Offshore and Interconnector Techno-economic Studies

EirGrid Offshore Workshop

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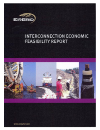
Context

- Previous presentation examined technical options for connecting offshore wind.

- This presentation analyses offshore grids from an techno-economic viewpoint.
  - Interconnection between Ireland and its neighbours;
  - Interaction between offshore wind and interconnection.

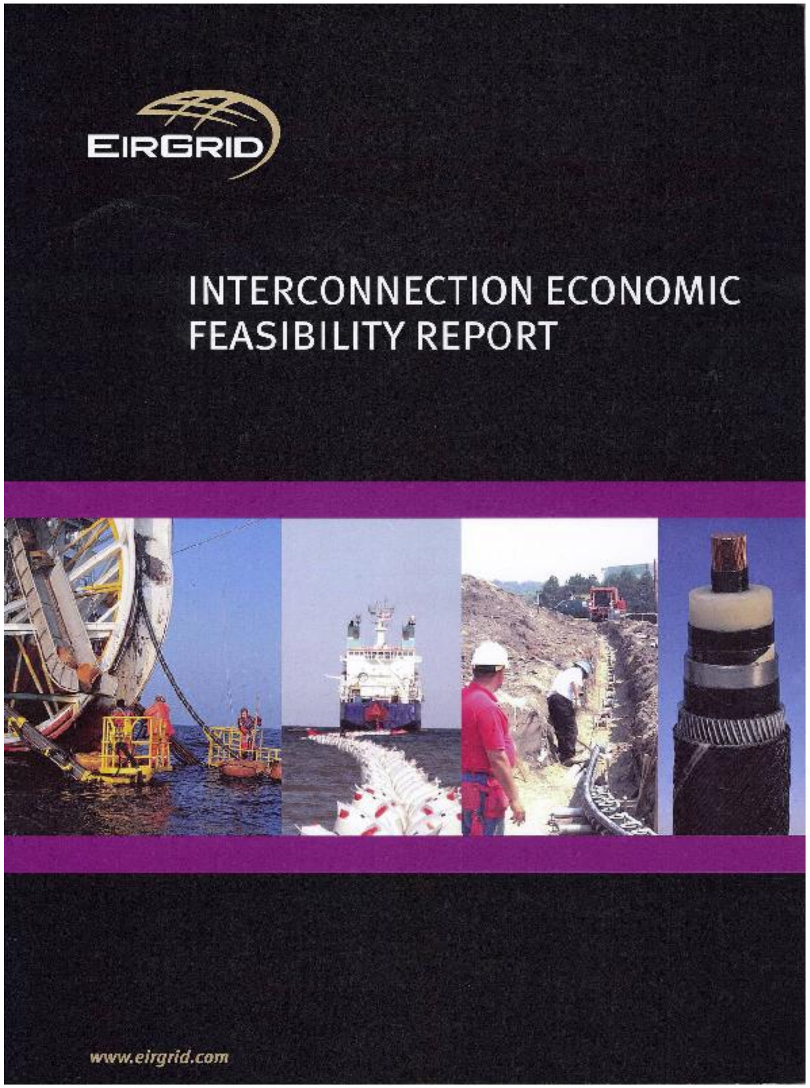
- Contents of this presentation are as follows:
  - a quick review of the 2009 Interconnection Economic Feasibility Report;
  - subsequent analysis based on more detailed modelling;
  - scoping of further studies on off-shore wind.



Comparison of Presentations

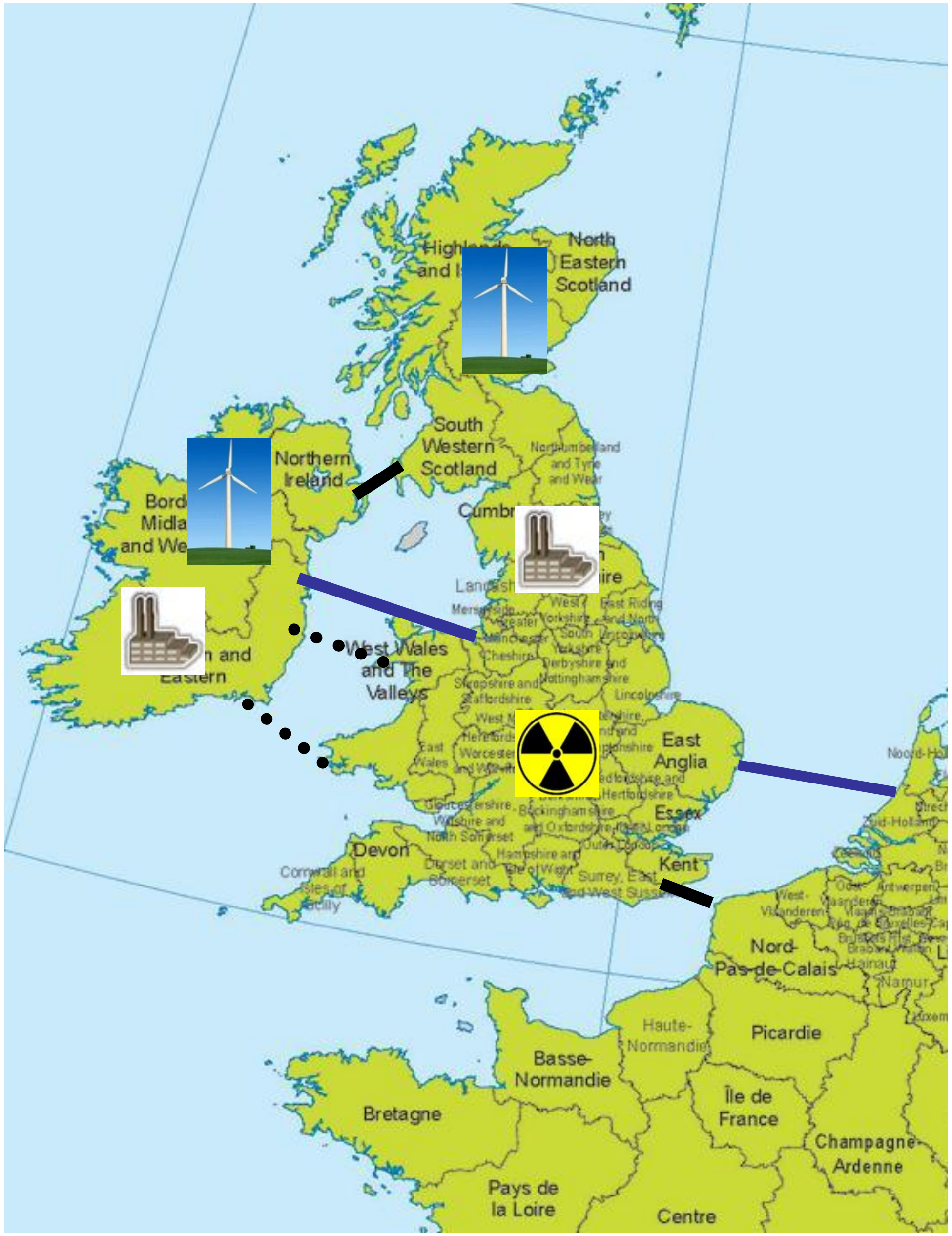
Previous Presentation	Current Presentation
Optimal design of offshore grids	Economic justification of offshore grids
Full Network, Meets N-1	No internal network constraints
5 snapshot hours per year	8760 hours per year
2010 – 2030 examined in 3-year intervals	Predominantly 2020; also 2015 and 2025
Generic price for Europe	Europe generation and load modelled in detail

2009 Interconnection Economic Feasibility Report



In 2009 EirGrid published a report on the feasibility of further interconnector between Ireland and Great Britain and Ireland and France called Interconnection Economic Feasibility Report.

Interconnection between Ireland and Great Britain



- The Moyle and East-West interconnectors are shown by solid lines.
- Two additional 500 MW interconnectors were studied as indicated by dashed lines; the routes are indicative only.
- Multiple scenarios were examined e.g. high renewables, high storage, flexible plant, new coal, fuel price.

East-West Interconnector:
Range of Savings =
50 – 73 €M p.a.

4th Interconnector:
Range of Savings =
12 – 32 €M p.a.

3rd Interconnector:
Range of Savings =
27 – 50 €M p.a.

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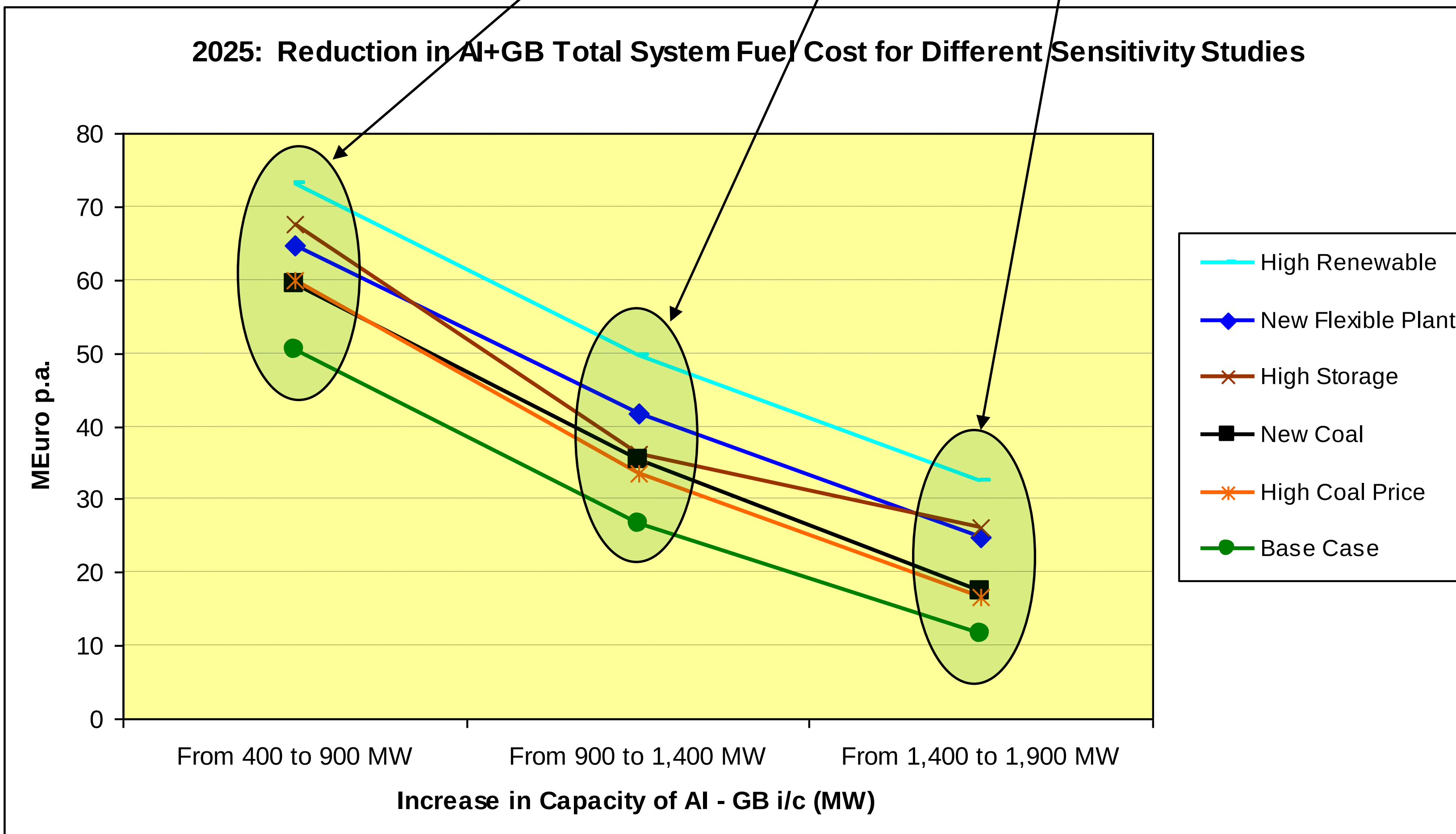
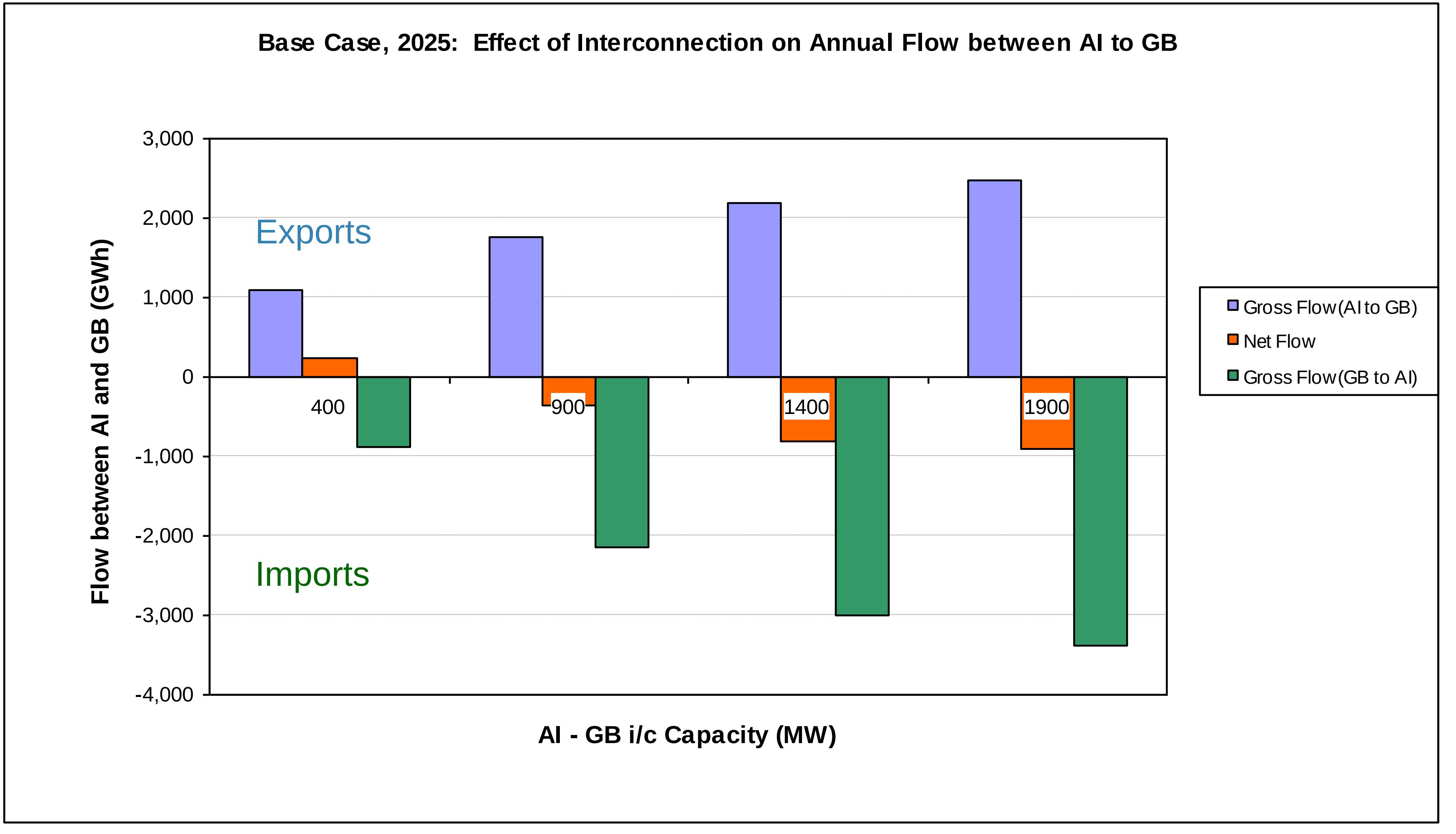
Energy Cost Savings in 2025

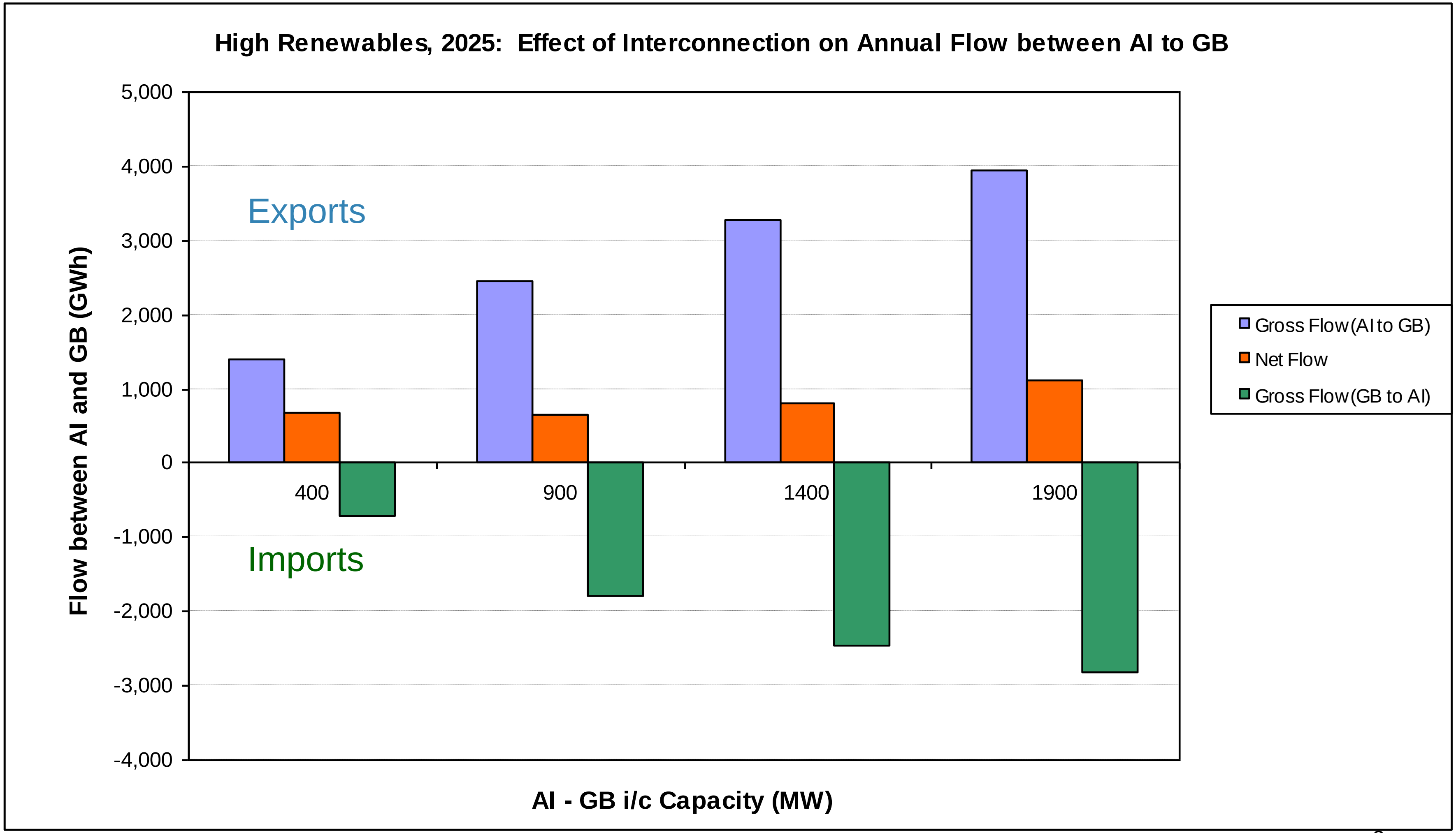
- Additional interconnection brings lower overall energy costs.
- High Renewable scenario shows maximum benefits



Interconnector Flows between AI and GB
Base Case, 2025

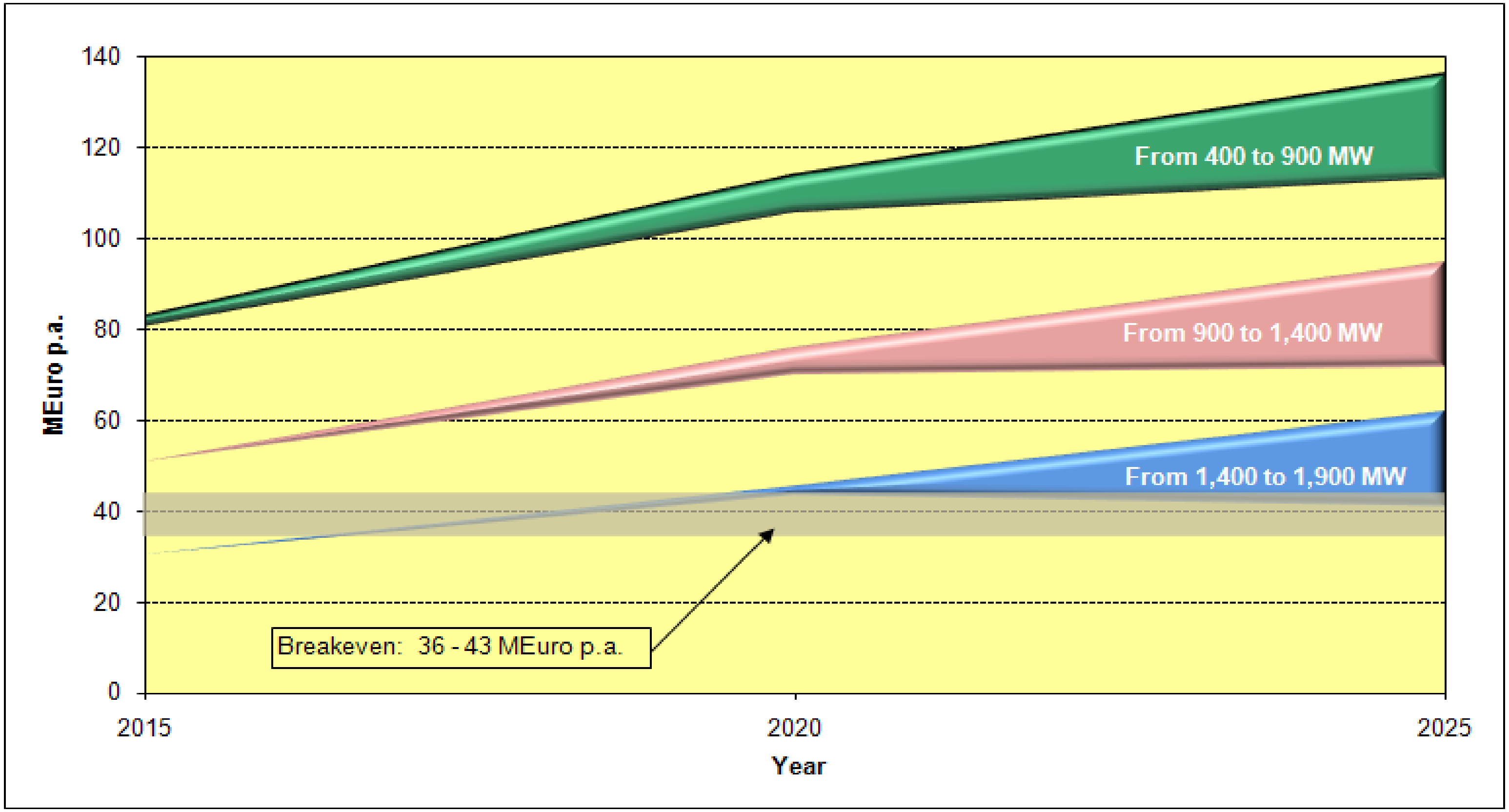


Interconnector Flows between AI and GB
High Renewables, 2025



Combined Benefits

- In general, interconnection becomes more economically attractive further out in time;
  The incremental benefits of interconnection decrease with each subsequent interconnector.

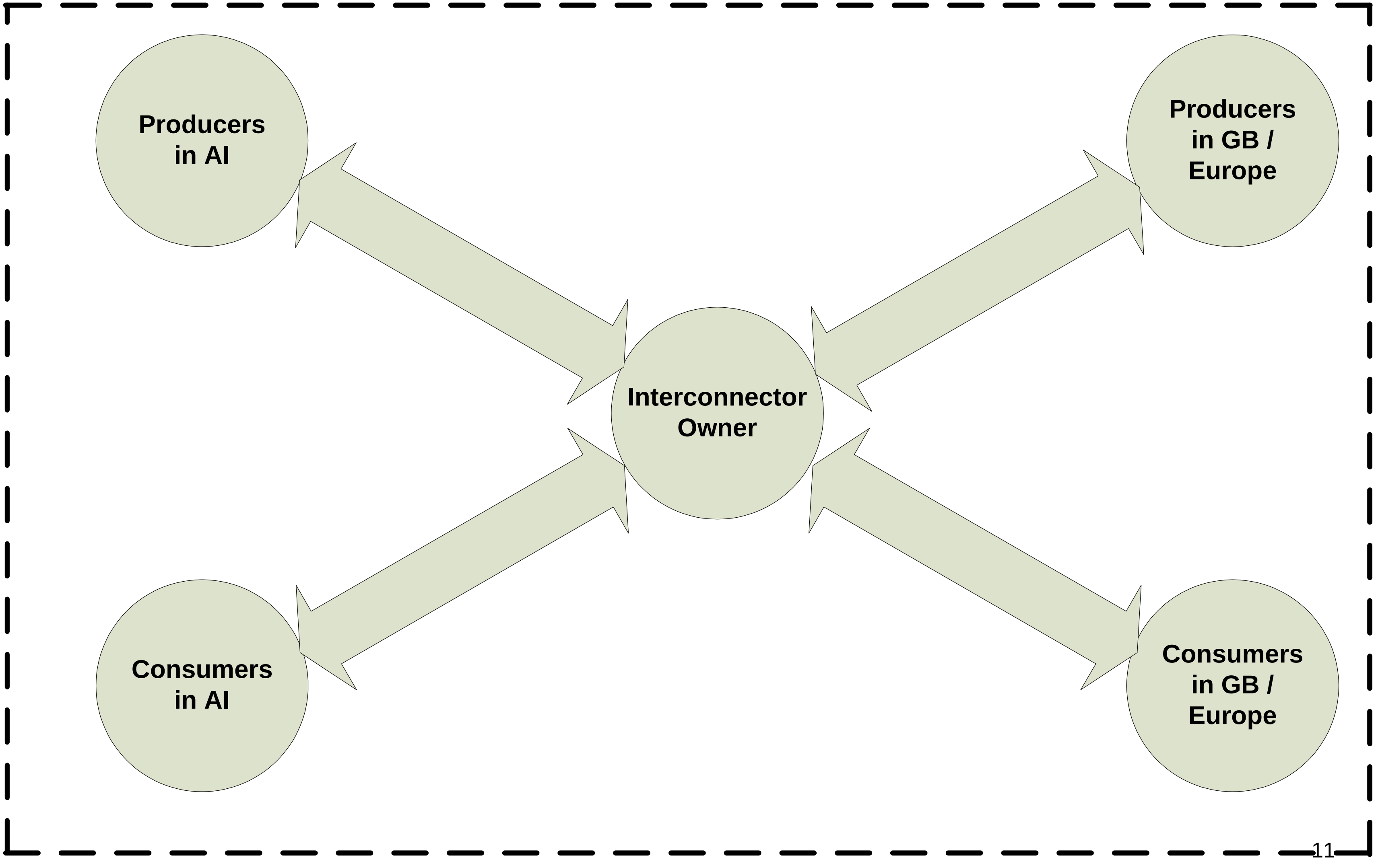


100% capacity benefits and 100% production cost savings assumed.

Benefits of Interconnection

- Lower production costs √
- Less generation capacity required √
- Ancillary Services X
  - Black start capability;
  - Shared reserve.
- Societal benefits X
  - Diversity
  - Greater competition
  - Closer European integration

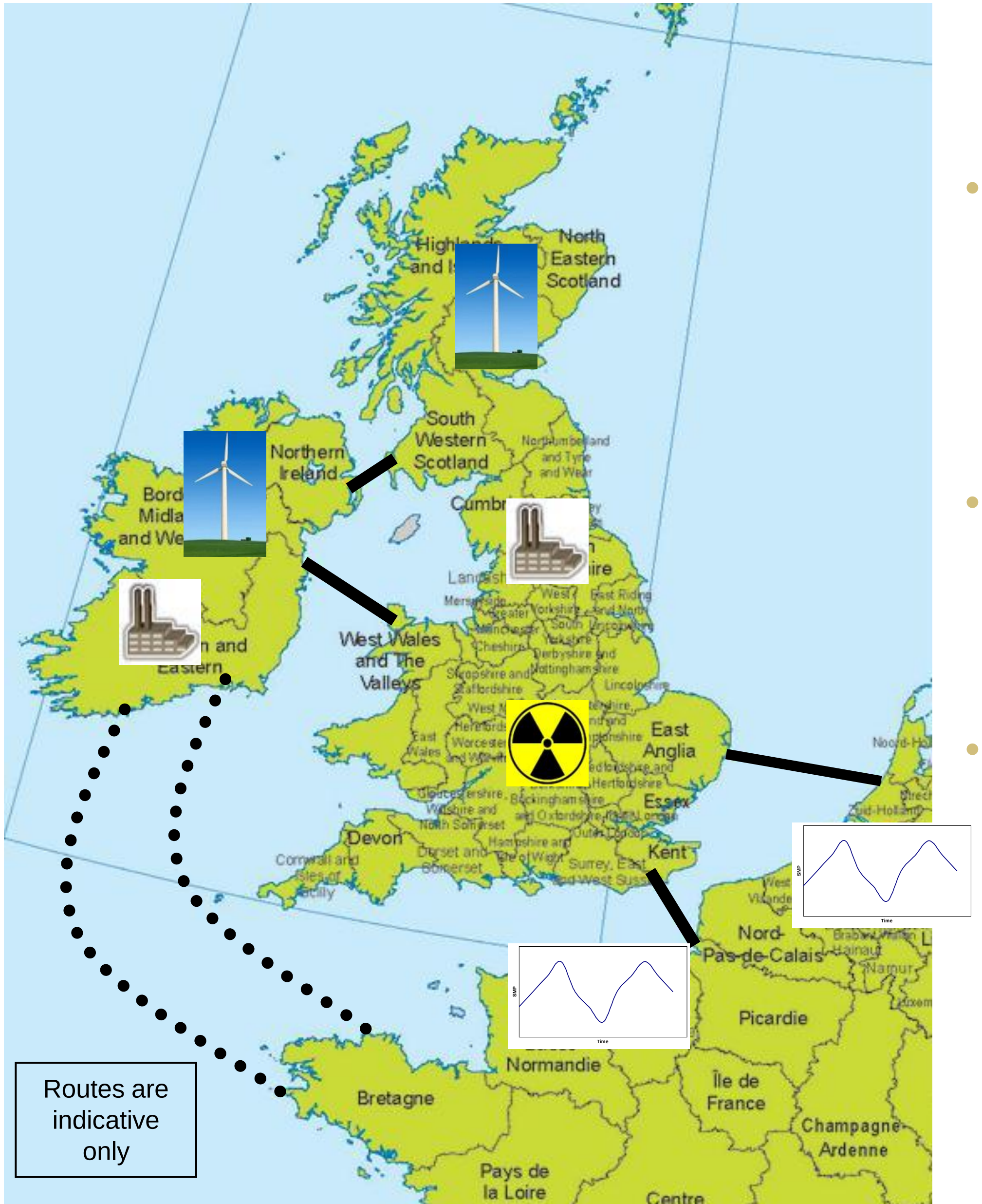
Total economic benefits evaluated in the study; not apportioned to individual parties



Conclusions for AI – GB Interconnection

- This analysis reinforces the very strong economic case for the East-West Interconnector, currently under development.
- A further (third) 500MW interconnector between AI and GB is economically attractive in 2020, and more so in 2025.
- A fourth 500MW interconnector between AI and GB is economically feasible by 2025 in some scenarios, such as High Renewables.

Interconnection between Ireland and France



- France highly interconnected with surrounding countries
  => can't be considered in isolation.
- Therefore, a much simpler model is used for France as blocks of hourly energy prices.
- Scenarios with 1 x 500MW and 2 x 500MW interconnectors were examined.

Production cost savings for Ireland-France interconnection

Savings (€M p.a.)	2015	2020	2025
AI - FR i/c from 0 to 500MW	38	56	63
AI - FR i/c: from 500 to 1,000MW	27	37	37

More detailed modelling required for French power system.

More detailed modelling of Europe based on EirGrid collaborative work in ENTSO-E North Sea Region

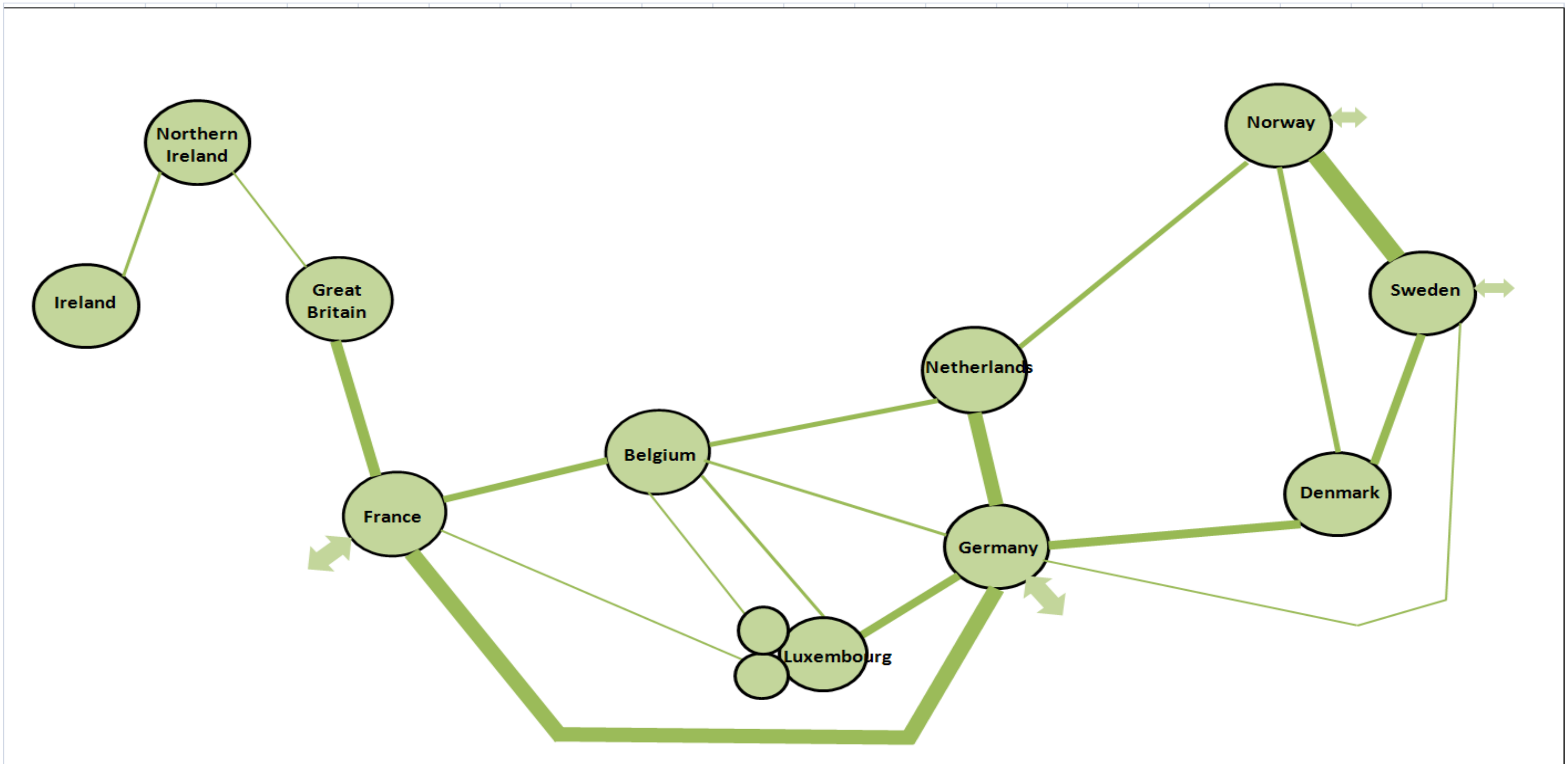
Multi-model approach for ENTSO-E North Sea Region

- 10 countries:
  - Ireland, United Kingdom, France, Belgium, Luxembourg, Netherlands, Denmark, Germany, Norway and Sweden
- Four countries volunteered to do the market modelling:
  - Belgium, France, Netherlands and Ireland
- Results will inform next ENTSOE Ten-Year Network Development Plan (TYNDP)

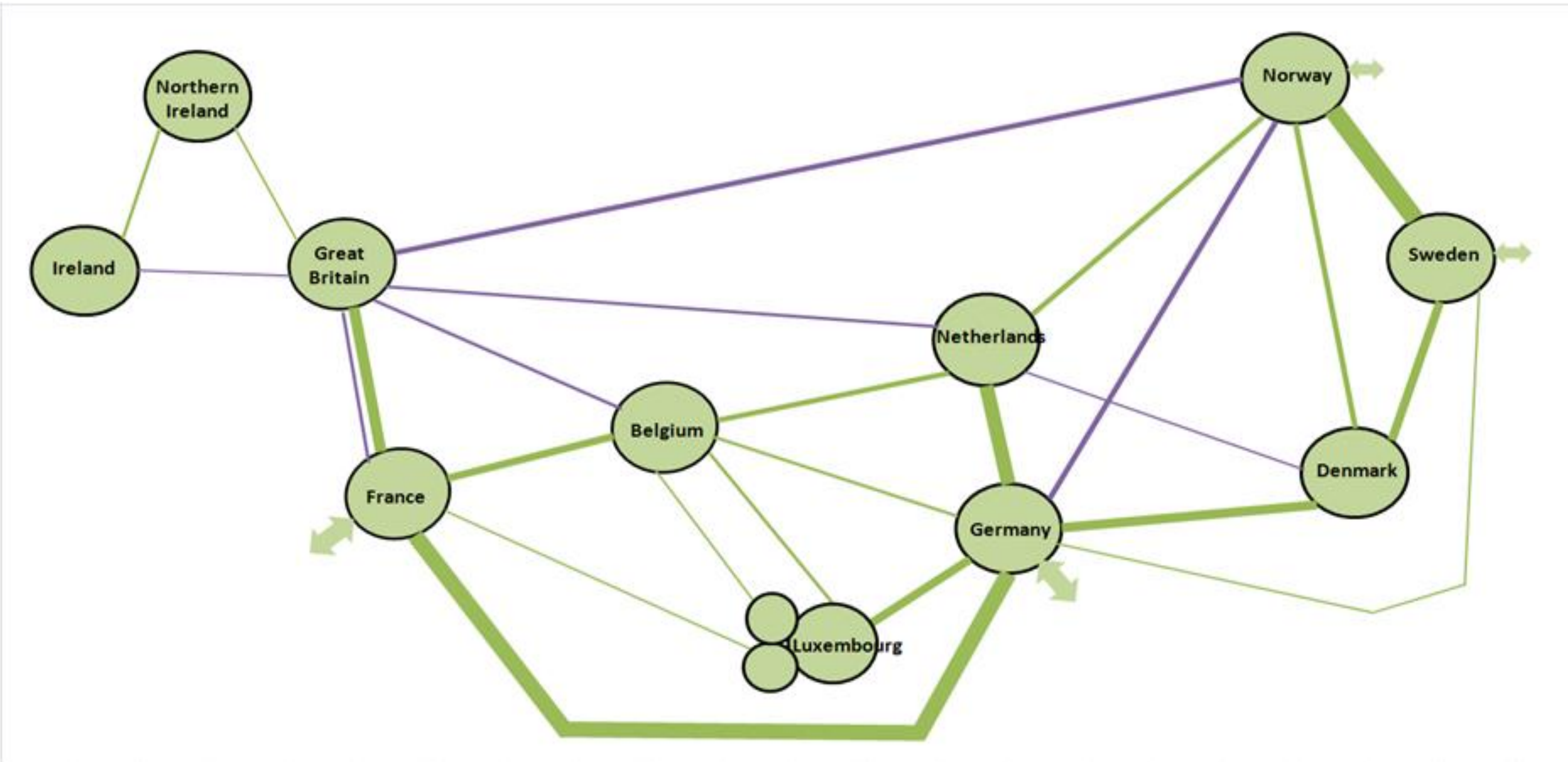
North Sea Region Characteristics

- Peak demand 340GW
  - All-Island 7.6GW (2%)
- Energy 2100TWh
  - All-island 44TWh
- Extensive interconnection to Eastern and Southern Europe
- Gas, Nuclear, Hydro, Coal, Lignite, Solar and Wind generation

Simulation 1
2020 with current off-shore network

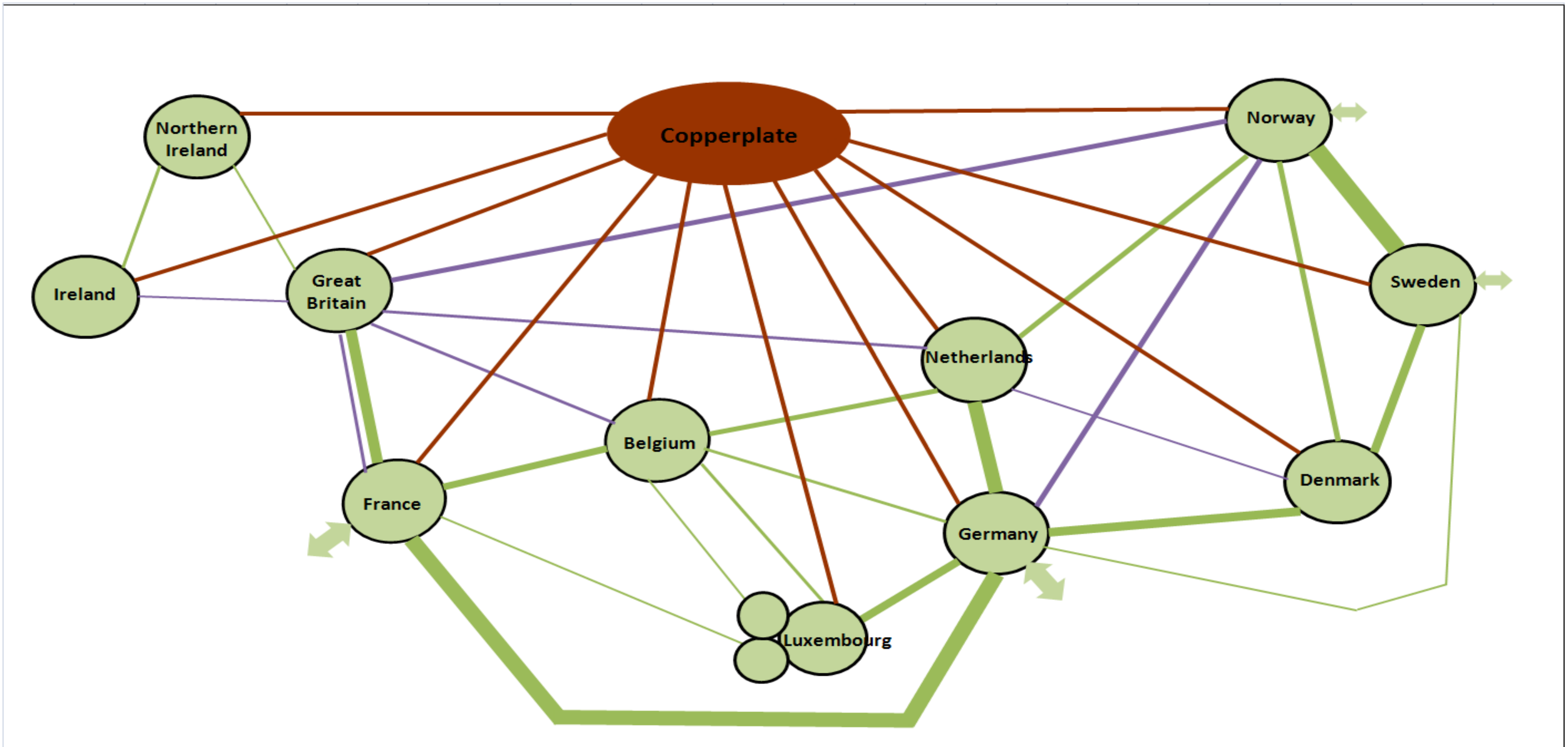


Simulation 2
2020 with additional interconnectors per ENTSOE pilot Ten Year Network Development Plan

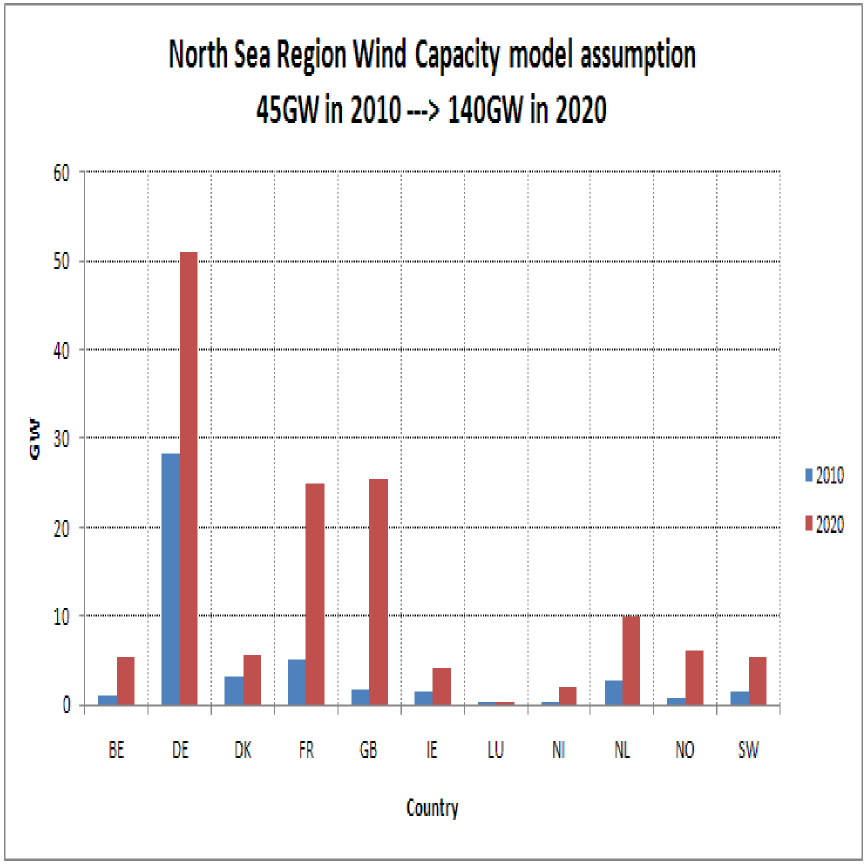


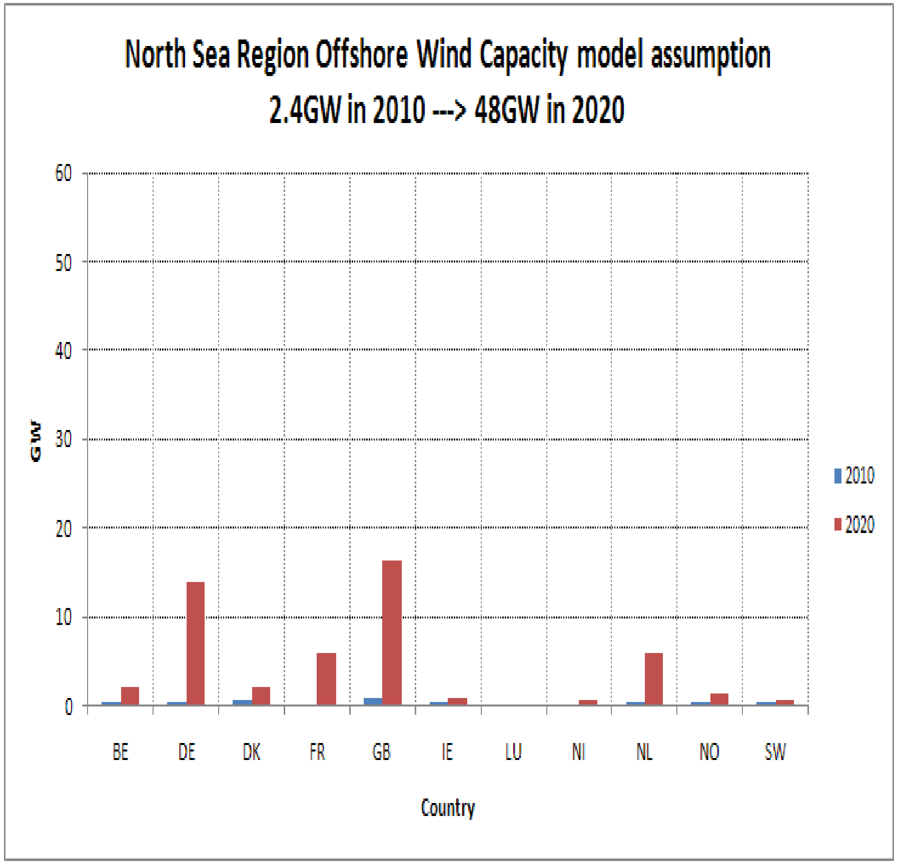
Simulation 3
2020 with unlimited copperplate interconnection

This gives the theoretical maximum interchange

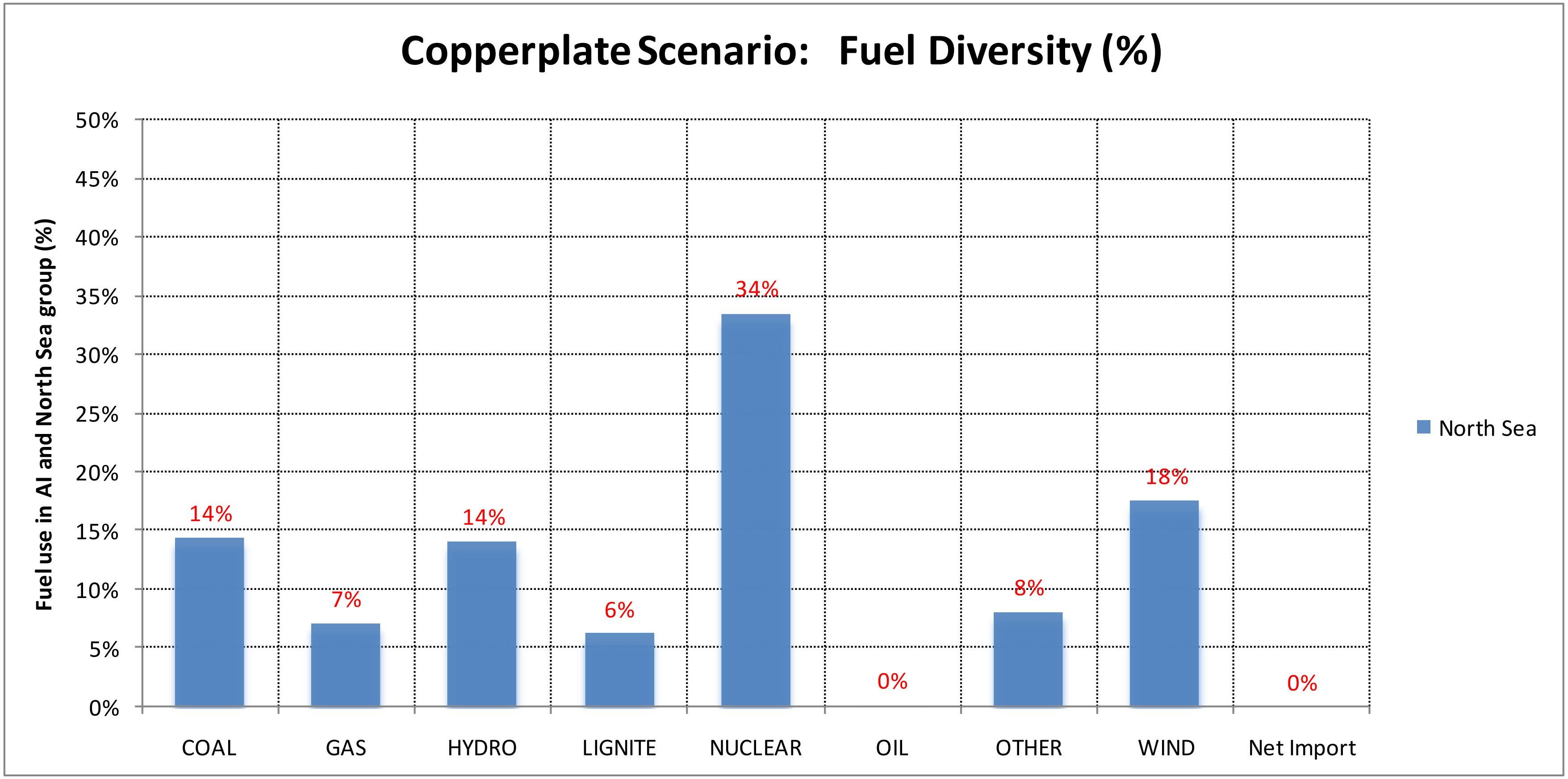


North Sea Region Wind Capacity Model Assumptions





Fuel Diversity in North Sea region for low carbon price €25/tonne



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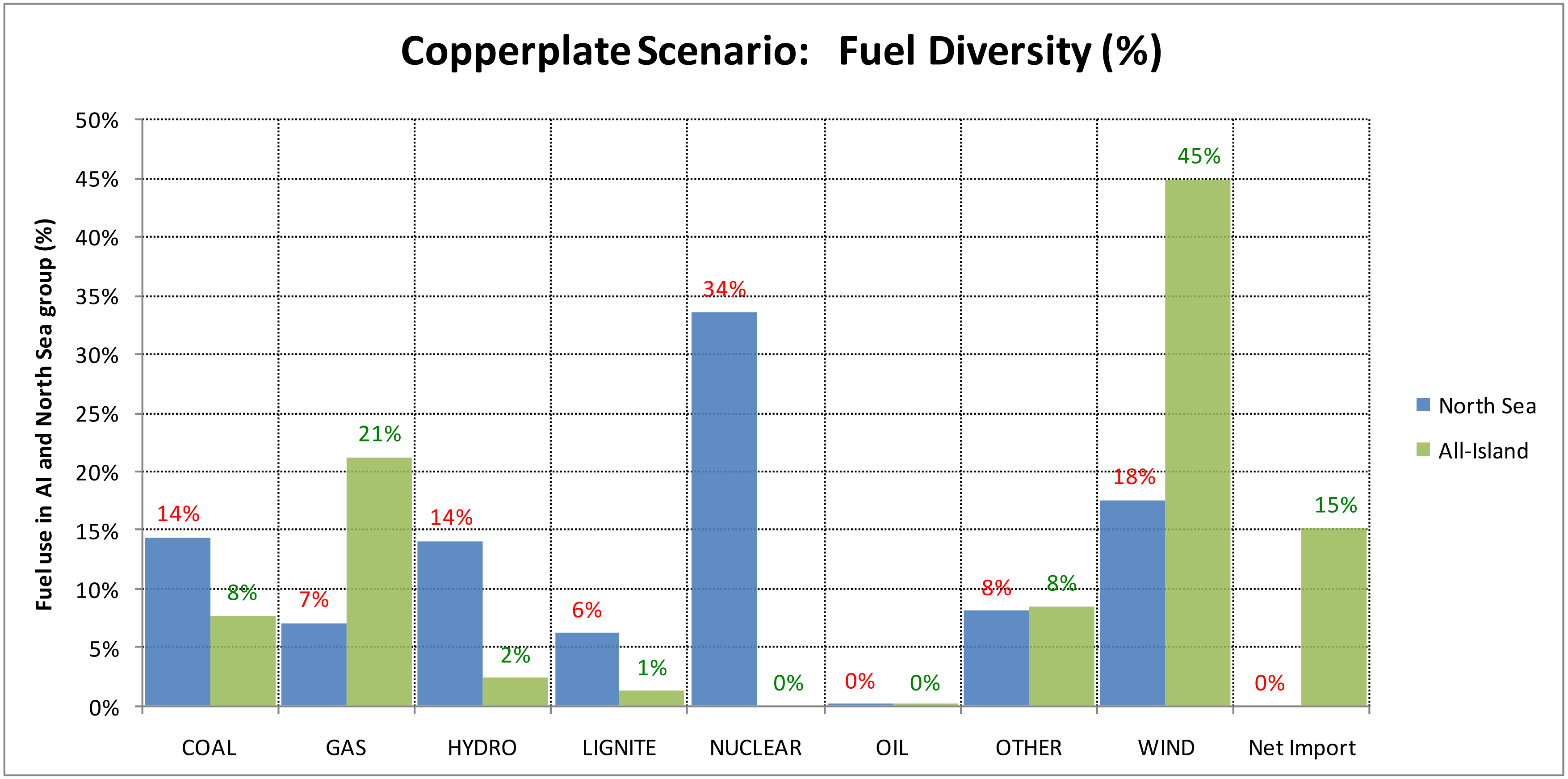
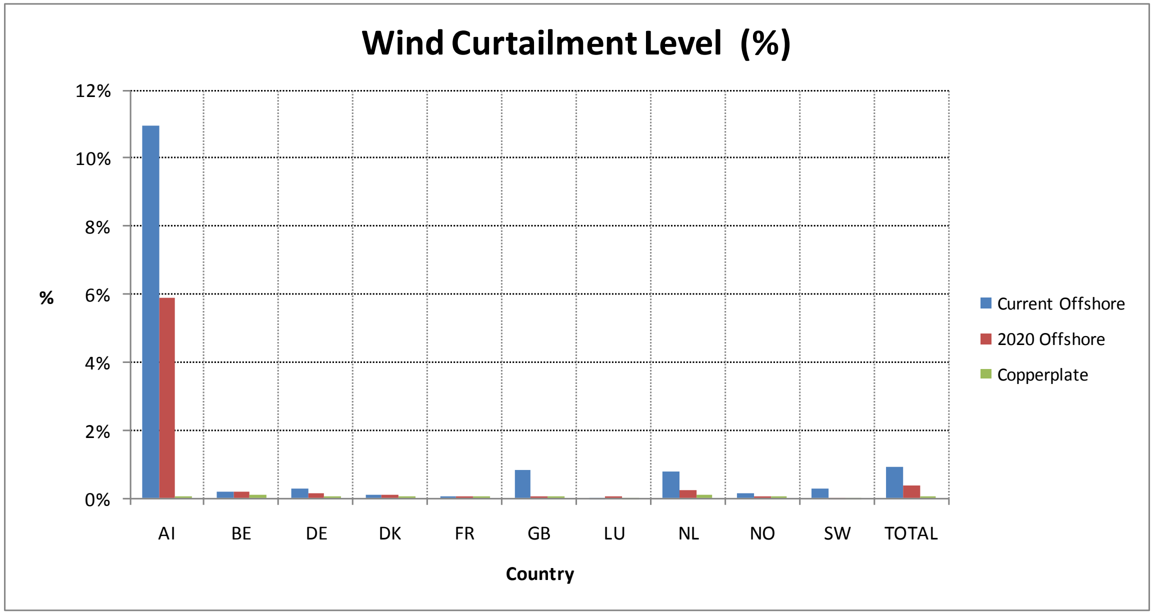
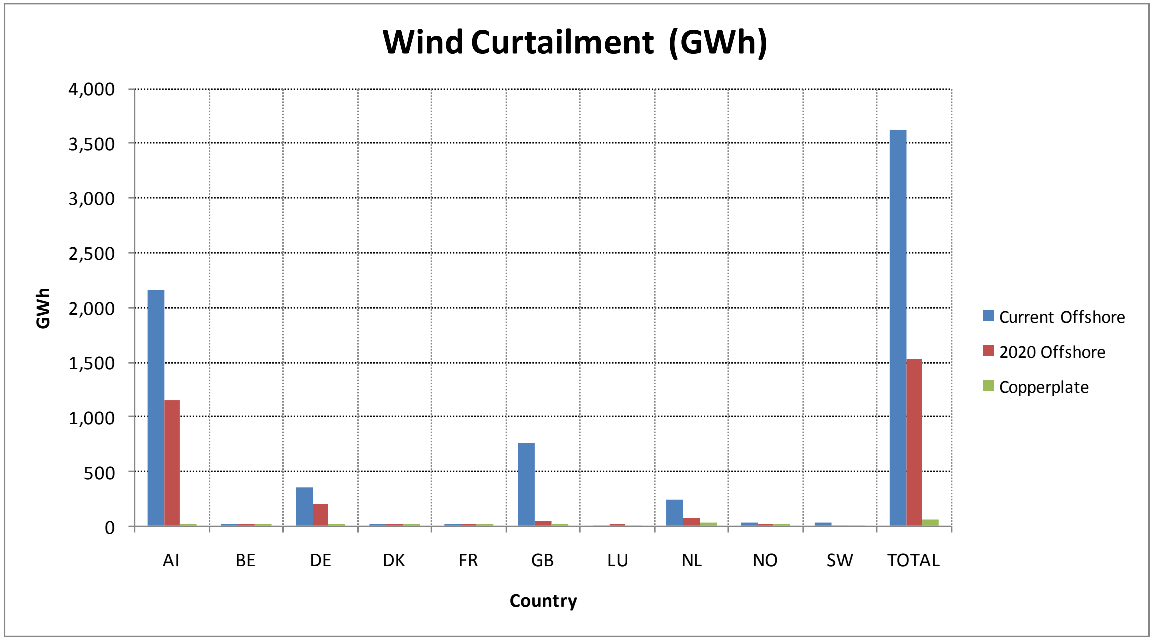
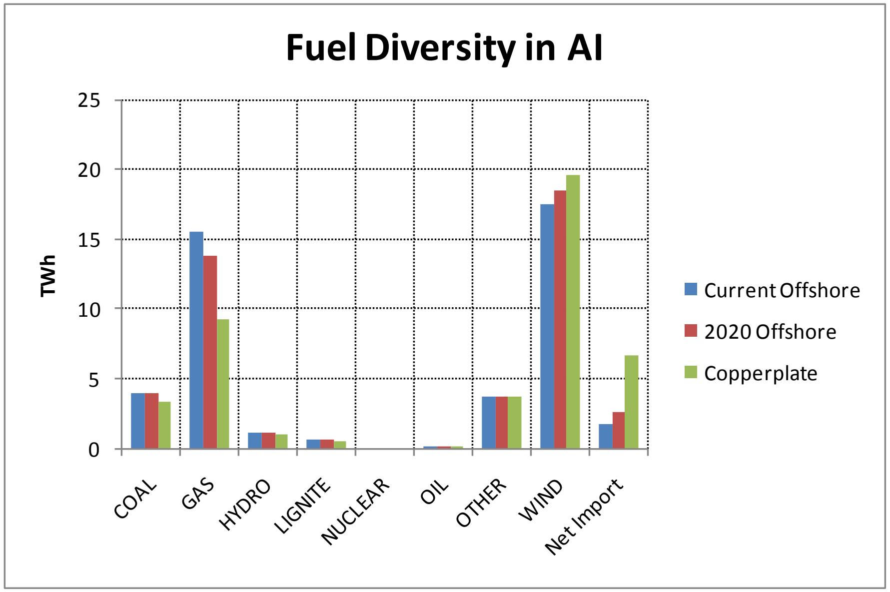


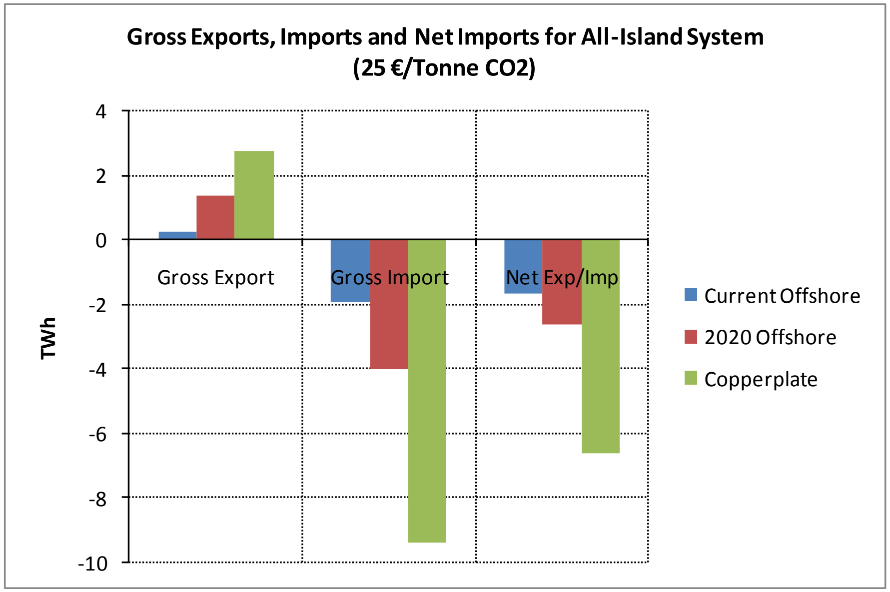
Wind Curtailment





Results for All-Island Market

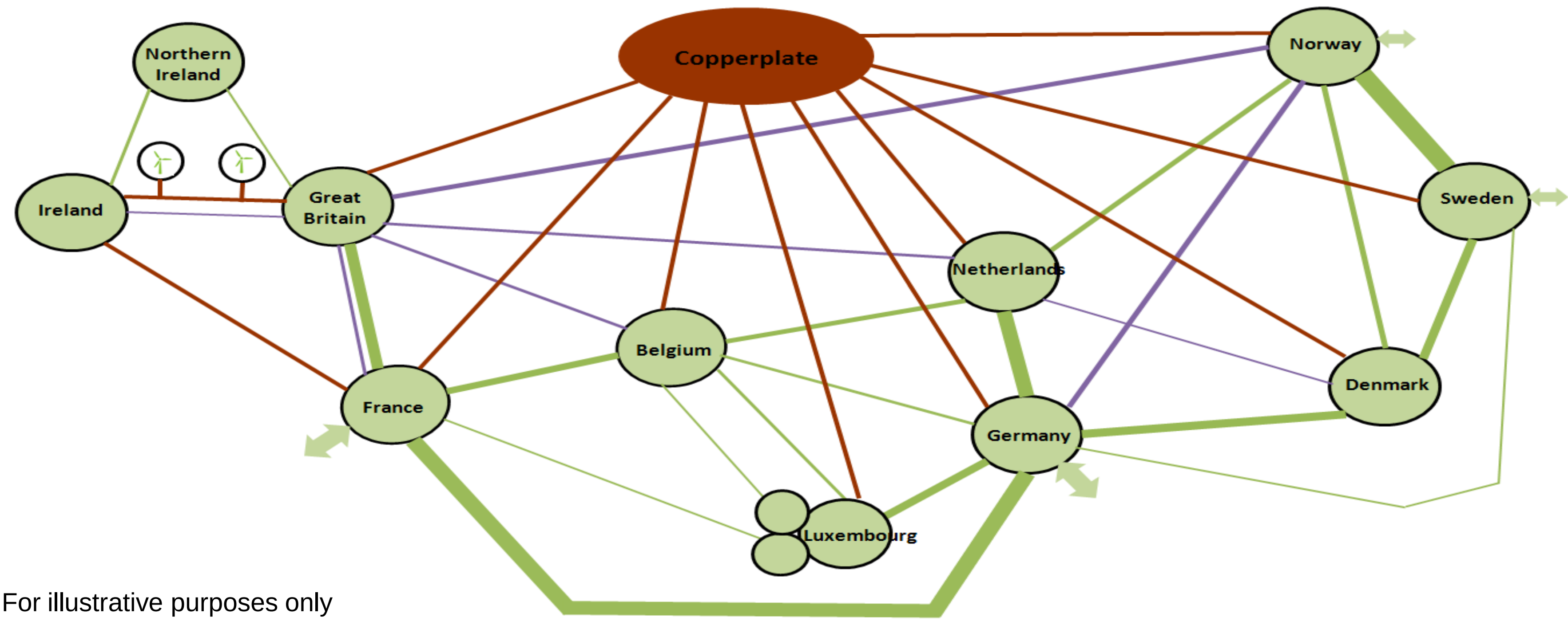




- Predominantly gas and wind generation.
- High wind curtailment except in Copperplate scenario.
- Increased flows in both directions (particularly imports), with more interconnection indicates possible case for further interconnection capacity.
- Very large imports relative to system size.

Next Steps:

- Based on these modelling results, EirGrid will be up-dating the Interconnector Feasibility Report.
- Decompose the copperplate to a practical offshore grid that economically connects offshore wind generation and markets



For illustrative purposes only

Proposals for Further Modelling of Off-shore Wind

- Examine substantially higher levels of off-shore wind than that proposed in the NREAP;
- Add a wider range of interconnectors from Ireland to Great Britain and/or France;
- Examine the optimum interconnection for a particular level of offshore wind.
- Detailed modelling of the power systems of Great Britain, France and other continental European countries;
- A test case has been created for 2020
  - 2030 is probably also required?

Data Assumptions

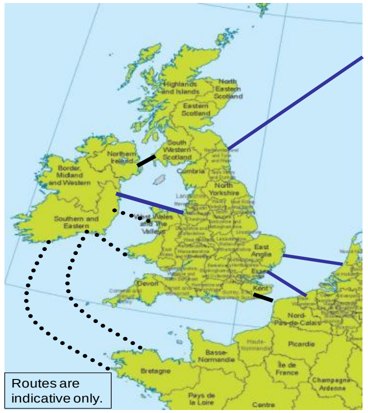
- On-shore wind in Ireland is consistent with the 2010 NREAP target of 42.5% electricity from renewable sources. Off-shore wind in Ireland varies by scenario, with at least 555 MW (the NREAP value).
- For Northern Ireland, 1000MW on-shore and 600MW off-shore wind is assumed.
- Great Britain generation portfolio impacts results significantly. A range of scenarios for Great Britain is probably needed.
- A single fuel forecast based on the International Energy Agency World Energy Outlook 2009 is used.
  - Is this enough or do we need a range of fuel forecasts?
  - Do we need to swap coal and gas in the merit order?
- The carbon price used is €25/Tonne . A range of carbon prices would be required.

Data Assumptions

- The minimum interconnection is EWIC (500 MW) and Moyle (assumed 500 MW in both directions).
- Further interconnection is added to Great Britain and/or France, depending on the scenario. It is increased in multiples of 1 GW, up to a maximum of 8 GW.
- 0.555, 3, 5, or 7 GW of offshore wind;
  - Location of off-shore wind not studied
  - Capacity factor 39%
  - Only a single time-series data was available – more would be better.

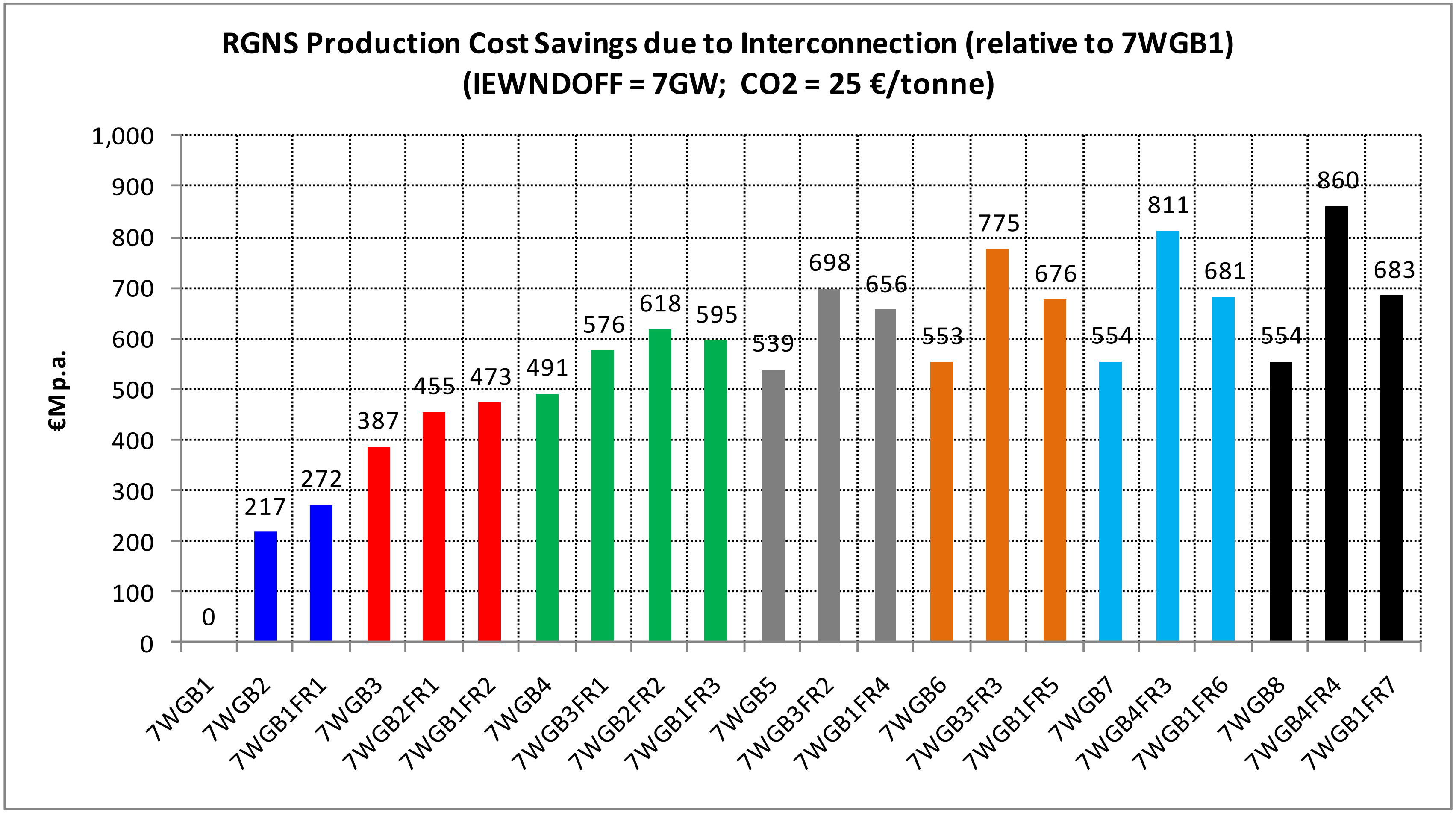
Cost Assumptions

Parameter	1 GW Interconnector	
	Between IE and GB	Between IE and FR
Capacity (MW)	1,000	1,000
Specific Cost (€M / MW)	1.0	1.5
Total Cost (€M)	1,000	1,500
Lifetime (years)	20	20
Discount Rate (%)	6	6
Annual Cost (€M p.a.)	87.2	130.8



Parameter	1 GW Offshore Wind	
	Capital Cost	Connection Cost
Capacity (MW)	1,000	1,000
Specific Cost (€M / MW)	3.0	0.5
Total Cost (€M)	3,000	500
Lifetime (years)	20	20
Discount Rate (%)	10	6
Annual Cost (€M p.a.)	352.4	43.6

Sample Production Cost Results for 7GW wind



Summary

- In 2009, EirGrid produced a report on the feasibility of interconnection. Assumptions on wind had a significant effect on the conclusions.
- EirGrid is working with other TSOs on interconnection studies to inform the next ENTSOE Ten-Year Network Development Plan (TYNDP).
- EirGrid is interested in getting industry views on further studies of offshore wind and interconnection that would be of benefit.

End of Presentation

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