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Facilitating the integration of wind energy into the Australian National Electricity Market – the role of market design

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IAEE International Conference – Bridging Energy Supply and Demand
Istanbul, 18-20 June 2008

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Wind energy's diverse values

- Energy
  - depends on investment + operational costs compared against benefits of energy provision + alternative supply options
  - *significant temporal + locational variability + uncertainty determined by desired energy services, combined investment + operational characteristics of all demand + generation*
- Environmental
  - greenhouse emission reductions – depends on other generation options and has relatively little temporal + locational variation
  - regional air + water benefits, amenity costs
- Social
  - possible investment + job outcomes with industry development

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The wind facilitation challenge

- Maximise total energy, environmental + social values of wind
- For high wind penetrations, maximising energy value becomes more challenging
  - 'best' windfarm sites may be taken early
  - Increasingly significant integration costs
    - *network connection* + *management*; match of wind with existing Tx + Dx
    - *security*; particularly wrt possible large + unexpected aggregate regional or system-wide swings in wind power production
    - *economic operation* + *investment*; implications for other generation of highly variable + somewhat unpredictable low-operating cost wind power
- Key electricity industry issues
  - How well do industry arrangements mesh underlying economic energy value with commercial signals to market participants?
  - *…and in particular, wrt new technology + participants*
    - *Wind the first significant generation with a highly variable, somewhat unpredictable + non-storable primary energy source*
    - *Now testing the adequacy of industry arrangements around the world*
  - Interactions with specific renewable policy support measures

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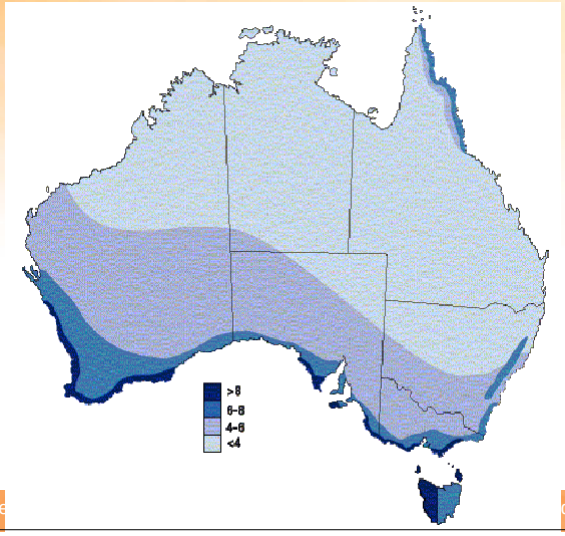
The Australian wind resource

(Simple estimates of background wind – Australian Greenhouse Office)



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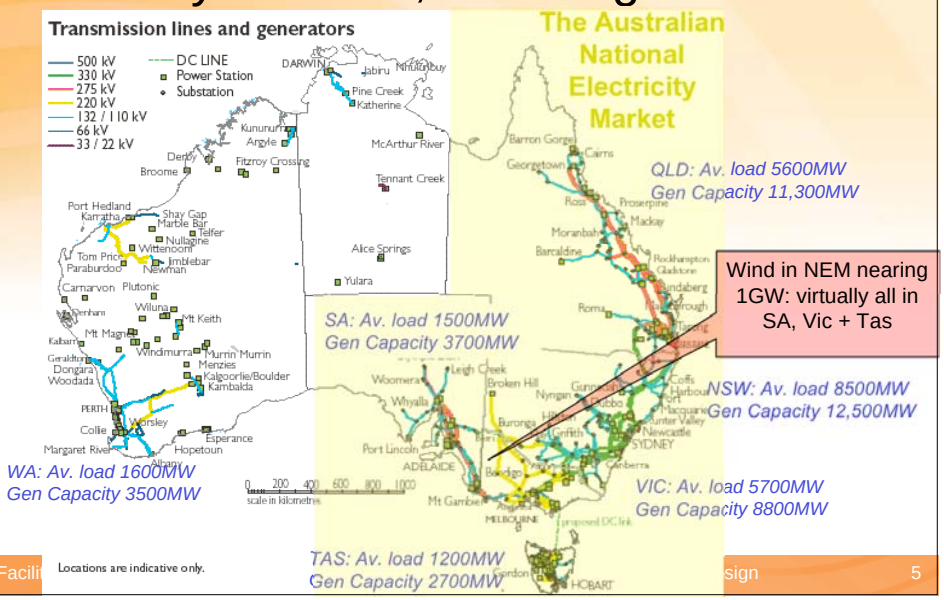
Electricity demand, Tx and generation



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Features of National Electricity Rules (NER)

- NEM covers all participating states:
  - A multi-region gross pool with intra-regional loss factors
  - Spot market hybrid 5/30 min (dispatch/commercial)
  - 8 Frequency Control Ancillary Services markets for < 5min
  - No capacity market or equivalent; participants determine unit commitment through energy spot market bidding strategy
  - Centralised projections – day ahead, 1 week (STPASA), 2 years (MTPASA) and 10 years (Statement of Opportunities)
  - Operated by NEMMCO (owned by states)
- Compulsory participants in NEM:
  - All dispatchable generators & links > 30 MW (unless intermittent)
  - Network service providers & retailers
- Networks
  - Regulated monopoly NSPs obliged to provide non-discriminatory access; technical connection standards, 'shallow' connection costs
- Outside formal NEM rules + arrangements…
  - Range of OTC + exchange derivative markets used to manage spot price risk + underpin investment

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The changing status of wind in the NEM

- Non-scheduled
  - *Existing category for intermittent gen – wind treated as negative demand*
  - Can only be curtailed for system security or key network issues
  - Don't pay for FCAS
  - *Recent changes:* technical connection standards relevant to wind generators
  - Historical windfarm outputs published
  - Centralised wind forecasting system (AWEFS) in progress
- Scheduled
  - *South Australia currently requires new wind farms to register as scheduled*
  - Submission of dispatch offers
  - Compliance with targets
  - Causer-pay for ancillary services
  - Ability to offer ancillary services
  - Publication of individual outputs:- forecast, offered & actual
- Semi-Scheduled
  - *Specifically intended for intermittent gen >30MW + compulsory from March 2009*
  - Submission of dispatch offers
  - Causer-pay for ancillary services
  - Ability to offer ancillary services
  - Are treated as positive supply
- If involved in a constraint
  - Compliance with targets if less than forecast

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Facilitating wind integration in the NEM

- Current market design relatively supportive
  - Supply/demand balance for energy + FCAS via gross pool, not mainly bilaterally
  - Transparent regional prices for all market participants that reflect considerable locational, temporal and uncertainty value of electricity
  - Potential for 5min rebidding lets all participants revise offers with improving forecasting information + creates strong incentives to enhance short-term operational flexibility
- Wind as non-scheduled generation
  - Generates whenever wind is blowing (possibly s.t. to N/W constraints)
  - Operate as "price takers" although high penetrations will impact prices
  - Value of wind energy depends on region + intra-regional location, + how regularly wind farms producing when spot prices are high
    can be reasonably good correlation seasonally and daily cycle
- Market enhancements
  - Historical SCADA information for major windfarms published
  - NEMMCO has interim and progressing major Forecasting System (AWEFS)
    - Forecasts from 5 min to 2 years, windfarm level and regional aggregations, + including uncertainty estimates
  - More formal participation by wind in the NEM – a price of success

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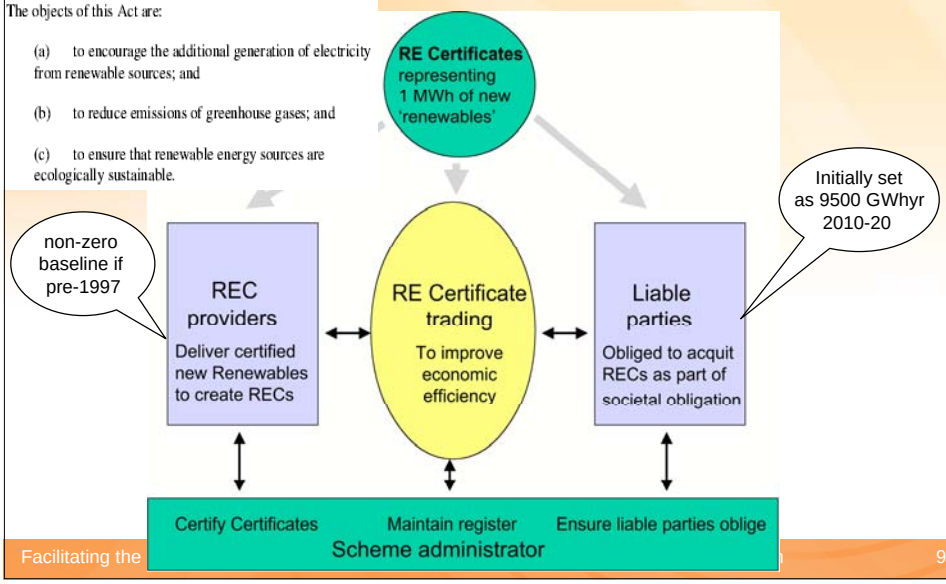
MRET – a 'designer' market

The objects of this Act are:

(a) to encourage the additional generation of electricity from renewable sources; and

(b) to reduce emissions of greenhouse gases; and

(c) to ensure that renewable energy sources are ecologically sustainable.



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MRET performance

- The good
  - Facilitates integration of renewables into NEM
    - Provides additional revenue above energy mkt revenue; for existing projects typically order of 50% of cashflow is from RECs
  - Modest ramping target easily met + considerable new investment
  - Apparent efficiency – highly competitive RECs market with low project costs by international standards
  - Technology flexibility has proved valuable
    - eg. biomass an expected winner but slow uptake in practice => wind + other technologies filled the gap
- **However**
  - Inappropriate baselines for 'old hydro' – *a failure of governance*
  - Boom + Bust cycle due to fixed end-date (2020)
  - Considerable regulatory uncertainty has significant price impacts

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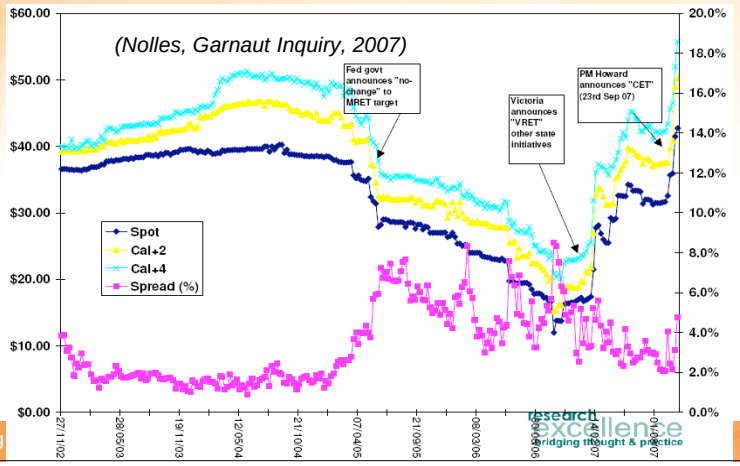
The REC market

- Little liquidity (+ hence price discovery) for forward prices through trading
  - Most projects financed via PPAs or other direct contracts
- Prices vulnerable to regulatory change
  => potential challenges in driving investment & industry development



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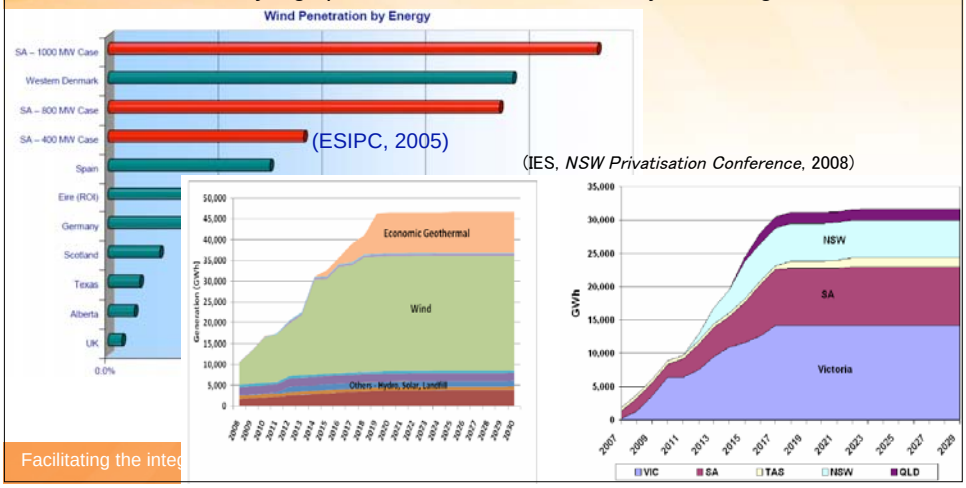
Now, wind penetrations set to rise significantly

- New Renewable Target of 20% by 2020 might see 10GW of wind
  - Note that scheme expansion rules still to be finalised
  - Possible very high penetrations in SA + Vic; a major challenge for NEM



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Conclusions

- NEM
  - Infused with uncertainty – *a key to driving competition*
    - Generators can rebid with 5 min notice, don't know dispatch beyond 5 min
  - Some success in commercialising costs + benefits
    - Spot/forward markets price current/future uncertainty for all generators
    - FCAS markets set frequency ancillary services costs
    - Principle of 'causer pays' although difficult in practice
  - Formal objectives of equal treatment… although difficult in practice
- Wind
  - Currently unscheduled generation + outside many NEM processes
    - NEMMCO has very limited opportunities to direct behaviour yet remains accountable for maintaining system security
  - Already 'sees' many of NEM's commercial signals; reasonable that they 'see' more of costs + benefits they bring to NEM + society
  - Wider environmental + industry development value needs to be recognised with 'external' policy support

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