FUTURE ENERGY STRATEGIES

Valuing Commercial Interconnectors

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OBJECTIVES

- Explain who Pöyry are and our experience with cross-border electrical interconnection
- Examine aspects of the economics of current commercial interconnectors
- Discuss how current trends may impact the economics of interconnection in the future

AGENDA

1. Objectives
2. About Pöyry
3. Valuing commercial interconnectors
4. Impact of market trends on interconnector value

FIVE BUSINESS GROUPS

Core business groups based on five knowledge clusters

PÖYRY MANAGEMENT CONSULTING

Europe's leading specialist energy management consultancy

○ Pöyry offices

● Pöyry Management Consulting offices

- Offering expert advice from strategy to implementation on policy, regulation, business operations, financing and valuation and sustainability
- Providing in-depth market intelligence across Europe
- Over 200 energy market experts in 14 offices across Europe:
  - Düsseldorf
  - Helsinki
  - London
  - Madrid
  - Milan
  - Moscow
  - Oslo
  - Oxford
  - Stockholm
  - Stavanger
  - Paris
  - Vienna
  - Villach
  - Zurich

SAMPLE OF CLIENTS

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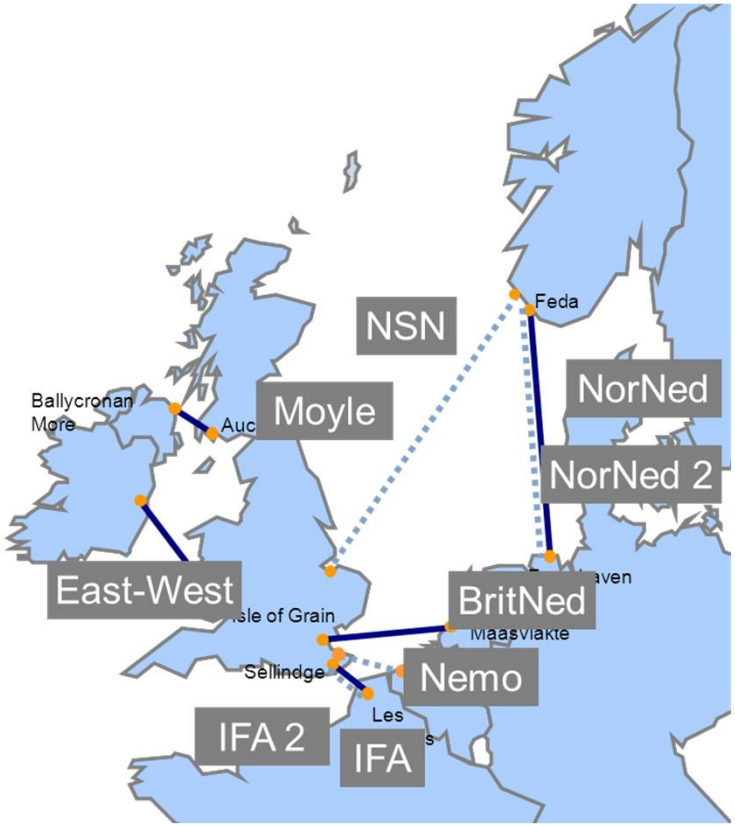
CURRENT AND PLANNED 'COMMERCIAL' ELECTRICAL INTERCONNECTORS

Poyry has been actively working on Interconnector models for 15 years

- Many interconnectors built in Europe (and elsewhere) by TSO's with costs distributed across network users
  - Logic for building is that society benefits from a cheap source of capacity and reserve
  - Often not driven by commercial incentives (i.e. market price differentials) with flows based on long-term contracts
- Pöyry has previously worked on a number of Interconnector projects for Grid companies and various commercial clients
- Work for 'commercial' interconnectors consists of revenue projections, environmental impact assessments, trading advice and auction analysis
- Key commercial valuations utilise Pöyry models to project scenarios for power prices by country on an hourly basis to 2035
  - Key to capturing full interconnector value

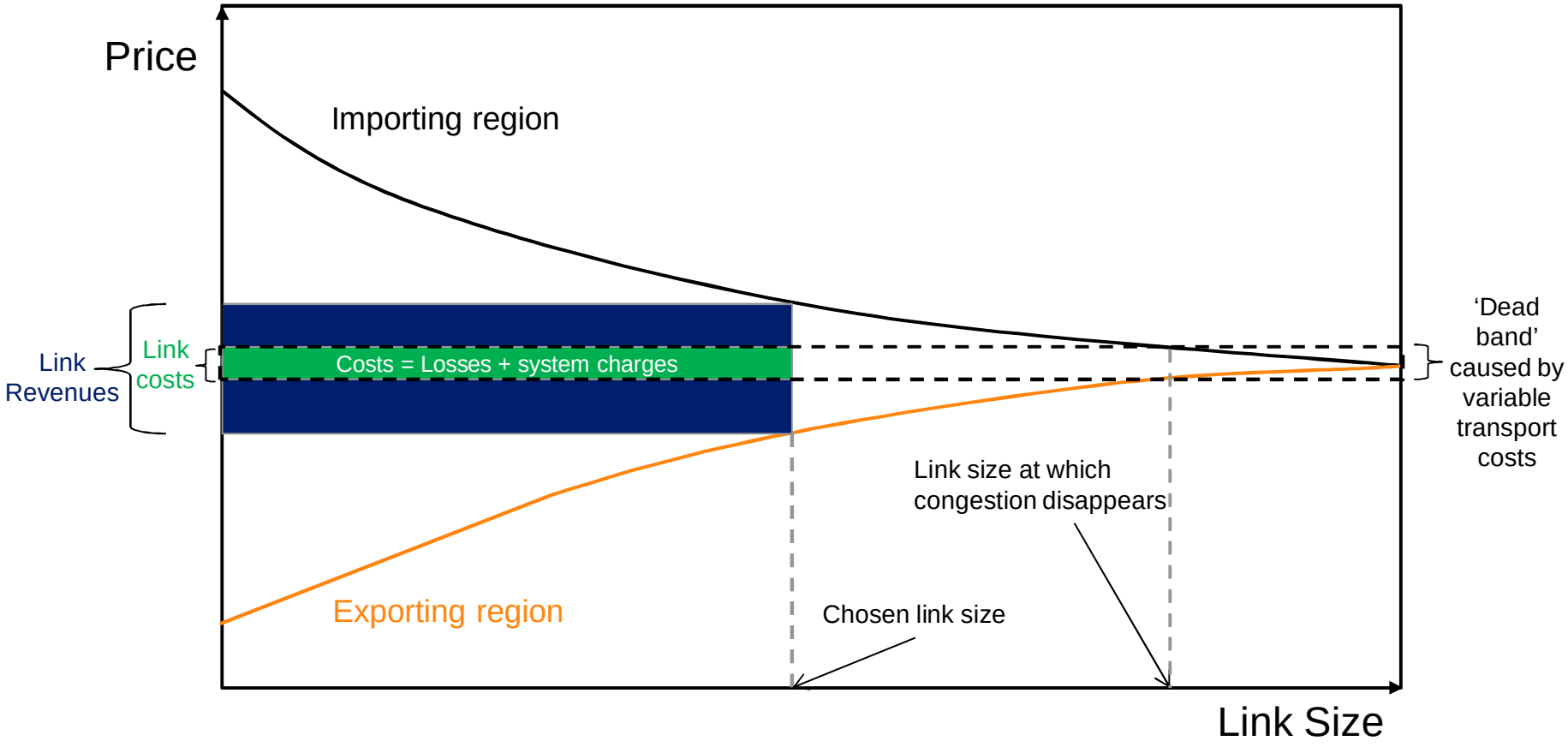


Selection of current and planned European Interconnectors assessed by Pöyry Management Consulting (UK) Ltd since 2008

INTERCONNECTOR VALUE THEORY

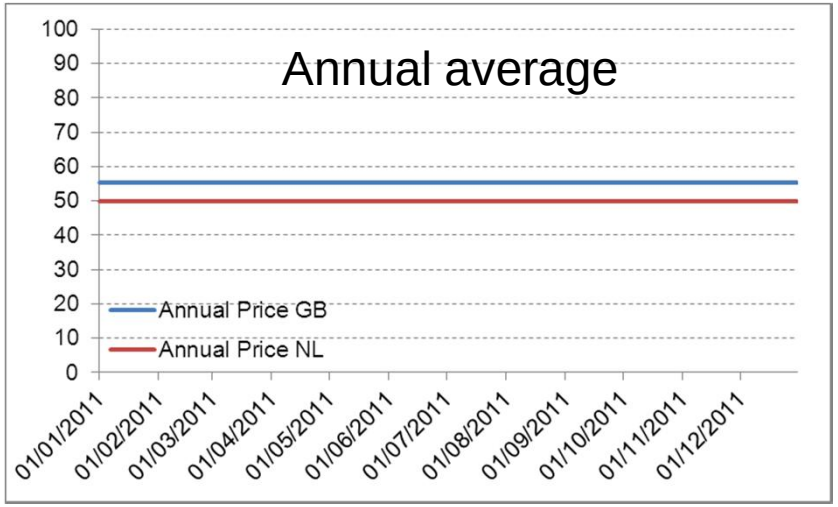
An extremely large Interconnector will converge prices and reduce link revenues to zero

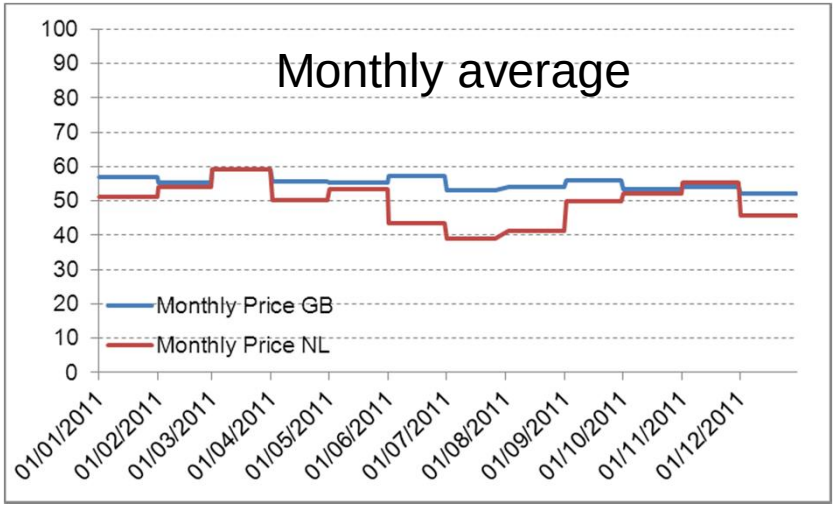
The optimal size of a link maintains some degree of congestion in flows

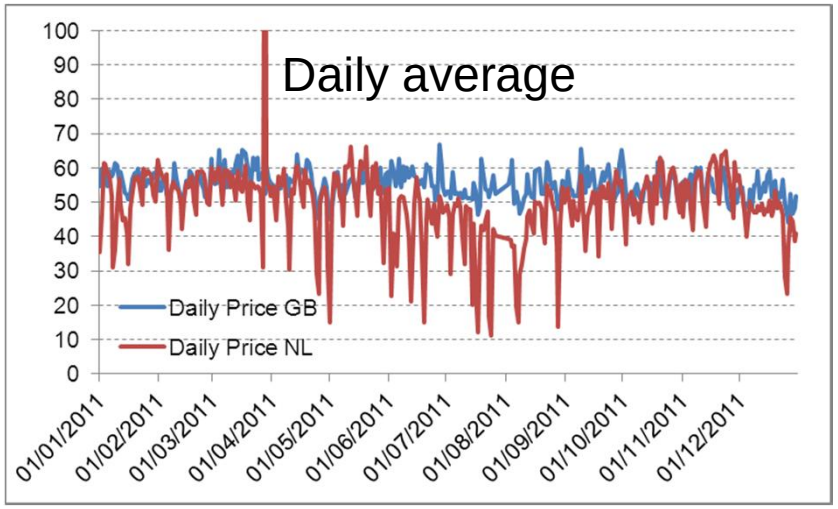


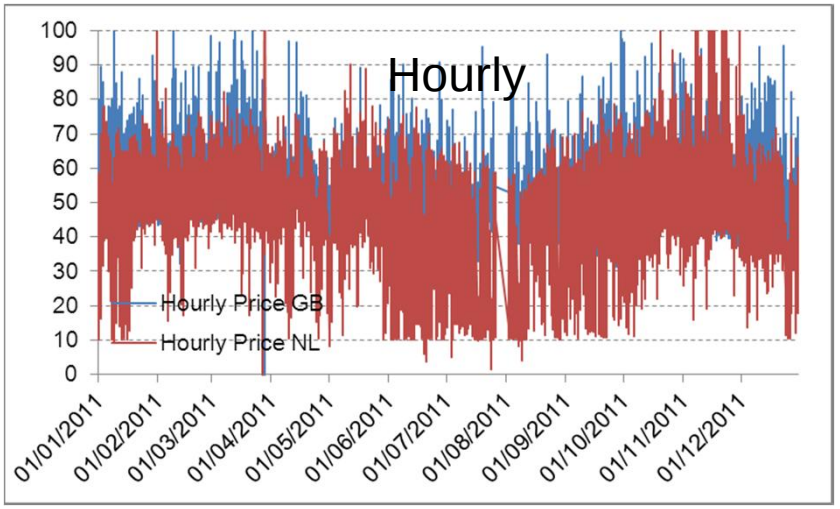
REVENUE SHAPE IN GB AND NL MARKETS

2011 Data for GB and NL – Prices faced by BritNed





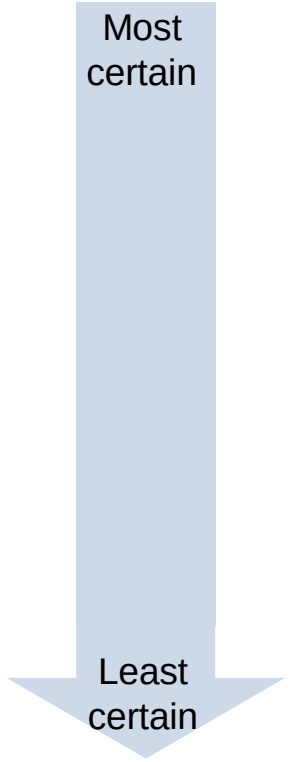




SOURCES OF INTERCONNECTOR REVENUE

Useful method for understanding IC revenue is to break it down by type

- **Shape revenue** – Shows a base level of revenue due to the underlying average shape in prices over the day/month/year
  - Relatively predictable and 'certain' as it exists even if annual average prices move together and there is low or zero 'volatility' in prices
  - Can be further categorised into hourly shape, daily shape, monthly shape etc.
- **Price Level revenue** – Shows the additional revenue above 'Shape' revenue from differing annual average prices
  - Significant in certain markets **BUT** value may appear or disappear with changes in precipitation/gas/carbon prices or installed capacity base
- **Volatility revenue** – Shows additional revenue above 'Shape' and 'Price Level' from adding unpredictable price peaks and troughs into the market
  - Will only appear close to real time (may even be intra-day rather than day-ahead)
  - By nature, this revenue is not certain (i.e. consistent) but can be very important
- **Additional non-energy services** – Covers non-energy revenues
  - Key examples are System Operator services + Renewable Energy transfers
  - Dependent on negotiations + market rules



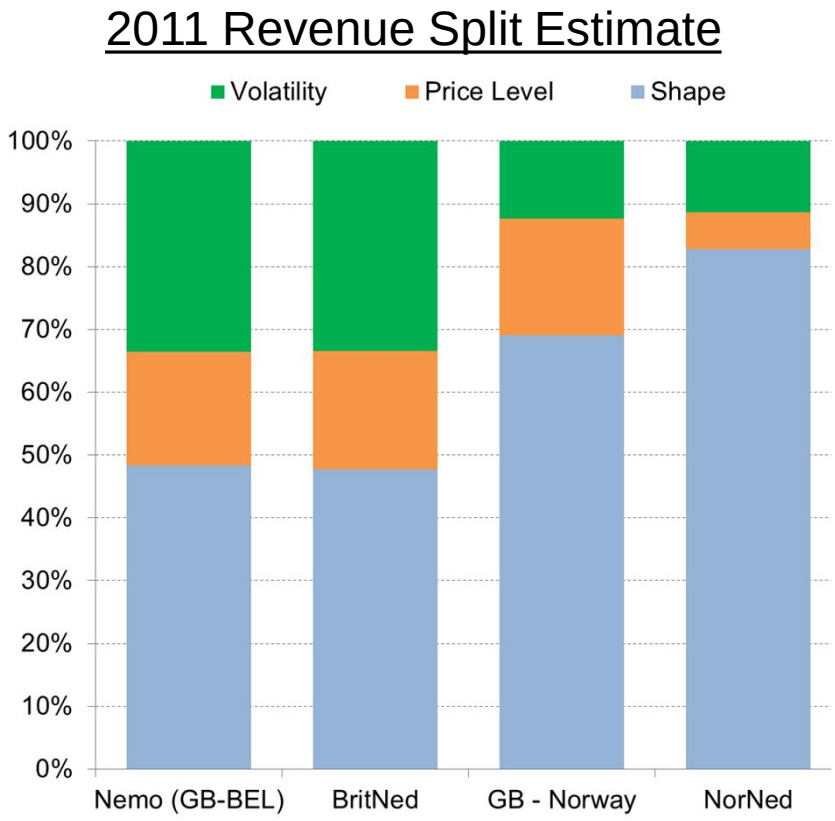
??? Dependent on market arrangements

Shape + Price Level + Volatility + Additional services = Total Revenue

SOURCES OF INTERCONNECTOR REVENUE

'Energy' revenue proportion derived from each 'source' will vary between IC as well as over time

- Differing price shapes between markets (both within year and within day) lead to a high 'Shape' revenue
  - E.g. summer vs. winter peaks; heavily shaped vs. flat hourly prices
- Large difference in annual av. prices lead to a high 'Price Level' revenue
  - E.g. gas normally on margin vs. nuclear or Hydro on margin
- Increased peaks and troughs lead to a high 'Volatility' revenue
  - variations in demand, fuel prices and intermittent generation
- Non-energy services value currently small (<10%) on most commercial interconnectors

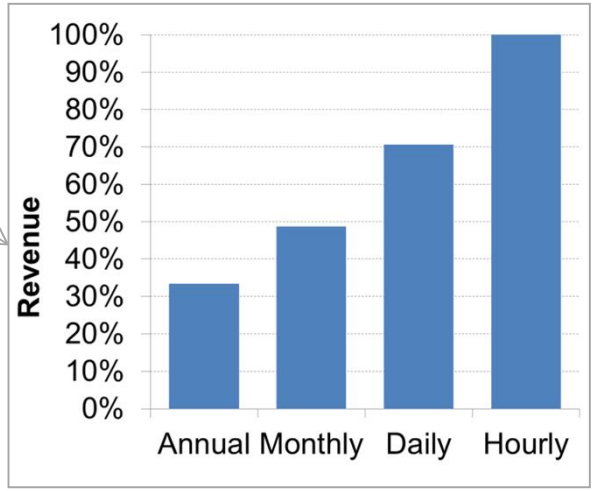


Revenue split based on recent Pöyry analysis of Interconnectors and potential interconnectors

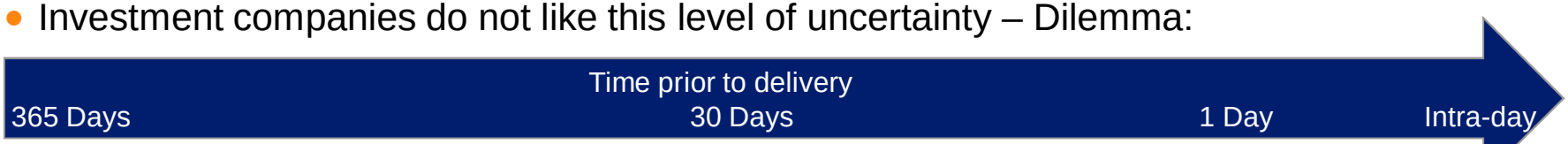
EXAMPLE OF REVENUE SPLIT – 2011: GB AND NL PRICES

Potential revenue only accessible as granularity of traded product increases

- Significant value derived on all ICs from both Shape and Volatility revenue
- Full revenue can only be captured if trading occurs on an hourly basis
  - Significant additional revenue achieved from each 'increase in granularity'
  - Some 'volatility' revenue only accessible within day!
- However, whilst maximising revenue involves trading at an hourly basis, this means that revenue can only be realised once hourly products can be traded
  - In GB and Netherlands market this is ~2 days before delivery (day-ahead stage)
    - Dependent on sufficient 'liquidity' that capacity can be traded



- Investment companies do not like this level of uncertainty – Dilemma:



Trade Earlier…
Stable predictable cash flow, more liquid markets but risk loosing revenue as cannot lock in price differences

Vs.

Trade Later…
Volatile, more unpredictable cash flow, potential liquidity problems, but potentially higher revenue capture

PÖYRY

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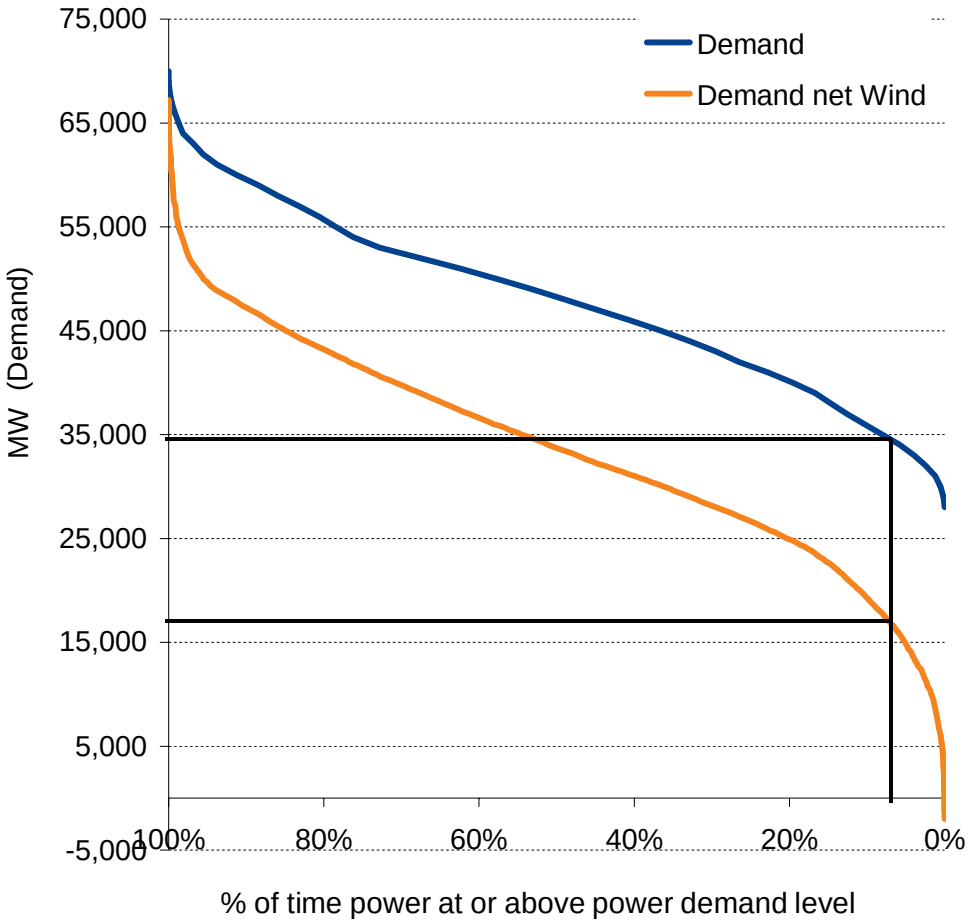
MARKET TREND: WIDESPREAD ADOPTION OF WIND & SOLAR IN EUROPE

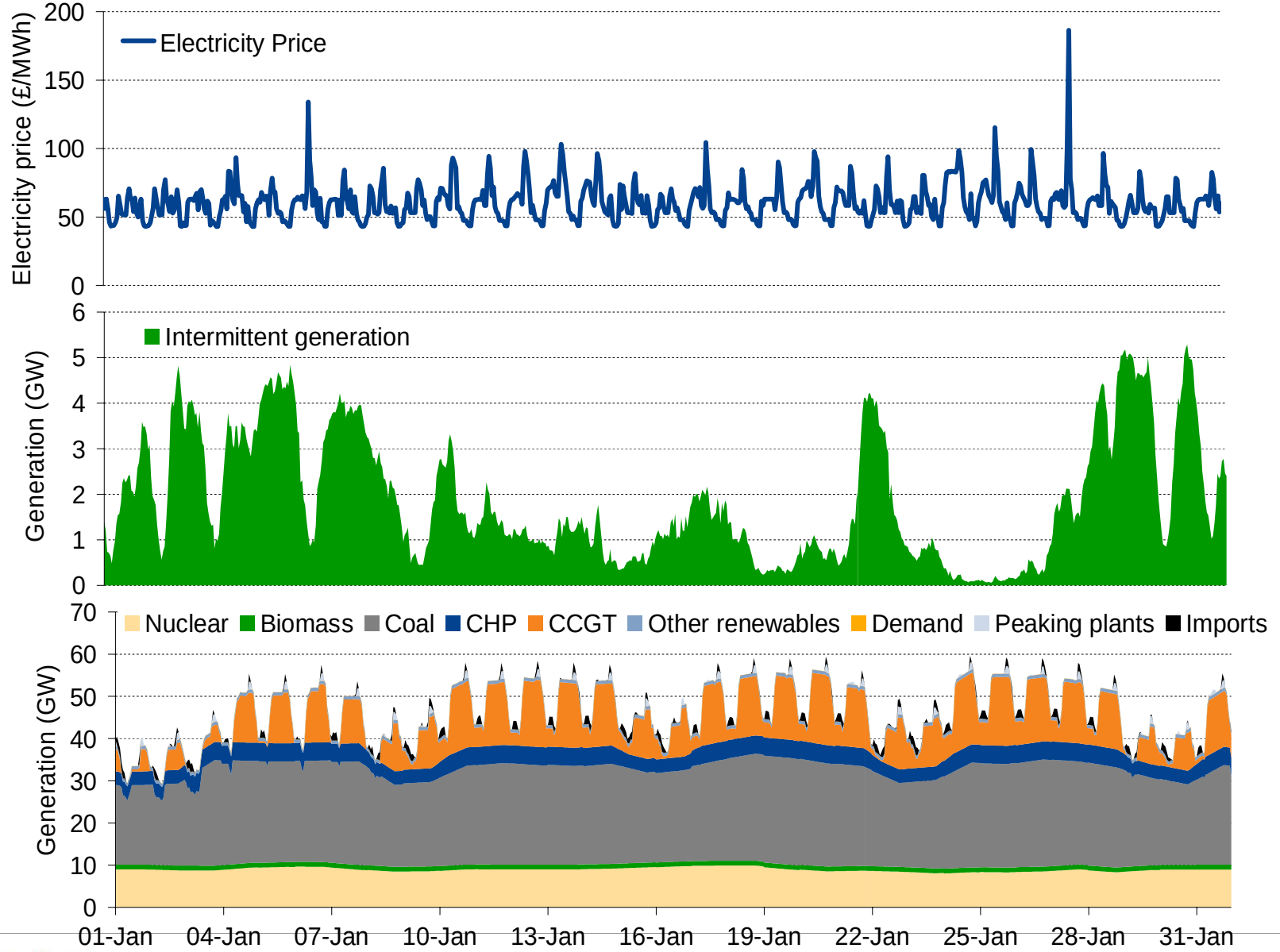
Example: GB market projections in 2030: Up to (~40GW of off + onshore wind)



- 2030 requirement for around 35GW of continuous power demand
  - Current continuous baseload requirement of around 30GW
  - Net of generation from wind, 'remaining' demand zero for certain hours by 2030
- Demand net wind much more variable than demand alone
  - In core scenario demand net wind varies between 0-65GW
- Less need for baseload generation
  - Load factors of all plant face downward pressure

Source: Pöyry Intermittent Generation study, http://www.poyry.co.uk/linked/services/pdf/14.pdf

GB – January 2010 (based on year 2000 weather patterns)



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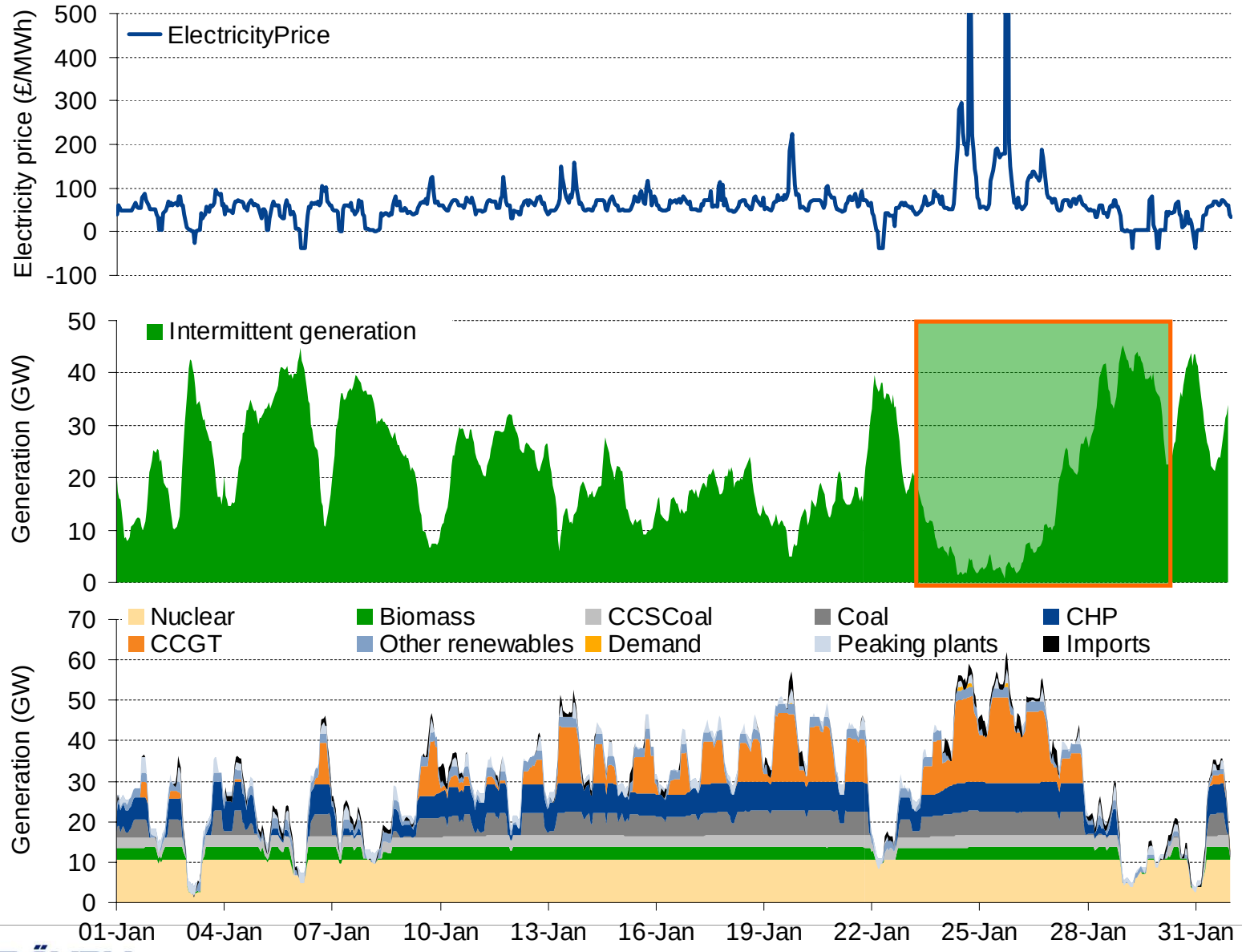

SUMMARY: IMPACT ON INTERCONNECTOR VALUE

- Introduction of widespread wind and solar generation in European markets
  - Higher volatility in prices
  - A need for increased System Operator services (provision of short-term response and other flexibility)

- Drives potentially greater value for interconnections
  - Volatile prices in markets create potentially higher energy revenues
  - Interconnectors are, by their nature, very flexible so should be ideal candidates to provide these services to System Operators (or other purchases of flexible capacity)

- However, much of this value will be in categories that are hardest for a 'commercial' interconnector to access
  - Volatile energy revenues that cannot be accessed until close to delivery
  - Increase in value in 'intra-day' services – currently insufficient liquidity to access market
    - Introduction of the European 'Target Model' which implies that European markets will need to have day-ahead market coupling BUT no solution yet envisaged for intraday trading

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