Governance of electricity networks

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Joint Cambridge-MIT Conference
Electricity Markets
http://www.electricitypolicy.org.uk
Challenges for managing EU networks

• Managing existing network
  – unbundling
  – efficient use of transmission
  – congestion management, plant operation

• Cross-border investment
  – ISO or RTO?
  – Who pays? Cross-border tariffication
  – handling increasing wind penetration
Cross-border Electricity Exchange in EU

Year

1998 1999 2000 2001 2002 2003 2004 2005

Exchange/Consumption

7.5% 8.2% 8.9% 8.8% 9.4% 9.6% 9.1% 10.3%
Physical energy flows 2007

Total: 350800 GWh
UCTE: 304117 Gwh

* Not to be confused with contractual electricity exchanges
Electricity consumption and exchanges in regions in Europe in 2005

UK and Ireland
Cons. 400 TWh
Exch.Int. 2 TWh = 0.5%
Exch.ext. 12 TWh = 3.0%

Central Western Europe
Cons. 1310 TWh
Exch.Int. 97 TWh = 7.4%
Exch.ext. 111 TWh = 8.6%

Iberian peninsula
Cons. 303 TWh
Exch.Int. 12 TWh = 4.0%
Exch.ext. 9 TWh = 3.0%

Italy
Cons. 328 TWh
Exch.Int. 0 TWh = 0.0%
Exch.ext. 51 TWh = 15.2%

Northern Europe
Cons. 388 TWh
Exch.Int. 36 TWh = 9.3%
Exch.ext. 28 TWh = 7.2%

Baltic countries
Cons. 23 TWh
Exch.Int. 2 TWh = 10.0%
Exch.ext. 3 TWh = 13.0%

Central Eastern Europe
Cons. 335 TWh
Exch.Int. 39 TWh = 11.6%
Exch.ext. 70 TWh = 20.9%

South East Europe
Cons. 207 TWh
Exch.Int. 25 TWh = 12.1%
Exch.ext. 20 TWh = 9.7%

Cons. = Consumption
Exch.Int. = Cross-border electricity inside region
Exch.ext. = Cross-border electricity between regions
Cross-border trade

• Under-investment in connecting markets
  – benefits of robustness, competition undervalued

• existing network inefficiently used
  – inadequate arbitrage between markets
  – ETS should reduce price differences
  – but congestion supports market power

• Hampered by vertical integration, opacity
Centred moving average annual PX prices 2004-7

Euros/MWh

NL
UK
ES
FR
DE
Algebraic differences, centred annual averages relative to France, 2004-7

Euros/MWh

1-Jan-00 11-Feb-00 23-Mar-00 4-Jan-00 14-Feb-00 24-Mar-00 3-May-00 14-Jun-00 24-Jul-00 3-Sep-00 13-Oct-00 24-Nov-00 8-Jan-01 19-Feb-01 27-Mar-01 7-May-01 17-Jun-01 28-Jul-01 7-Sep-01 18-Oct-01 28-Nov-01 8-Jan-02 18-Feb-02 31-Mar-02 11-May-02 21-Jun-02 1-Aug-02 11-Sep-02 22-Oct-02 12-Jan-03 22-Feb-03 4-Apr-03 15-May-03 25-Jun-03 5-Aug-03 15-Sep-03 26-Oct-03 6-Dec-03

NL
UK
ES
DE
Absolute price differences between countries, centred annual averages, 2004-7

Euros/MWh
Unbundling

• Apr 08: CEC Report on progress
  – functional unbundling incomplete
  – Interconnectors: unbundled TSOs invest twice as much as legally unbundled TSOs
  – B-D-F-LUX-NL agree flow-based cross-border capacity allocation

• Feb 08: E.ON announces divesting networks
  – June 08: RWE plans to sell of gas network
Integrating markets better

• improved use of interconnectors could
  – reduce market power
  – lead to more efficient dispatch
  – lower average costs

• TLC (APX) market coupling useful example
Efficient use of network

- Florence Forum: ETSO+Europex to address capacity allocation by March 2008
- CB auctions + PXs inefficient, replace with:
  - market splitting: Nordpool, Mibel
  - market coupling: TLC = NL+BE+FR
  - transmission models: NTC => flow based
  => intraday markets and balancing

*Incremental but slow progress*
Day-ahead allocation
Jan 2007

Implicit auction
Explicit auction
No congestion
Access limitation
Other method
Cross-border investment

• 3rd Energy Package: 10-yr investment plan should be published by TSOs every 2 years
  => First UCTE plan published June 08
  +90 GW consumption
  +220 GW generation (o.w. 80 GW wind)
  mismatch makes transmission planning hard
  – mostly planning to undertake “studies”

• € 17 billion *should* be invested over 5 yrs

*Most TSOs lack locational price signals*
Comparison of transmission tariffs G+ L: impact of location

Locational pricing rare
Interconnection

- Under-investment in connecting markets
  - benefits of robustness, competition undervalued
- Optimal transmission investment needs information on generation investment plans
  - when, where and what (wind or dispatchable?)
  - wind increases need for interconnection
- Hampered by vertical integration, opacity
- Who pays and how?
Financing interconnection

• Who should pay? Beneficiaries?
  – Easy with merchant lines and zonal pricing
  – Norned very profitable
  – but vulnerable to future investments in G and T
  – and incentive to under-invest

• Resilience and reduction of market power undervalued

*How well does current compensation work?*
Inter-TSO compensation (ITC)

- 2002: 8 TSOs sign voluntary ITC agreement
- 2004: regulation 1228/2003 effective, guides ITC
- Florence process to choose ITC
  - ETSO prefers With & Without Transits method: WWT
  - IIT proposes Average Participation method: AP
- 2007: 28 (+7?) countries agree ITC for 2008/9
- Choice will impact transmission charges
  - and returns to cross-border transmission investment
IIT study for 2002 for DGTrEn

- Based on 24 hour/month flows
  - assumes 35,200 Euro/km/yr cost of 400kV line
- Switzerland, CH, as example (key transit zone)
- CH data in MW:
  G=5,197, L=4,499, X=3,489, M=2,932
  net X-M=557 (cf F at 8,194, I at 5,693)
  transit=2,932 (second after DE at 4,438)
Starting from European flows look at CH
Payments (Provisional Method) for 2002

Payments by countries mill. euros

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Total use of CH’s network =34.6, use by CH =22.4, so net receipt by CH is 12.3 m Euros
### Payments under WWT method

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CH’s network used 162.5, uses others 105.2, receives 57.2
Payments under AP method

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CH’s network used 155.6, uses others 132.6, receives 22.9
Non-zero sum games

- CBT for existing network is zero-sum game
  - unlikely to lead to efficient pricing
- New cross-border links should add value
  - issue is how to finance to deliver net gains
=> Leave agreed CBT for existing network?
- Design mechanism for new links
  - planning agency selects best projects
  - simulates gains, proposes charges to TOs
  - tenders for construction
The challenge of renewables

• 20% EU renewables target by 2020 agreed
  =15% renewable ENERGY for UK
  =30-40% renewable ELECTRICITY
• likely to be large shares of wind
  – Much in Scotland: queue of 11 GW, 9GW Wales
• At 25% capacity factor, 25% wind
  = 100% peak demand
=> volatile supplies, prices, congestion, ….
Transmission and market design

• Standard EU model: small PX (<10% G), self-dispatch, SO balances
  – decentralised, simple cross-border trade
  – not well-suited to intermittent generation

• US model: nodal pricing, central dispatch, combined balancing, closer to Pool model
  – more efficient dispatch
  – simplifies access of intermittent generation
Ability to vary thermal output

- Coal 10 Oct 2005
- Gas 22 Nov 2005
- Renewables 25 Nov

Renewables relative to mean for period

GWhrs/half hour

10 Oct 2005
22 Nov 2005
25 Nov
Efficient congestion management

- Nodal pricing or LMP for optimal spatial dispatch
- All energy bids go to central operator
- Determines nodal clearing prices
  - reflect marginal losses with no transmission constraints
  - Otherwise nodal price = MC of export (or MB of import)
- Financial transmission contracts hedge T price risk
More wind => more volatility

Price duration schedule
Implications of substantial wind

• Much greater price volatility
  – mitigated by nodal pricing in import zones
  – requires CfDs and nodal reference spot price
• Encourages interconnectors (esp to Norway)
• Coal and gas for peaking/balancing?
  => Greater need for wider area balancing
  => increased need for contracting (good)
  => further stimulus to integration? (not so good)
Conclusions

• Improved management => easy gains
  – needs unbundling/ISOs and market coupling
  => move to wide area nodal pricing?
• Increased interconnection
  – reduces market power, aids renewables
  – needs financial model, detach from CBT
• Wind => volatility => increases gains from better transmission management
Governance of electricity networks

David Newbery

Joint Cambridge-MIT Conference

Electricity Markets


http://www.electricitypolicy.org.uk