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Experience to date and prospects for wind energy in the Australian National Electricity Market

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NSC ATSE DIISR Australia Taiwan Strategic Workshop
Sydney, 21-22 May 2009

www.ceem.unsw.edu.au

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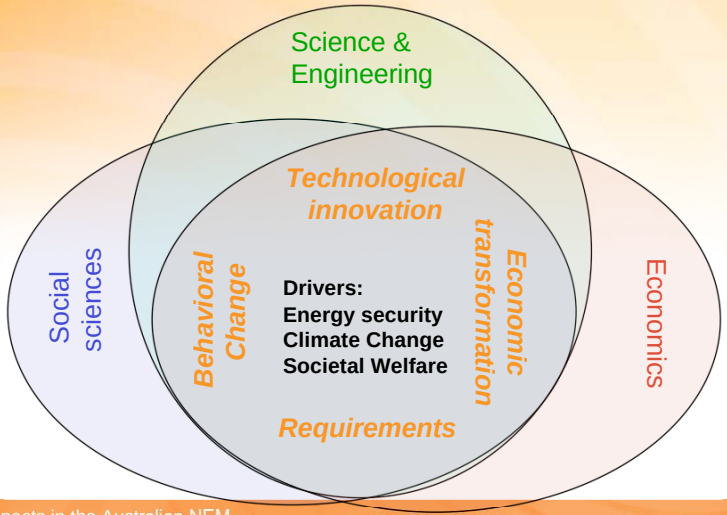
Key interdisciplinary perspectives & tools required to address our energy challenges



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CEEM established …

- *A formal collaboration between the* **Faculties of Engineering, Business (Economics and Management),** also Arts and Social Sciences, Science, Law
- *through UNSW Centre* aiming to provide Australian research leadership in interdisciplinary analysis + design of energy and environmental markets
- *focussing in the areas* of
  - Energy markets within restructured electricity industries
  - Related environmental markets – emissions trading, renewable obligations, energy efficiency certificate trading, Greenpower…
  - Wider policy frameworks and instruments for achieving overall energy and environmental objectives including technology innovation, infrastructure, energy efficiency, behavioural change…

Wind prospects in the Australian NEM 3

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Some current CEEM research efforts

- Facilitating wind and PV integration in the NEM
  - Energy market design, forecasting and operation
- Renewable energy policy support options in restructured industries
  - MRET, proposed expanded Renewable Energy Target, feed-in tariffs
- Emissions Trading Schemes + options for Australia
- Modelling participant behaviour in energy + environmental markets
  - Interactions between spot and derivative markets
- Technology assessment for sustainable energy policy frameworks
  - Energy efficiency, gas + cogeneration, renewables, CCS, nuclear
- Economic modelling of Distributed Energy
- Energy efficiency policy – regulation, financial mechanisms
- Policy frameworks for technology innovation
- Sustainable energy services in the developing world

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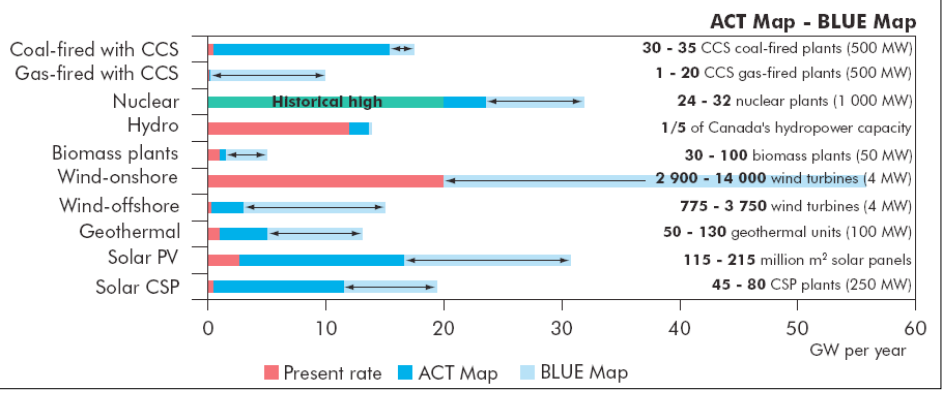
Wind – proven potential for low-carbon energy futures

- Likely a key role for climate protection in short-med term
  - Eg. IEA *Energy Perspectives Scenarios* (BLUE = 450ppm) for 2050 suggest wind could contribute 3 X Coal CCS, 2 X nuclear

Figure ES.3 ▶ **Additional investment in the electricity sector in the ACT Map and BLUE Map scenarios (compared to the Baseline, 2005-2050)**



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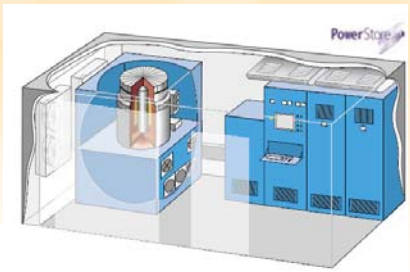
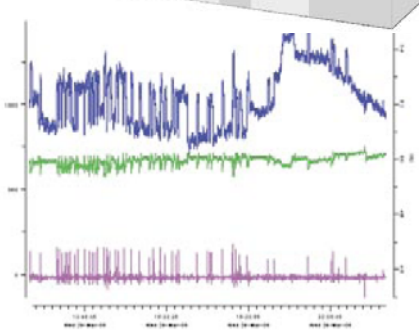
Australian wind technology development

- High penetration wind -diesel systems
  - Eg. PowerCorp.



The solution that helps things run smoothly.

The graph shows operation of the PowerStore installed on Flores Island at 04:24:53, Thursday 30th of March, 2006.



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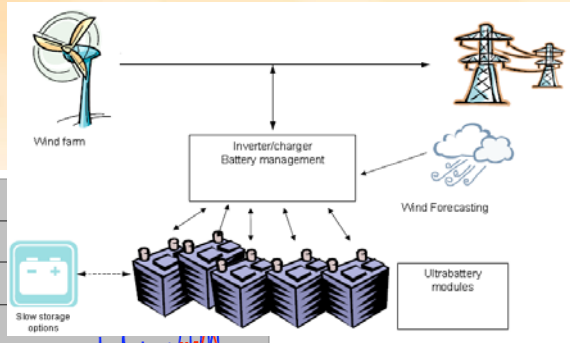
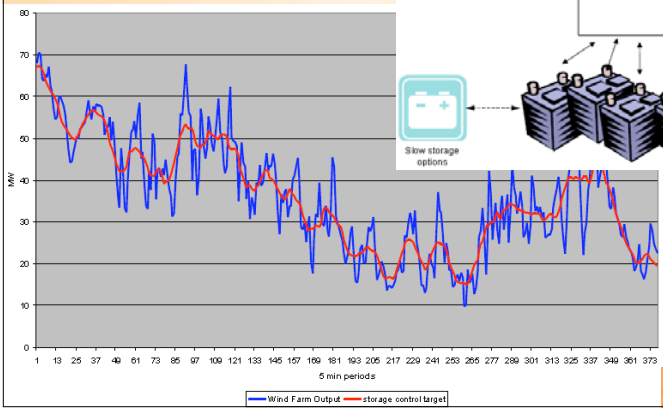
Australian wind technology development

- Grid connected wind + energy storage: CSIRO





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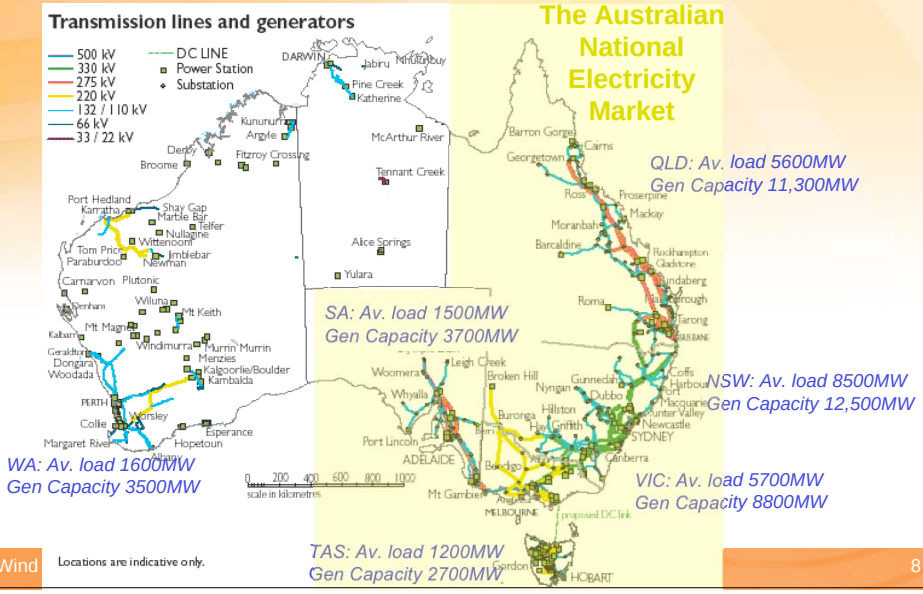
Electricity demand, Tx and generation



Wind

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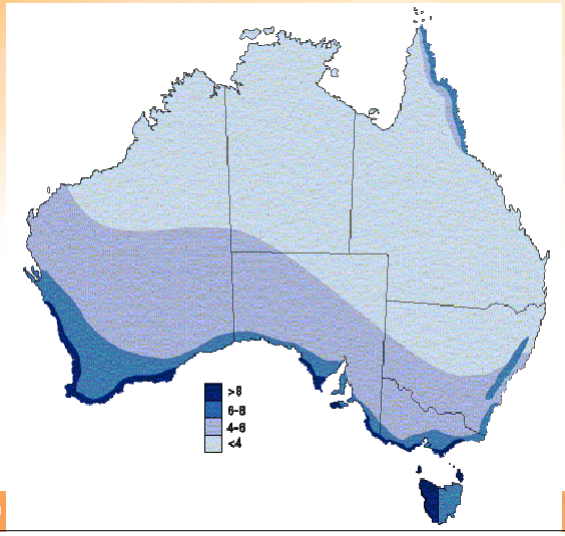
The Australian wind resource

(Simple estimates of background wind – Australian Greenhouse Office)



Wind prospects in 9

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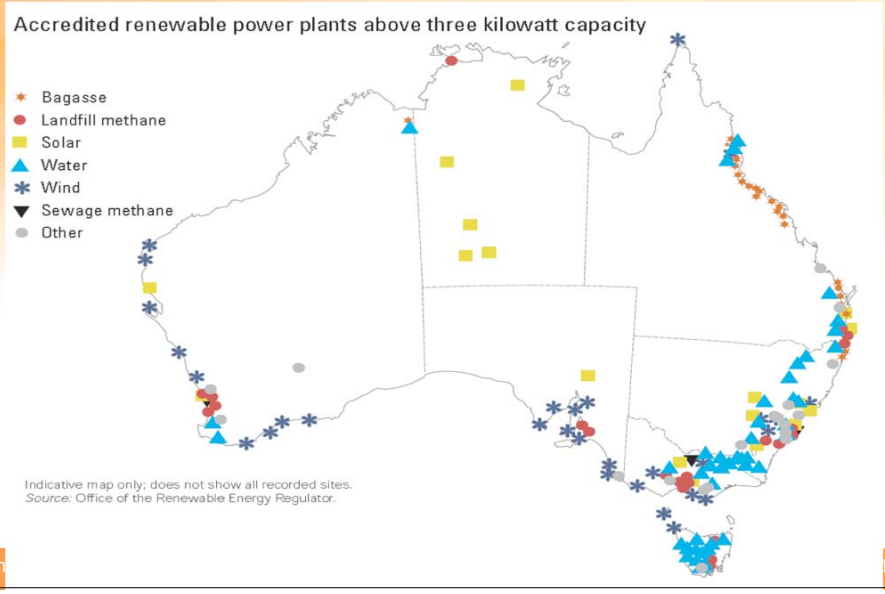
Renewable Energy generation locations



Win 10

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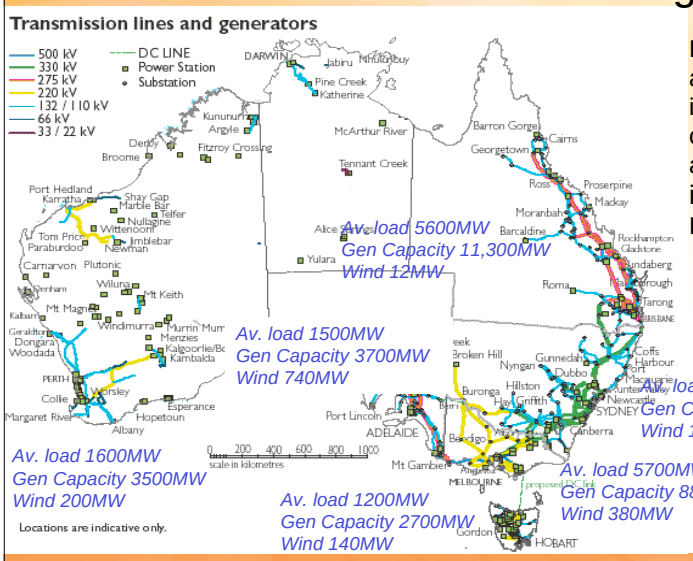
Current status of Australian wind generation



Estimated state average load, total installed generation capacity and approximate wind installed (ausWEA, ESAA)

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The wind integration challenge

- Maximise total energy, environmental + social values of wind
- For high penetrations, maximising energy value gets harder
  - 'best' sites taken early, increasingly significant integration costs
    - *network connection + management*; match of wind with existing Tx + Dx
    - *security*; particularly wrt possible large + unexpected swings in wind gen.
    - *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 intermittent generation: now testing the adequacy of industry arrangements & governance around the world*
  - Interactions with specific renewable policy support measures

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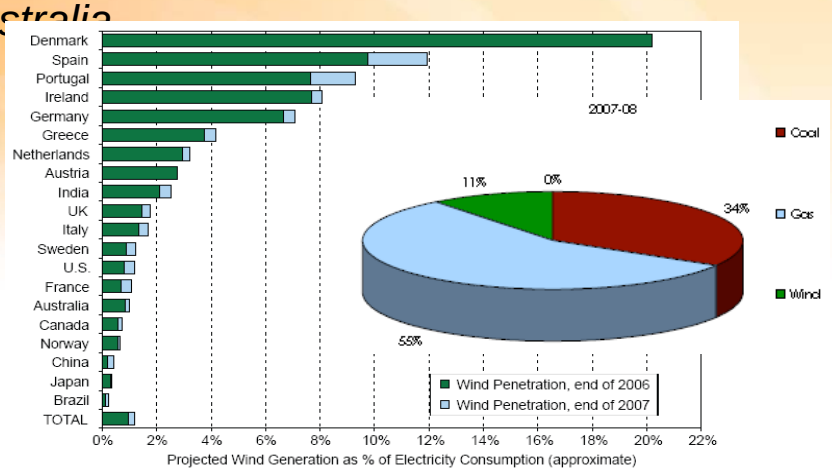
Wind significant contributor in growing number of electricity industries… *including South Australia*



Source: Berkeley Lab estimates based on data from BTM Consult and elsewhere.

Figure 4. Approximate Wind Power Penetration in the Twenty Countries with the Greatest Installed Wind Capacity

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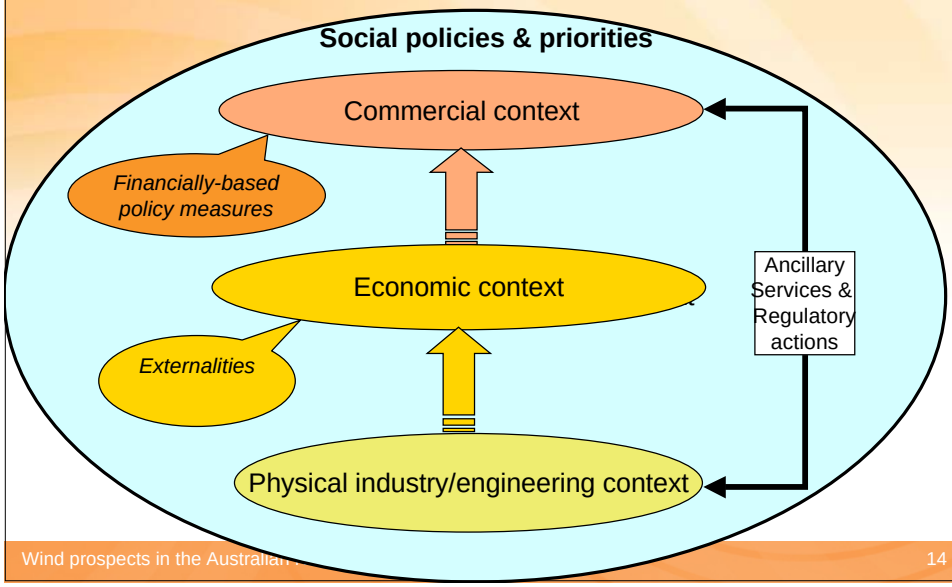
Various contexts of wind energy integration



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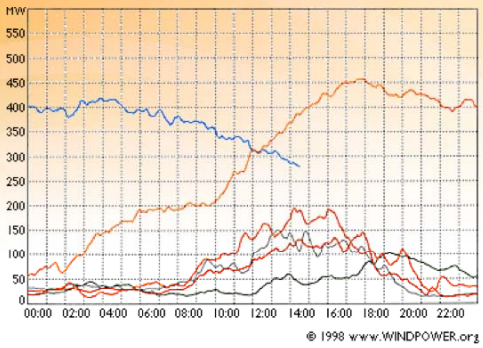
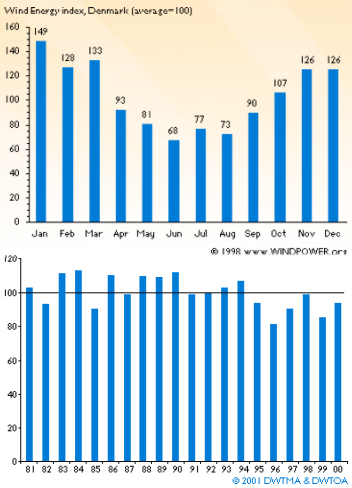
Wind power rather variable

(Danish Data, www.windpower.org)





Short-term, daily, seasonal and annual variations in wind speed

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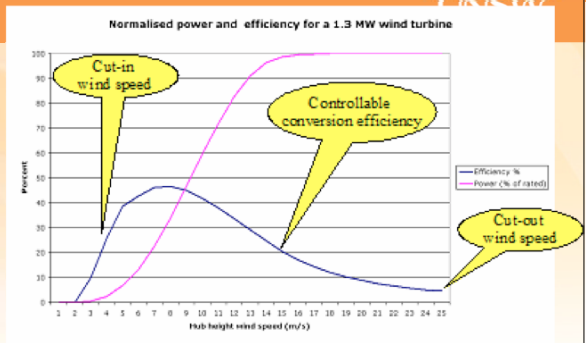
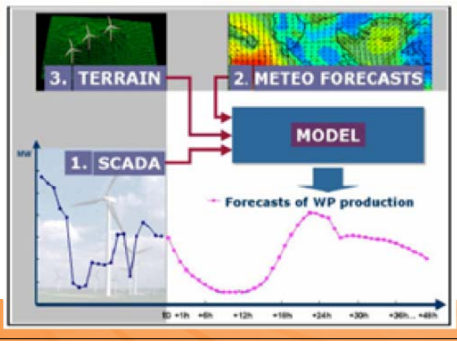
Wind generation

- Somewhat controllable



- ..and somewhat predictable



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Wind and the NEM technical regime

- EI requires high levels of coordination and 'good behaviour'
- Standards
  - **System:** required security, reliability & quality levels
  - **Access:** levels of plant performance required to connect. Technology standards that assure compliance with Access
  - *Challenges in appropriate alignment of system and access standards*
- Considerable challenges for new techs eg. Wind
  - Rules generally evolve from historical practice and technologies
  - potentially more onerous standards for new entrants than incumbents
- Ongoing efforts underway and likely to continue
  - Technical Standards for Wind Generation and other Generator Connections (2007)
  - AEMC Reliability Panel Technical Standards Review (Draft Report, 12/08)

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Some key wind challenges

- Forecasting
  - to inform & assist decision making by NEM participants
  - Security implications for NEMMCO, commercial implications for all market participants
  - Centralised forecasting AWEFS near deployment
- Formal wind participation in NEM scheduling + cost allocation
  - Licensing conditions in SA that wind register as 'scheduled' generation
  - New 'Semi-scheduled' generation category for intermittent renewables
  - A necessary price for success
- Transmission investment
  - Wind farms (and other potential renewables) often located in remote areas without major Tx
  - Current NEM arrangements may not facilitate timely and efficient Tx investment to support renewable generation through new lines & congestion management
  - Work underway as part of AEMC Review of Energy Market Frameworks in light of Climate Change Policies, (Discussion paper, 04/09)

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New commercial regimes relevant to wind

- **Expanded National Renewable Energy Target**
  - exposure draft legislation 12/08
- Carbon Pollution Reduction Scheme
  - exposure draft legislation 12/08
- Demonstration & commercialisation funding
  - $500M Renewable Energy Fund
  - $500M National Clean Coal Fund … and counting
- *numerous diverse State Government policy efforts*

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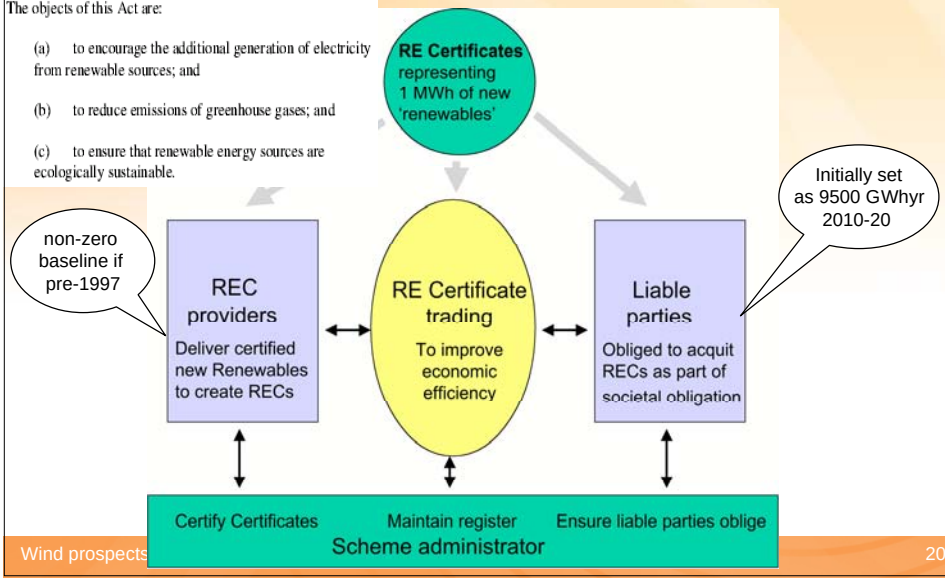
MRET – a 'designer' market

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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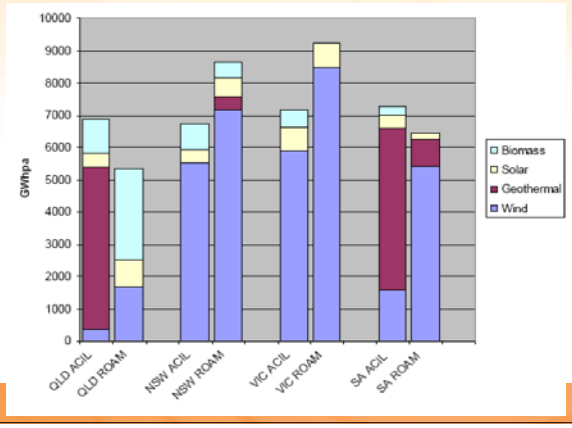
MRET performance to date… and for 2020?

- **To date:** modest ramping target easily met + considerable new investment with apparent efficiency – low subsidy $/MWh by internat'l standards
- **However:** internat'l experience generally poor with certificate schemes for reasons that seem to include governance capture by incumbents, risks for developers, market power on 'buy' side, single price for all
- **NEM** increasingly stressed infrastructure, changing structure including gentailers
- **Hence,** past modest success no guarantee of future performance with a significant target



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Conclusions

- Australia's National Electricity Market
  - Infused with uncertainty – *a key to driving competition but a challenge for investment*
  - Some success in commercialising costs + benefits
  - Formal objectives of equal treatment… although difficult in practice
- Wind integration one of a number of challenges
  - Currently unscheduled generation + outside key NEM processes
    - NEMMCO has very limited opportunities to direct behaviour yet remains accountable for maintaining system security
  - Already 'sees' some of NEM's commercial signals; reasonable that they 'see' more of costs + benefits they bring to NEM + society
  - Transmission investment likely to become more problematic
  - **Wider environmental + industry development value needs to be recognised with effective 'external' policy support – the major failure of policy and governance to date**