

Renewables integration and wholesale electricity market design

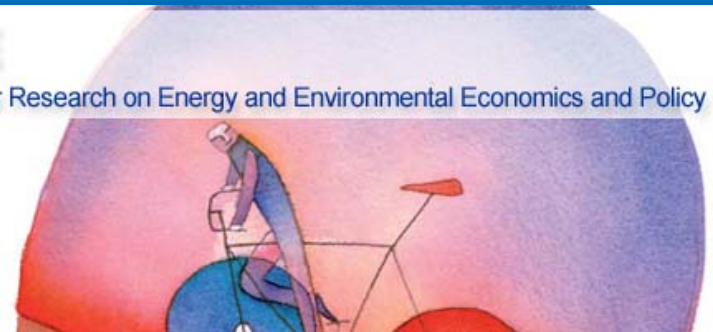
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Dmitri Perekhodtsev

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IEFE

Centre for Research on Energy and Environmental Economics and Policy



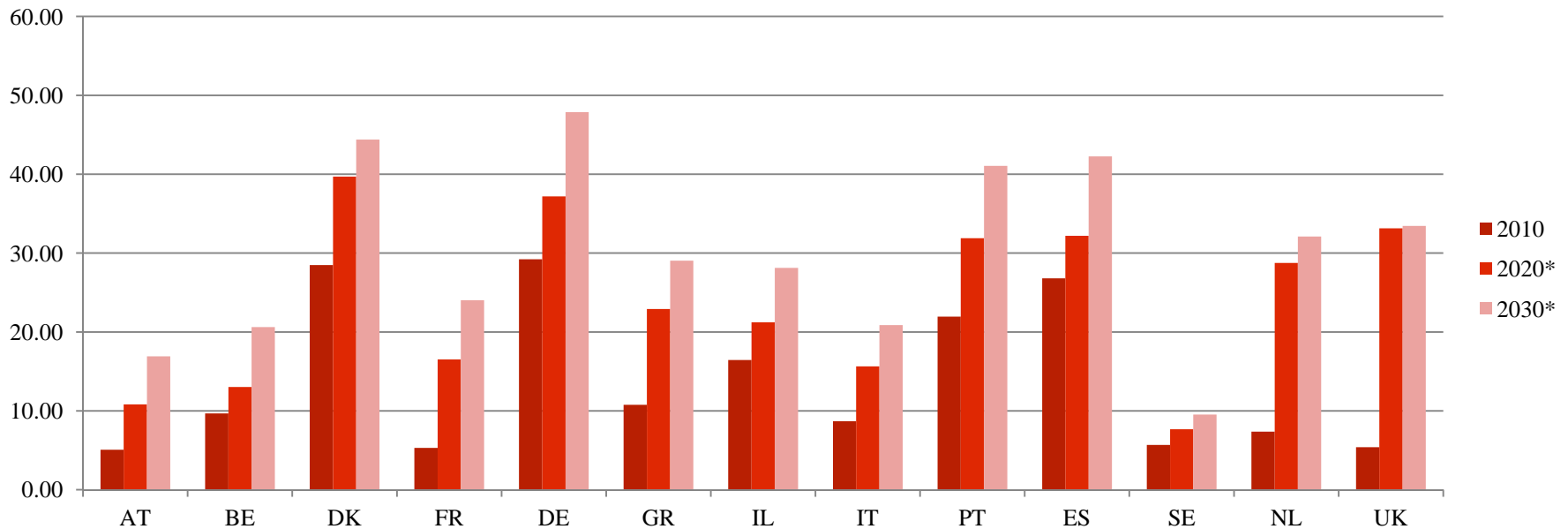
Agenda

- 2030 outlook for renewable power generation in Europe
- The impact of renewable generation on wholesale electricity prices and system operations
- How will the European “standard” market design fare with a large share of renewables?

2030 outlook for wind and solar generation in Europe

Renewable generation in Europe

Wind and PV Generation Capacity (% of total installed capacity)



- Renewable capacity in 2030: 309 GW
 - 59 GW PV (6%)
 - 250 GW Wind (27%)

The impact of renewable generation on wholesale electricity prices and system operations

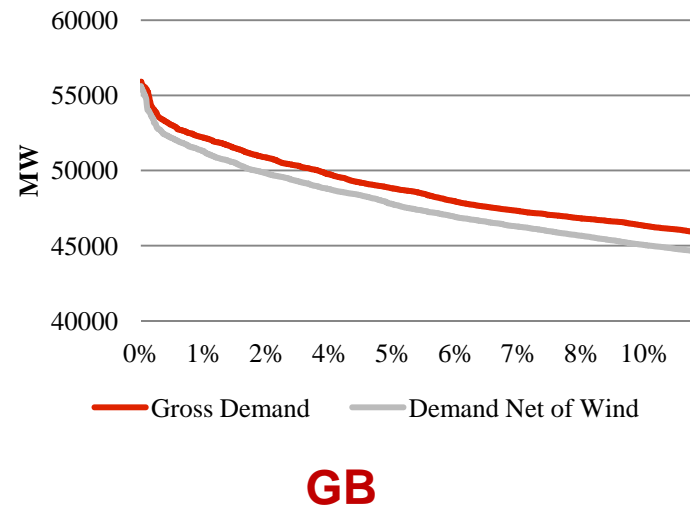
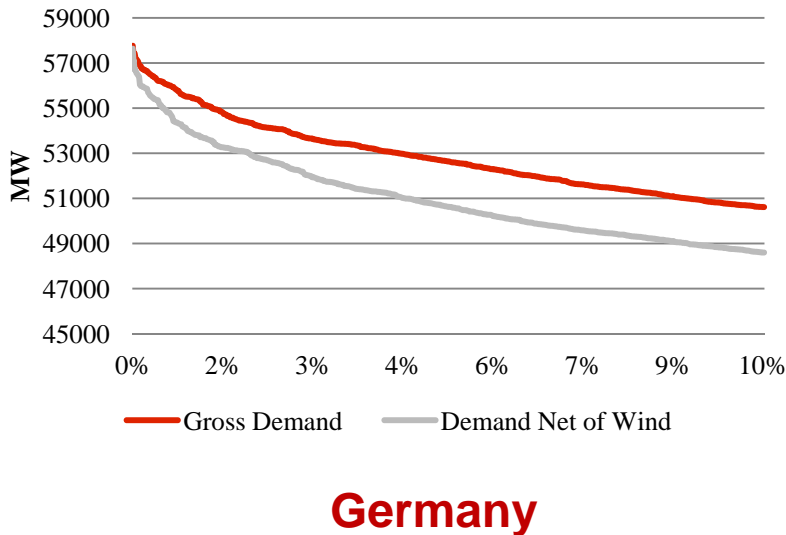
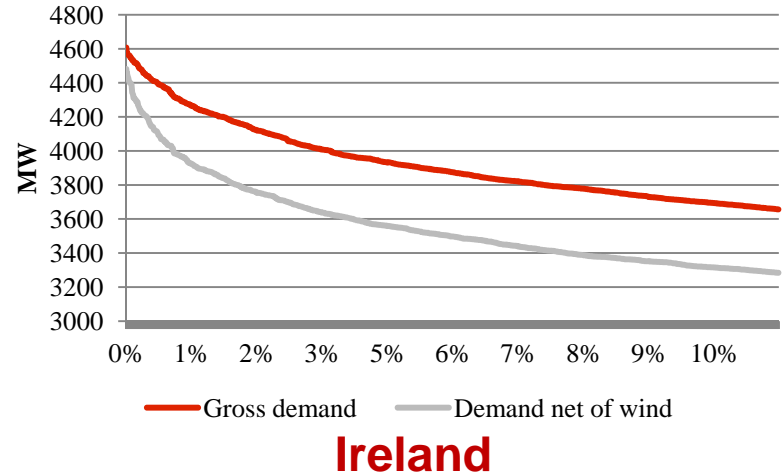
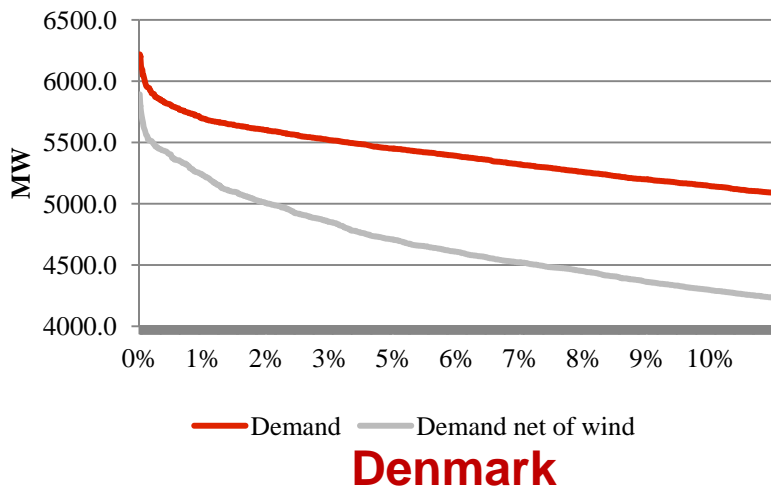
Short-term

- Average price fall and price-volatility across hours increase
- Greater intraday activity
- Higher demand for and prices of ancillary services

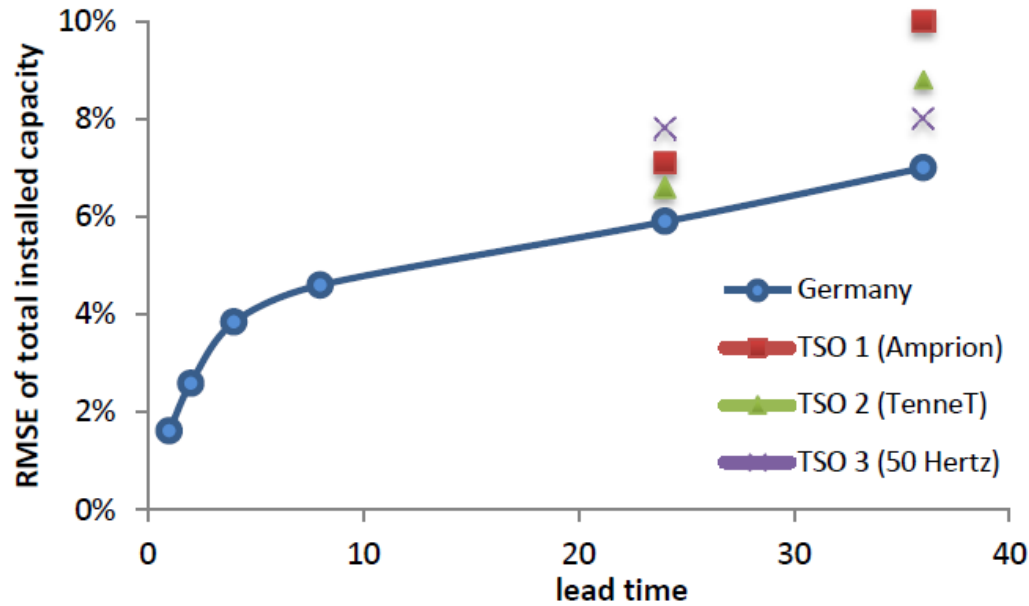
Long-term

- Fewer base-load thermal capacity
- Greater share of flexible thermal capacity (gas) and demand-side flexibility
- Higher price volatility and possibly average price

Load duration curves net of wind 2011 (first 1000 hours)



Larger intra-day activity - Germany

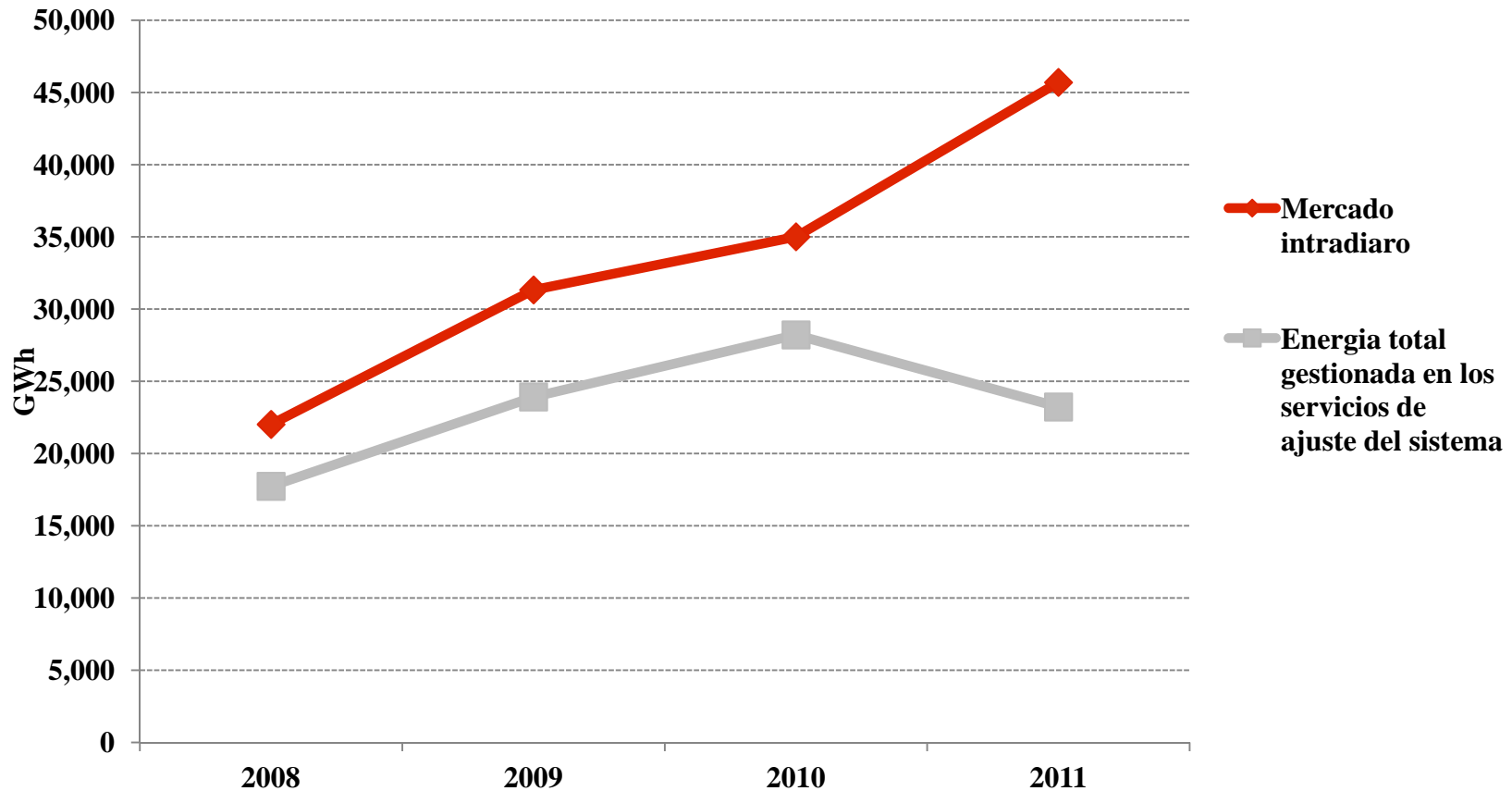


Source: Balancing and Intraday Market Design: Options for Wind Integration
Frieder Borggrefe, Karsten Neuhoff, January 2011

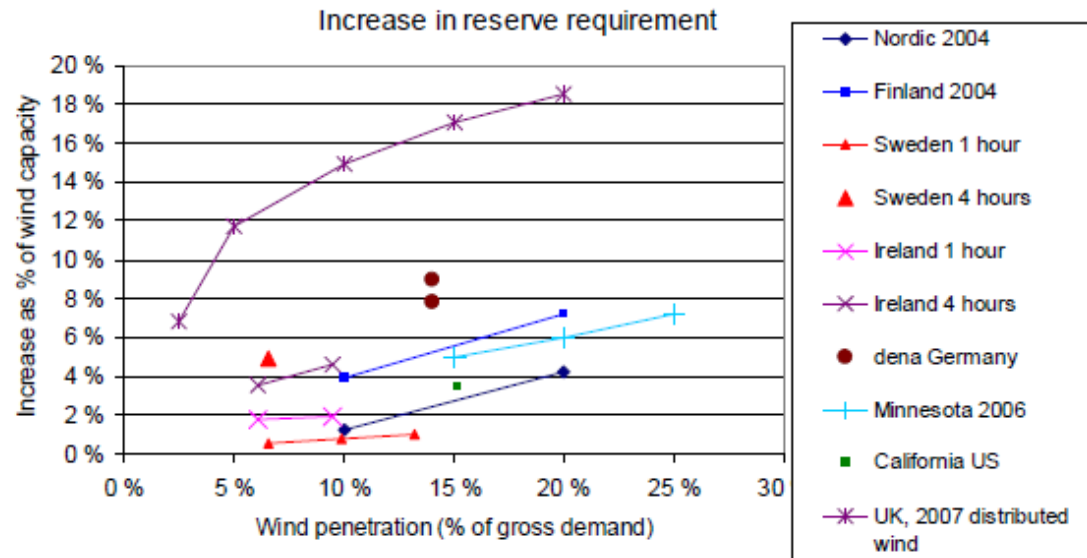
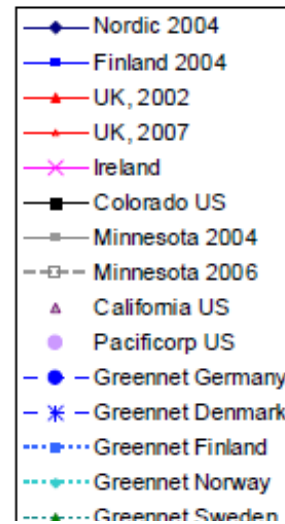
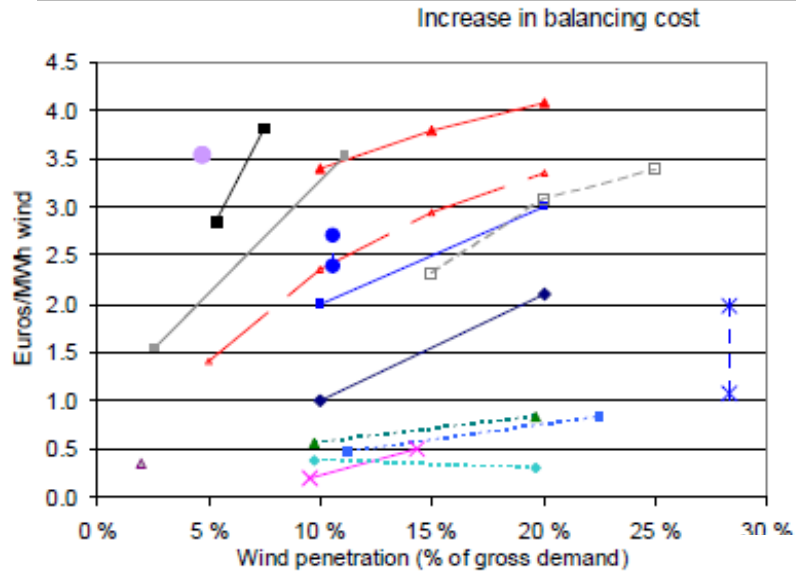
Intraday volumes in Germany increase from 5.66 TWh (2009) to 10.3TWh in 2010

The increase is primarily due to the sale of renewable energy by the TSOs on the EPEX Spot market.

SO and intraday volumes - Spain



Wind penetration and balancing costs

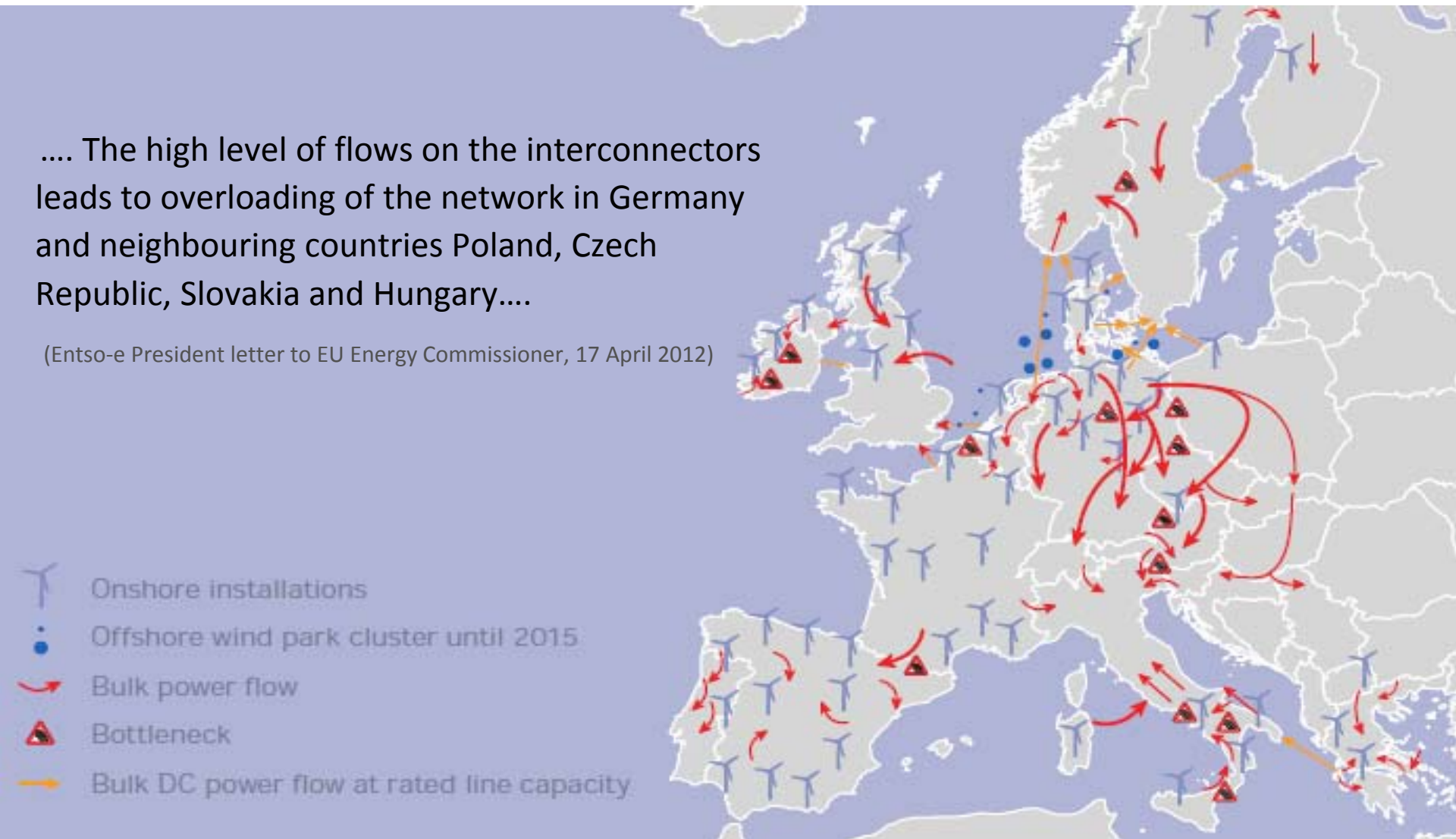


Source: IEA Wind Task 25, Final report phase one 2006-2008

Wind and congestions

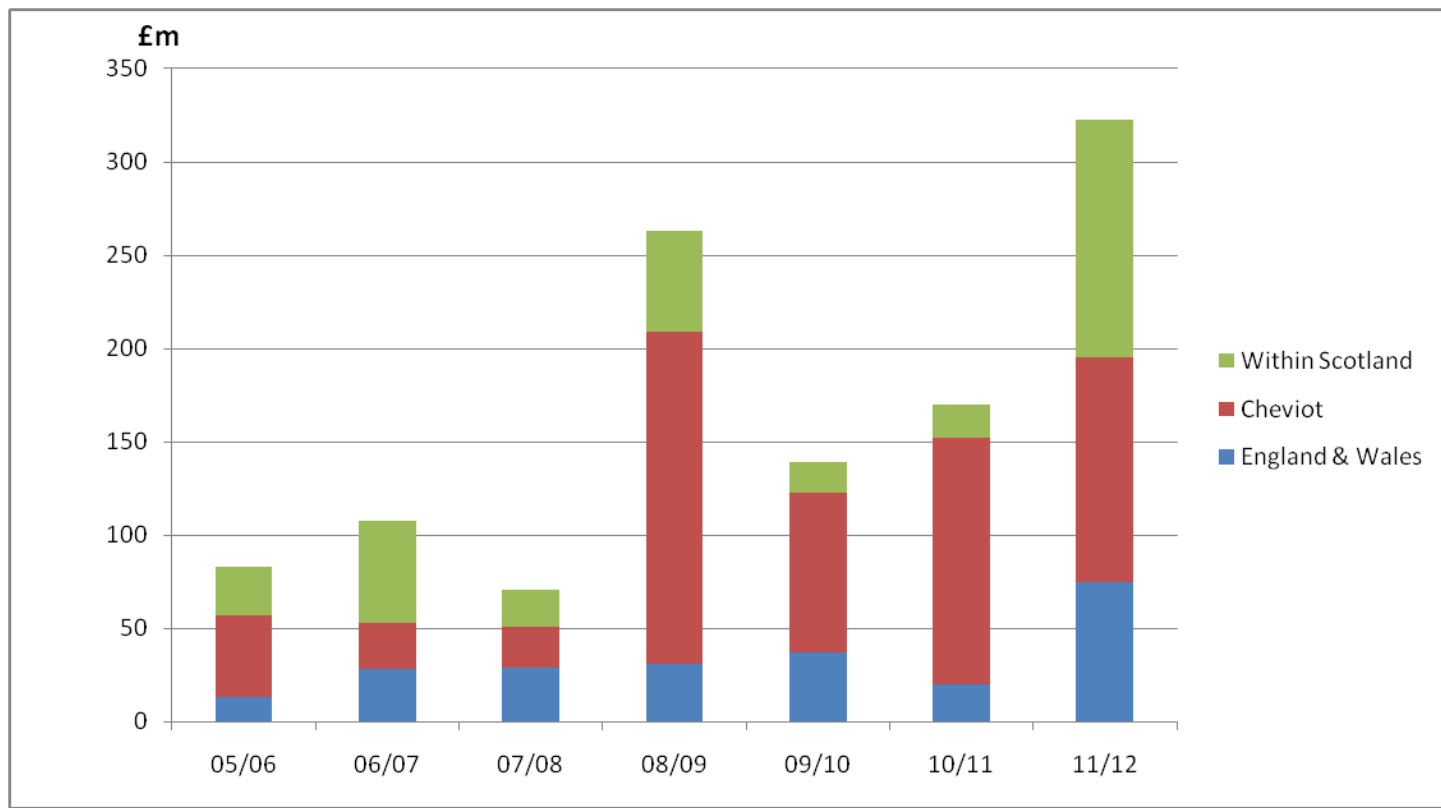
.... The high level of flows on the interconnectors leads to overloading of the network in Germany and neighbouring countries Poland, Czech Republic, Slovakia and Hungary....

(Entso-e President letter to EU Energy Commissioner, 17 April 2012)



Constraint costs - GB

Constraint costs 2006-2011 (Million £)



Source: National Grid

SO costs and renewable curtailment - Germany

- Congestion management cost increase in 2008 caused by high wind generation and reduction in 2009 by low wind

Source: Deutscher Bundestag, 2010, Kunz, F., 2011, "Congestion Management in Germany: The Impact of Renewable Generation on Congestion Management Costs"

- Wind production curtailment (Einspeisemanagement) for network congestion up 69% in 2010 compared to 2009, from 73GWh to 150GWh.

Source: German Wind Energy Association (BWE), Ecofys, Federal Network Agency

SO costs and renewable curtailment - Italy

- SO costs (per MWh consumed)



- Wind production curtailment:

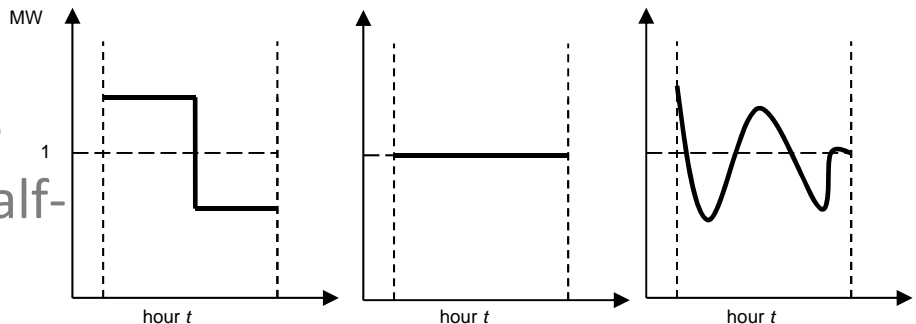
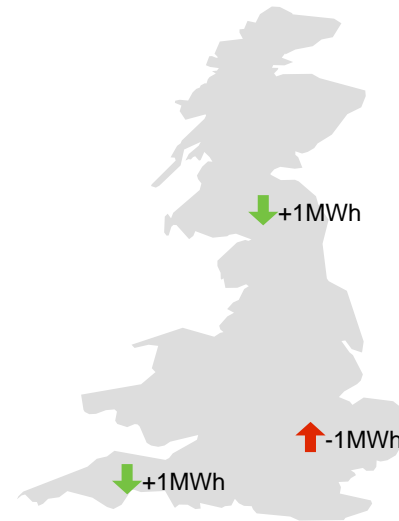
- 2009: 700 GWh
- 2010: 470 GWh
- 2011: 300 GWh

How will the European “standard” market design perform with a larger share of renewables?

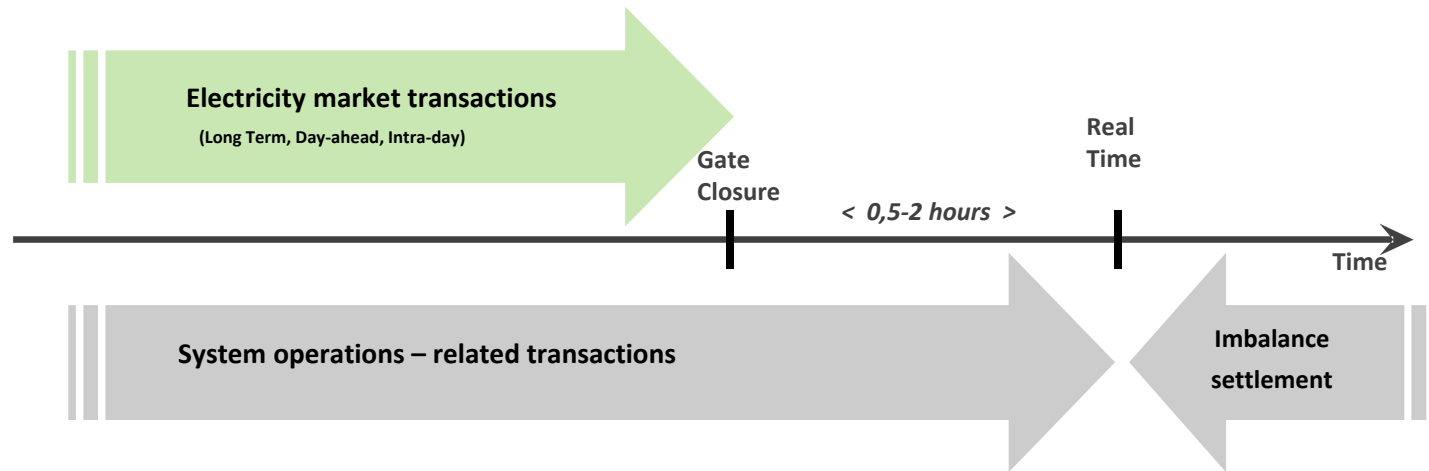
Product standardization of wholesale electricity: the European approach

A high level of product standardization up to (almost) real-time

- 1 MWh scheduled is the same product regardless of where it will be produced or consumed
- 1 MWh delivered or consumed with any time pattern during the same balancing interval (hour, half-hour) is the same product



A bright line between trading markets and ancillary service / balancing markets



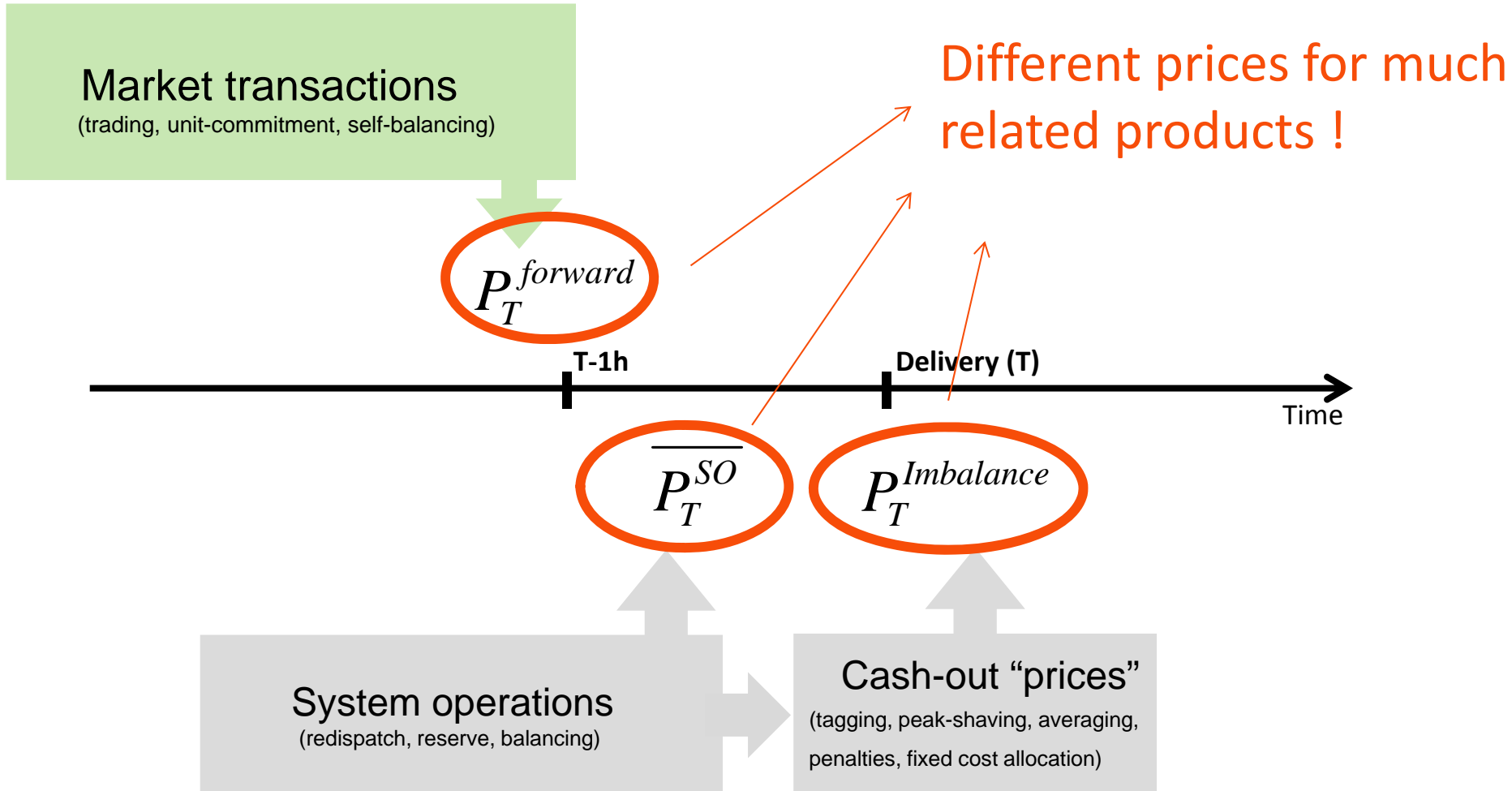
Transactions happen simultaneously close to real-time

- “standard” products: market participants / self-balancing
- “real” products: SO /balancing, reserves, congestion management

Opaque interactions between the two markets

- cross-border capacity to address internal issues (Italy, Sweden)
- SO’s veto right on schedules’ updates (Spain, Belgium)
- “regulated” redispatch markets (German proposal)

Implications /1: a loose connection between “trading” and “system-operations” prices



Implications /2: surplus redistribution and adverse bidding incentives

Lots of redispatch, i.e. market participants paid to “give up” their rights to schedule what they want

Regulatory-antitrust mitigation measures... difficult to implement:

- GB market power licence conditions ...
- Spain: “restriction market” cases
- Germany: regulated redispatch market proposal

Implications /3: short-run inefficiency

Not a necessary result, provided that

- the SO is required to redispatch deeply, i.e. to exploit all trading opportunities with positive net gain
- the SO has the necessary freedom to do that (they can trade in all timeframes)

... but more redispatch makes the “market” outcome less meaningful

Implications /4: generation investment

The “European-style” market design:

- needs some regulatory / administrative elements as part of the price-formation mechanism
- sacrifices some price-cost reflectivity for product-standardization

This produces a certain degree of opacity that may increase risk of investment in generation and in demand-side flexibility

Capacity markets: sweeping the dirt under the carpet?

Conclusion: addressing the increasing role of near real-time transactions

The optimist view: massive network investments will reduce the (price) gaps between standard and “real” products

Otherwise: more regulatory patches (and possibly higher cost of supply) and non-written rules to keep the current system going

Or may be a closer look at the US model?