The impact of wholesale market and system operation arrangements on Renewable Energy Support – case studies from Europe, Australia and New England (USA)

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Wholesale market arrangements

- Wholesale market design refers to how generation is offered to the market and traded within it

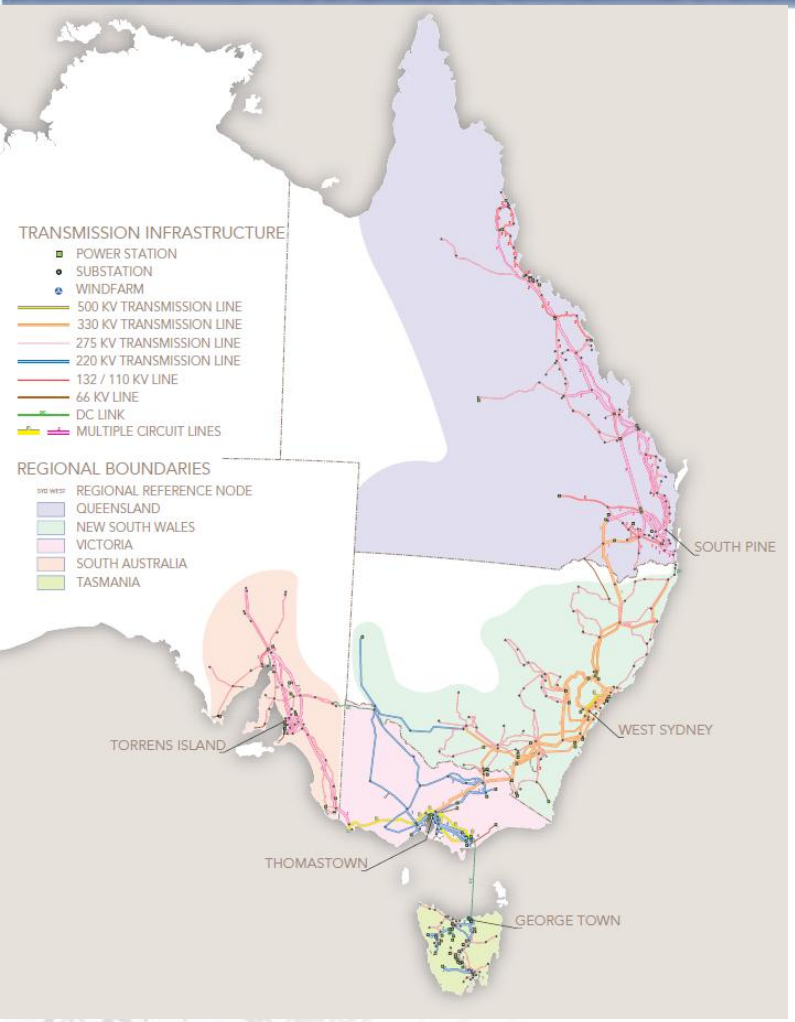
Aspects taken into consideration:

- Gate Closure times (GCTs)
- Responsibility for balancing and forecasting
- Cross border capacity allocation

System Operation

- System operation rules define how the system is operated by the TSO
- ↑ RES: important to readjust system operation rules, due to specific characteristics of RES
- System services maintain system stability and operational security
- System services: reserve capacity, frequency response, black start process, balancing

Case Study 1: Integrating RES in South Australia



Regions and networks in Australia's National Electricity Market (http://www.aemo.com.au)

- South Australia: 17% wind power generation
- National Electricity market (NEM): 2 % wind power generation
- Australian Energy Market Operator (AEMO) is the coordinating system operator

National Electricity Market

- NEM
  - operating under a bid-based security constrained dispatch
  - co-optimises the costs of meeting demand and maintaining system frequency
  - Market prices are calculated every five minutes → Flexibility
- Frequency Control Ancillary Services (FCAS)
  - FCAS maintain the frequency of the electricity system within required limits by ensuring that total generation matches total load in real time
  - ‘causer pays’ arrangement

Recent NEM reforms:

- NER were changed to allow wind generators to be integrated into the NEM dispatch process
- Implementation of a new centralised wind energy forecasting system

High potential of Wind in South Australia

- Could potentially affect network security
- Two impacts that need to be considered
  - Voltage must be maintained within specified tolerances
  - Wind generators are generally of small size – provide little system inertia – frequency fluctuations
- South Australian Government introduced a number of new technical requirements for generators:
  - Ability to remain connected and ride through faults
  - Ability to smooth short term fluctuations in output, produce and absorb reactive power

Standards are considered to be consistent with global best practices.

Case Study 2: The integration of RES in Europe

www.worldatlas.com

Wind Energy:

- Greatest Share of RES being developed in the EU over the past 10 years
- In 2009, wind power accounted for 39 % of all new European energy capacity installed

The implications of market design and system operation arrangements on RES

- GCT (gate closure time) arrangements
- Cross border capacity allocation
- Balancing obligations on renewable energy and the role of the TSO in balancing
- Centralised or decentralised systems to forecast non-programmable renewable energy generation
- Provision of network/system services by renewable energy installations in order to react to both changing meteorological and grid conditions
- TSO's orders to reduce wind production

GCT & Cross border capacity allocation

- Different GCT for day ahead market and intraday market
- RES is hard to forecast – especially wind energy
- Spain: cross border capacity allocation procedures are in place with respect to interconnections with Portugal and France
- Germany: different GCTs for each cross border capacity allocation

Balancing obligations on RES generators and the role of the TSO

- **Italy:**
  - Priority dispatch of RE
  - The TSO can require wind generators to reduce the instant power production (demand/load is low or null, security reasons)
- **Great Britain:**
  - Generators self-despatch their plants
  - Low generation price, low load factor from RE
  - Penalisation through imbalance setting (cash-out)
  - UK government: review of cash out price mechanisms
- **Germany:**
  - All RE installations have to be connected to the grid by the grid system operators
  - RE electricity may be fed into the grid at any time.
- **Spain:**
  - renewable generators are subject to the same balancing obligations as conventional forms of generation

Systems to forecast non-programmable renewable energy generation

- **Italy**
  - RES generators are not responsible for their imbalances → relevant cost = fully socialised
  - TSO = responsible
- **Spain**
  - a weather forecast centre managed by the TSO has been created to deal with the uncertainty of renewable energy flows
- **Germany**
  - TSO play a role as “marketer” for electricity
- **Great Britain**
  - TSO forcasts likely levels of wind generation using historical outturn data and detailed local wind forecasts
  - Shift to new system using three models

Provision of network/system services

- **Italy**
  - Mid-1990s: no system services for wind was required
  - Survey: TSO's needs concerning grid services - should be required from existing and planned wind plants
  - only a few of the oldest wind plants could be upgraded with new grid service technologies
- **Spain**
  - All RES generators with > 10 MW of installed capacity must follow reactive power instructions from the TSO in real time
  - Non programmable RES providers can only participate in network services when reducing production when needed for operational security
  - Wind >10MW, PV>2MW need immunity against voltage dips.
- **Germany**
  - New wind generation units need to fulfil certain technical standards to receive a feed in tariff.

Case study 3: The integration of RES in New England (USA)

www.discovernewengland.org

- USA: decision to impose RES requirements and goals is left to individual states
- ~36 states have such requirements
- Regional market: group of states participate
- FERC: Federal Energy Regulatory Commission
- Independent System Operator of New England (ISO-NE)

New England

- 1.5% of the total resources available in ISO-NE → intermittent generation
- Increased emphasis on RES
- FERC recently issued a notice of proposed rulemaking on Integration of Variable Energy Resources
  - Intra-hour transmission scheduling
  - Meteorological and operational forecasting data
  - Ancillary markets → balancing

Existing market design

- GCT:
  - FERC proposes to require protocols that allow scheduling at intervals of 15 minutes
  - The gate closure and clearing times differ from one market to another
- Balancing obligations on RES generators
  - ISO-NE utilises a regulation market to address balancing issues
  - not yet altered the reserves due to increased renewable resources

Existing Market Design

- Forecast system
  - is currently intended to forecast necessary load, and is not designed to address expected production from variable generators
- Dispatch
  - No priority dispatch for RES
- Provision of network/system services
  - no requirement for variable generators to provide grid services in the electricity market

Thank you for your attention!

www.energy-regulators.eu