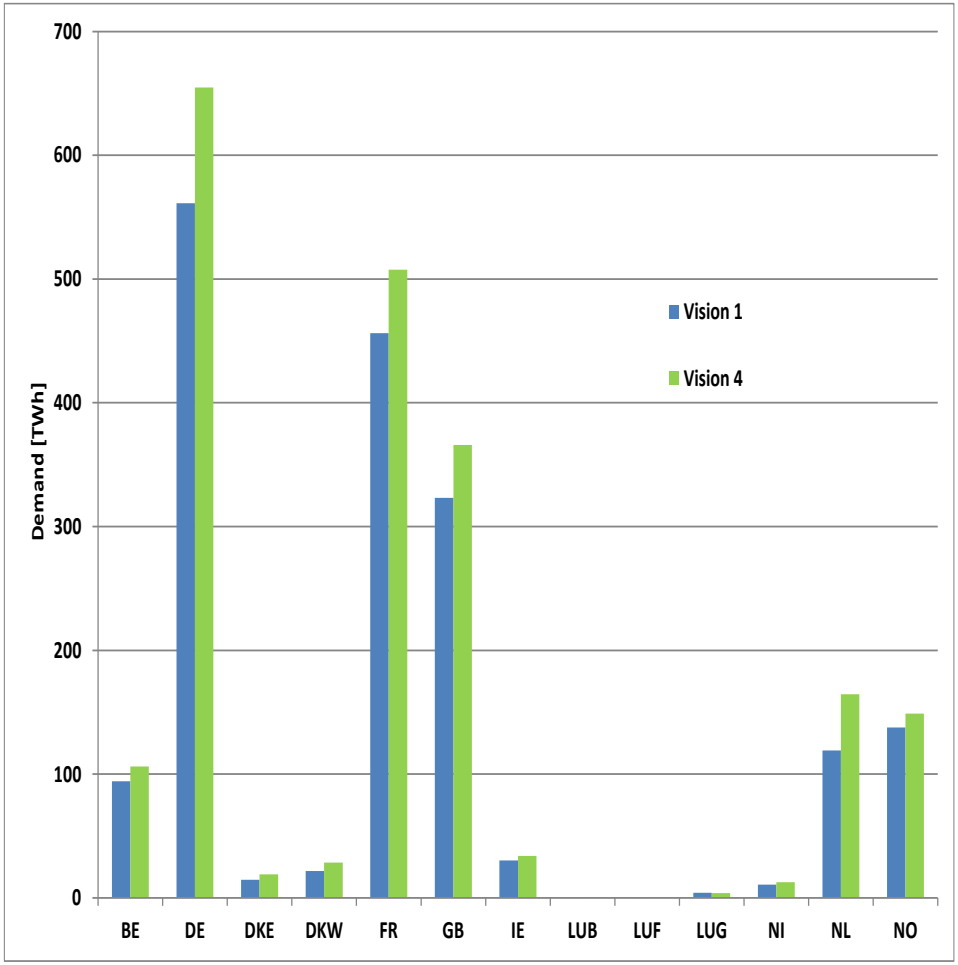


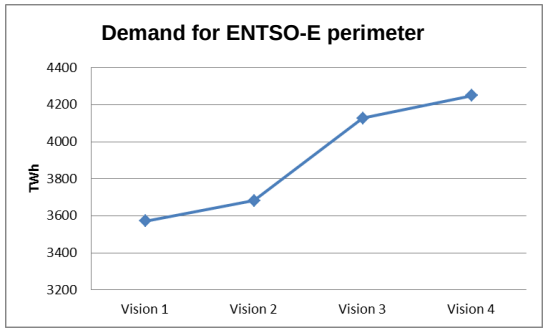
- Market model based on RGNS countries, Sweden plus first neighbours and fixed flows.
- First neighbours are modelled with PEMMDB data.
- Fixed flows are taken from Pan EU MS Visions
- RGNS countries and Sweden are modelled with enhanced PEMMDB data.

Main Assumptions (2)
Improvements of the RGNS model

- Norway and Sweden are more accurately modeled with many sub areas, compatible with the RGBS market model
- Usage of the Pan European Climate Database, to better model the temperature sensitivity of the load
- Replacement of flat heat rates of the thermal units by heat rate curves with lower part load efficiencies

Main Assumptions (3)
Demand in Visions 1 and 4





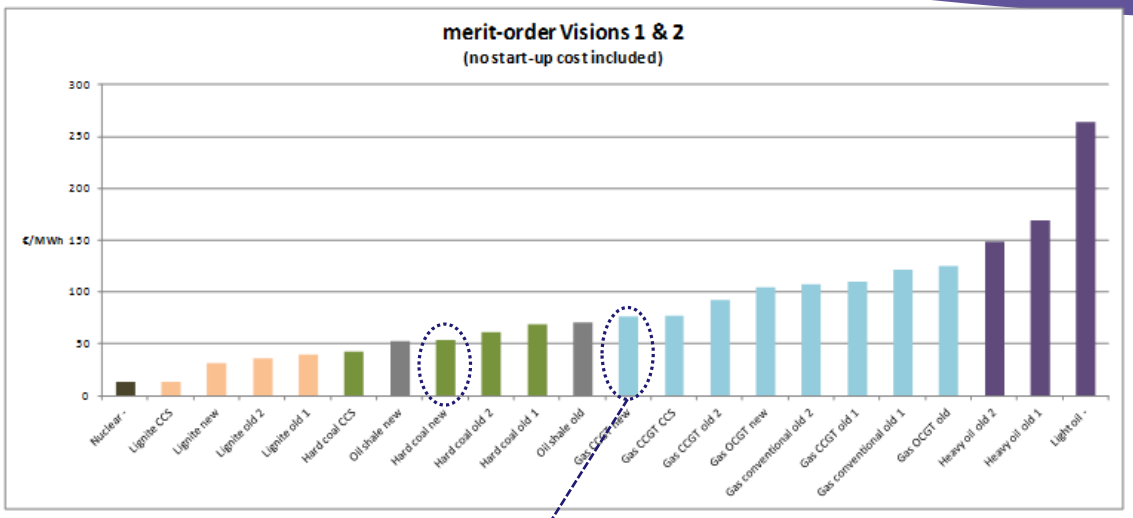
Demand increase in Vision 4 caused by

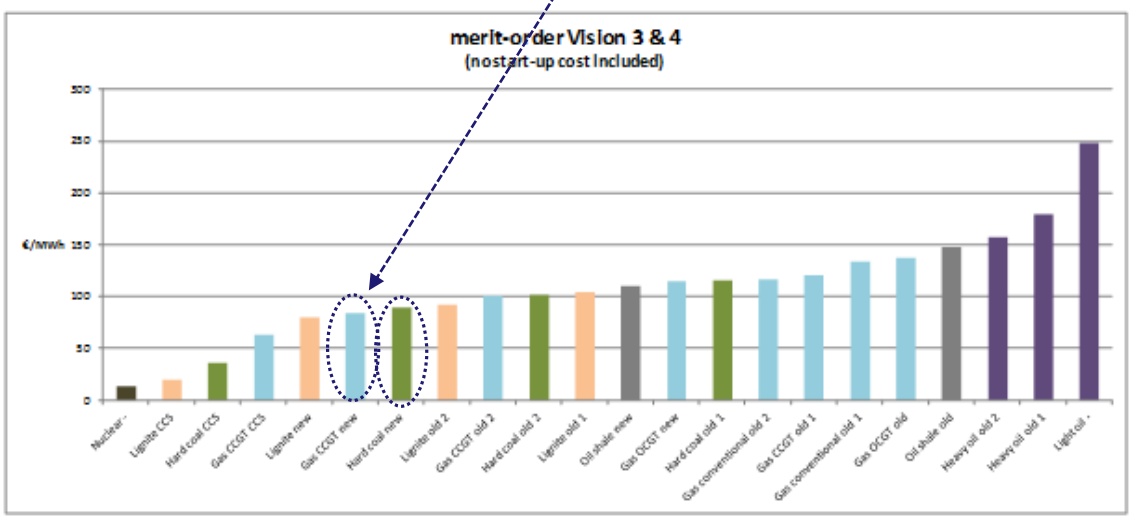
- *Electric vehicles*
- *Heat pumps*

Change in demand pattern in Vision 4 caused by

- *Demand response*

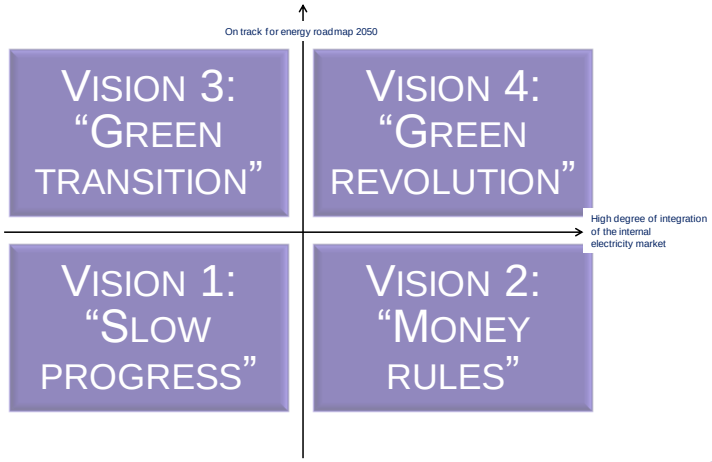
Main Assumptions (4)
Generation merit order





Variable Generation cost

- *Fuel cost*
- *CO2 cost*
- *Efficiency rate*
- *O&M costs*



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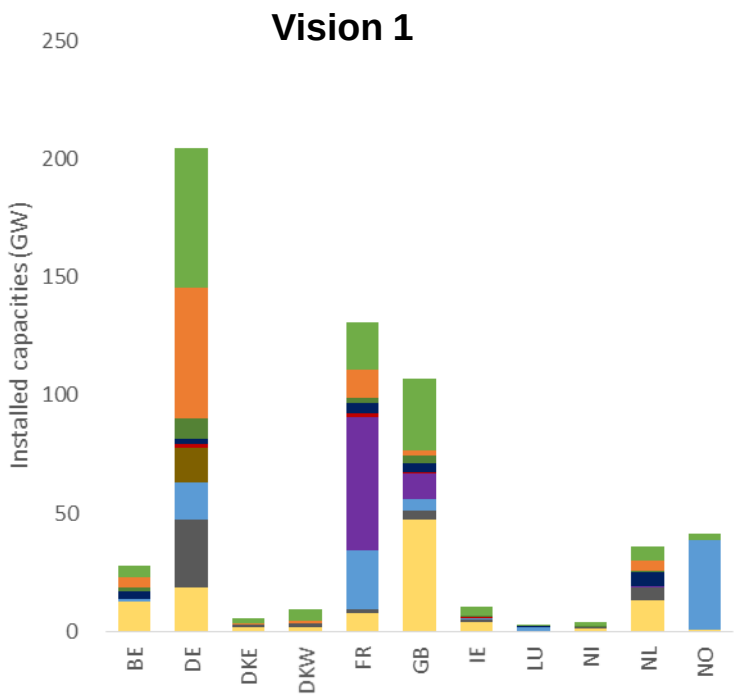
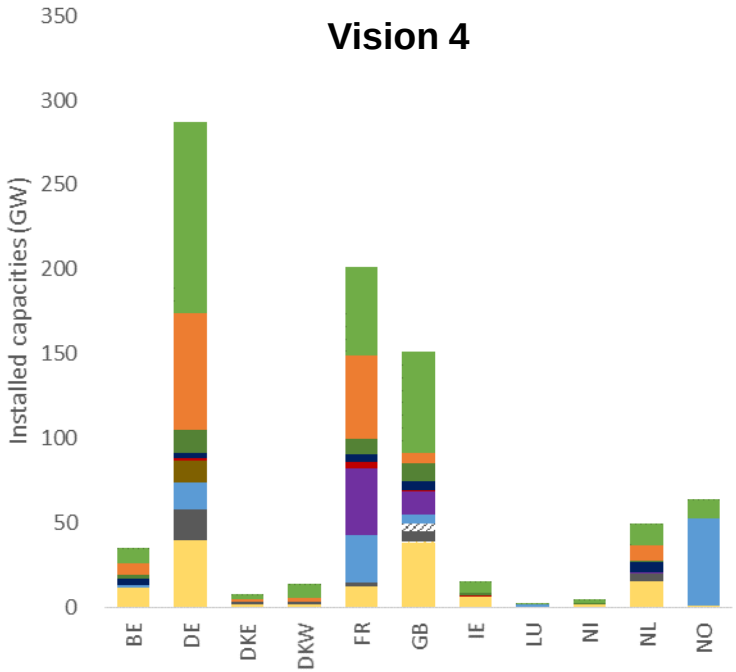
Main Assumptions (5)- Installed capacities in Visions 1 and 4 for the RGNS countries





Major increase of renewable capacities in Vision 4 relative to Vision 1

- **Wind**
  Germany, France, Great Britain
  Norway, Netherlands, Ireland, Belgium

- **PV: France and Germany**

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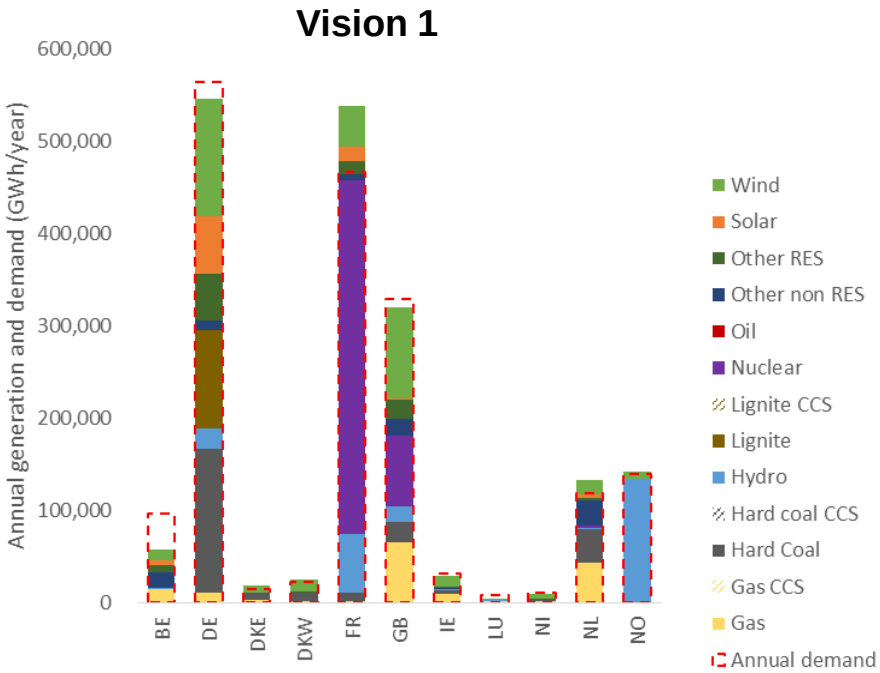
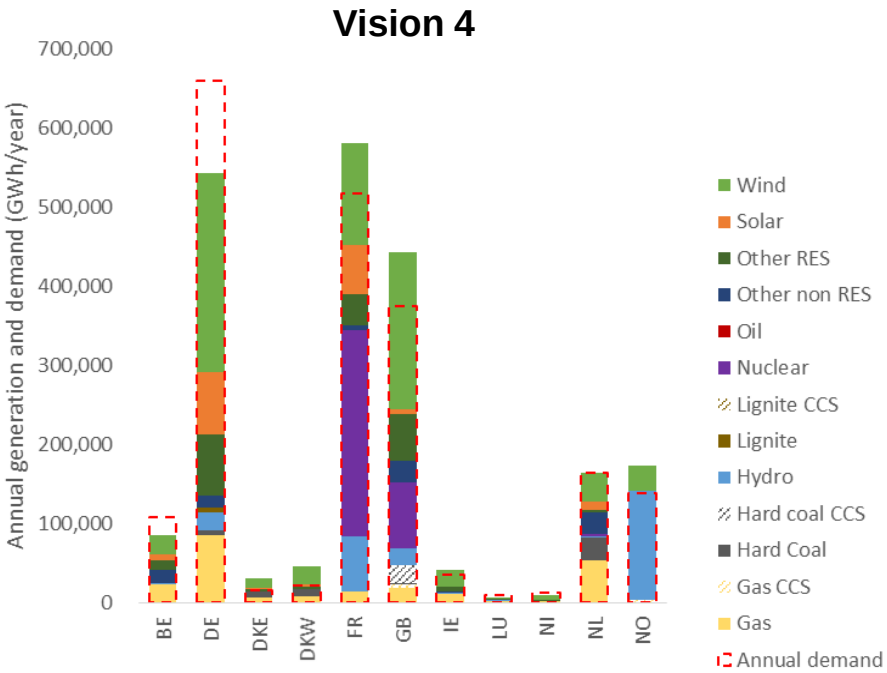
Market simulation results reference cases
Fuel Mix in Vision 1 and 4

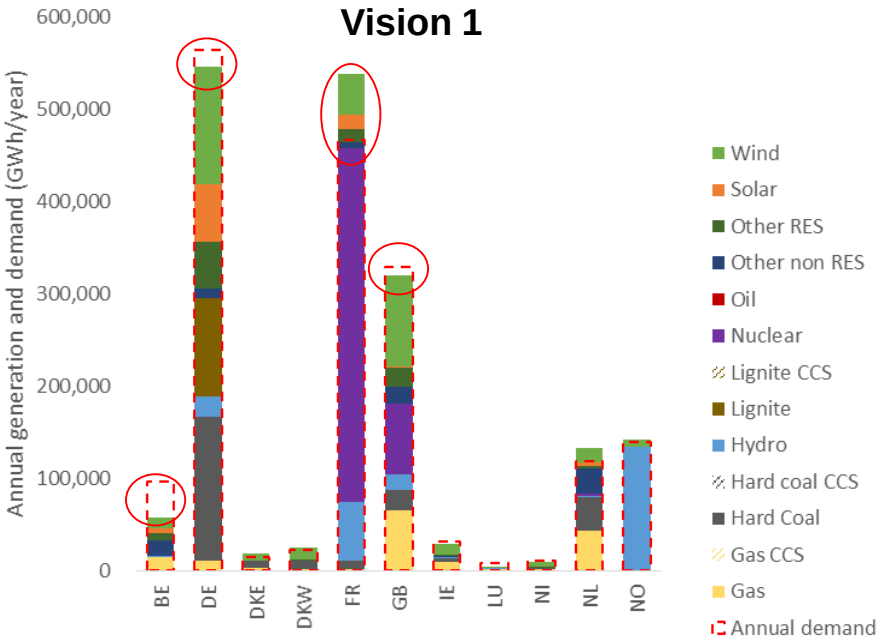


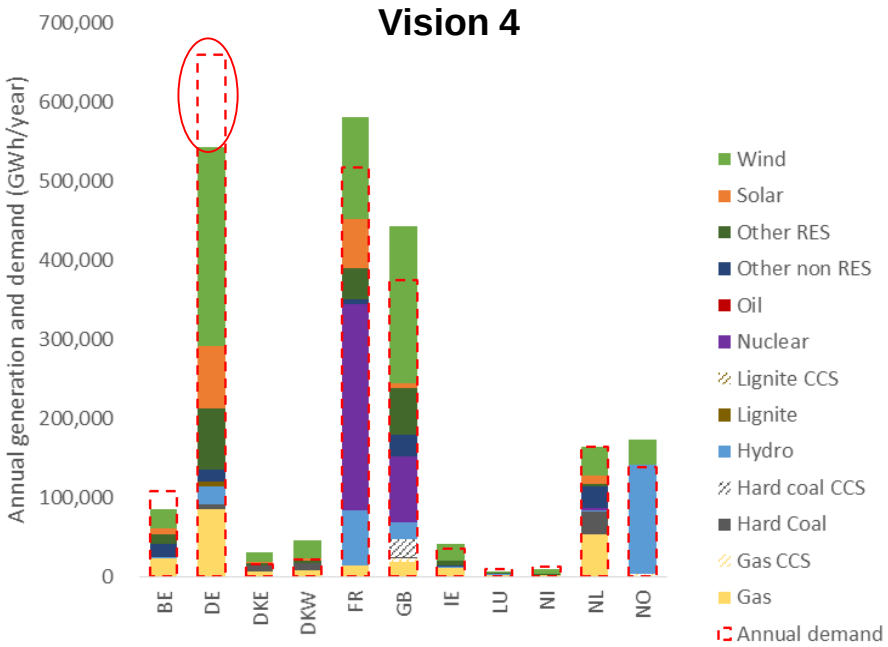


- Production from wind and solar covers 24% of the demand in the Region in Vision 1. This coverage increases to 43% in Vision 4
- Demand coverage by RES production (including production from hydro) increases from 43% in Vision 1 to 65% in Vision 4
- Swaps (caused by merit order shift) occur between coal and gas fired generation in Vision 4 relative to Vision 1

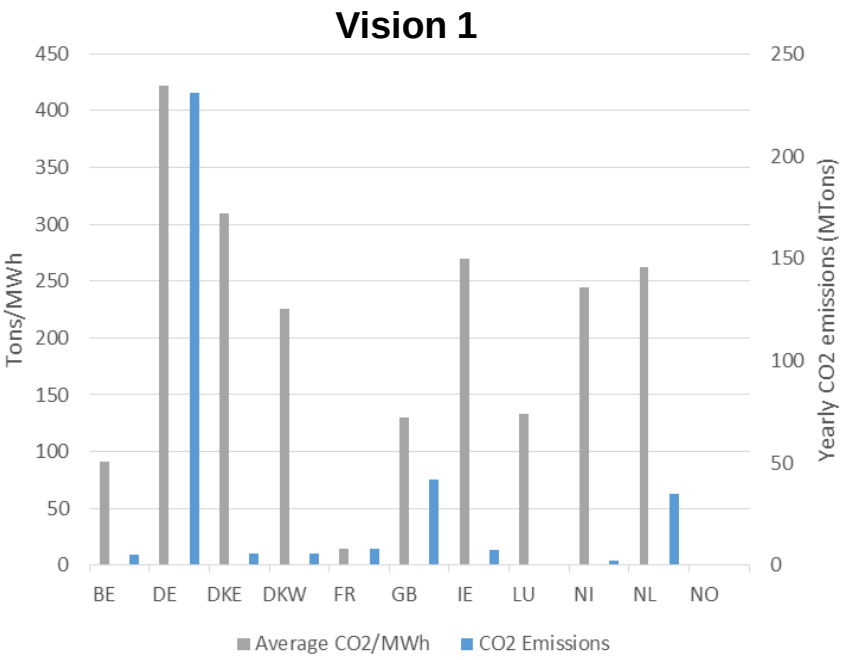
Market simulation results reference cases (3) Balances in Vision 1 and 4

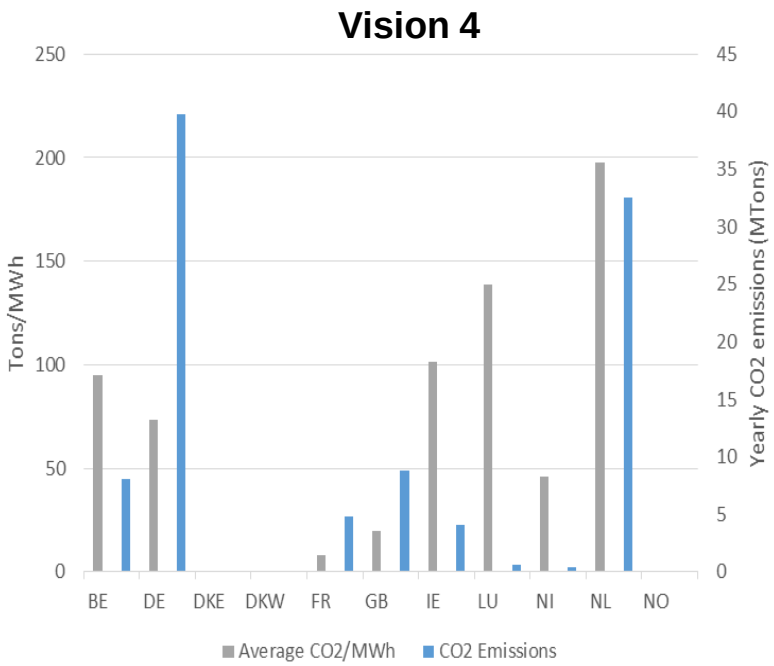
- In Vision 1 Belgium, Germany and Great Britain are large net importers. France is the major provider of this energy.
- The large increase of wind capacity in Great Britain in Vision 4, combined with the merit order shift between gas and coal fired generation, have the effect of Great Britain becoming a large net exporter together with France
- Despite of the large increase of renewables in Vision 4, Germany becomes largest imported in the Region. This is caused by the merit order shift between gas and coal fired generation





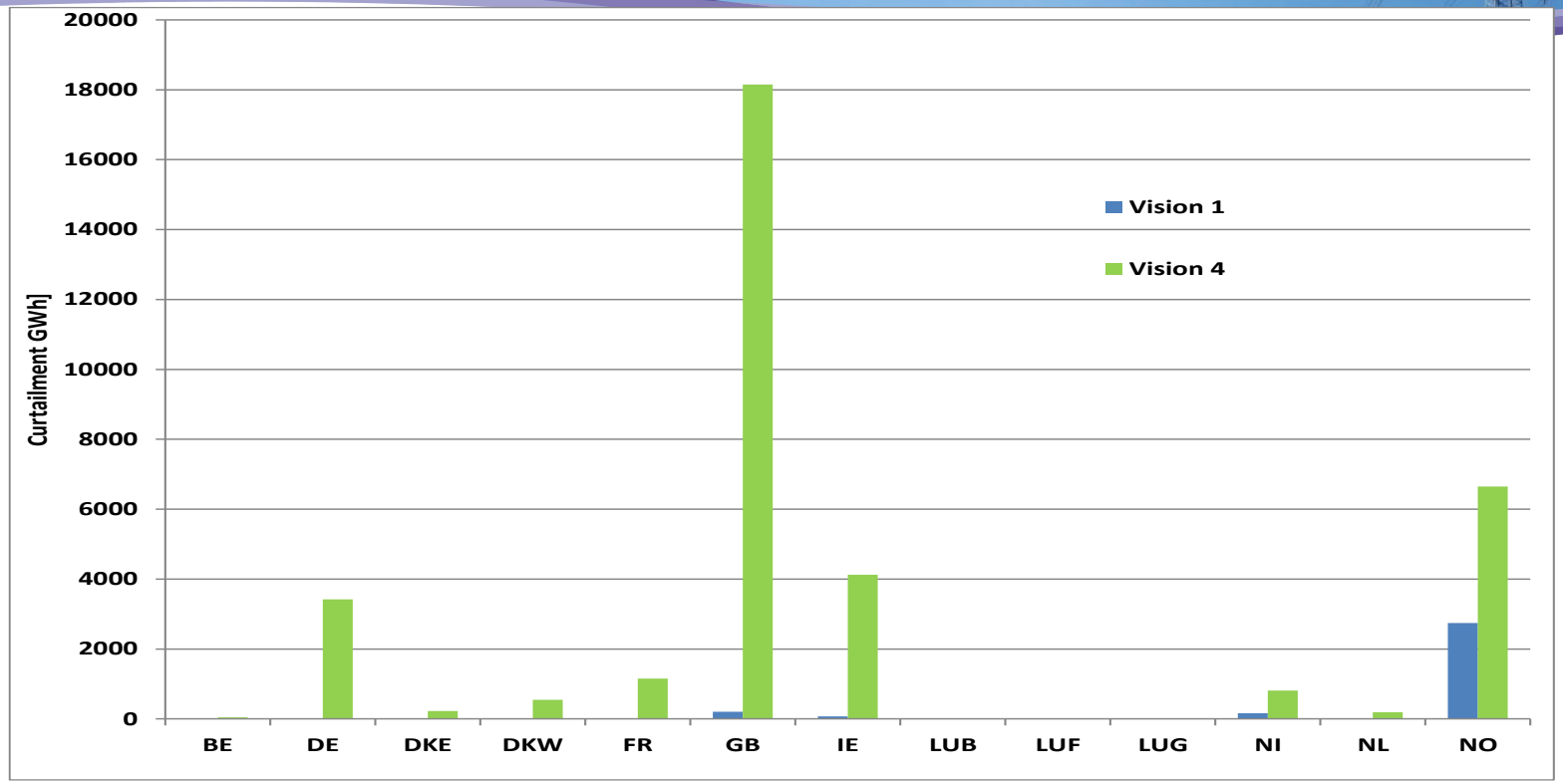
Market simulation results reference cases (4)
CO2 emission in Vision 1 and 4





- Decreased of generation from coal and lignite resources causes a large drop of CO2 emissions in the Region by 60%

Market simulation results reference cases (5)
Curtailment in Vision 1 and 4



Large increase of curtailment in Vision 4

- All Visions are studied with one grid, taking into account the current project table used in the TYNDP
- Extra investments in grid will reduce curtailments
- Main drivers for these investments:
  - Large wind capacities in GB, IE, DE and NO
  - Solar PV capacities in DE and FR

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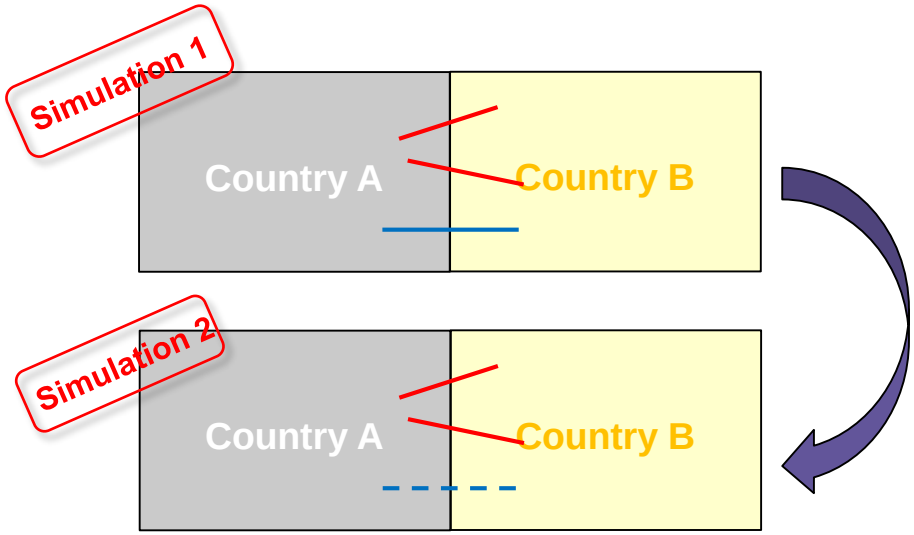
Project assessment
TooT approach

TooT* = *Take out one at Time

- ✓ By comparing the results between the two simulations is possible to evaluate the effect of the project under consideration



Assessed market indicators

- ✓ **Generation costs saving**
- ✓ **CO2 emission variation**
- ✓ **Dumped energy variation**
- ✓ **Security of supply**