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The economics of transmission constraints on wind farms – some evidence from South Australia

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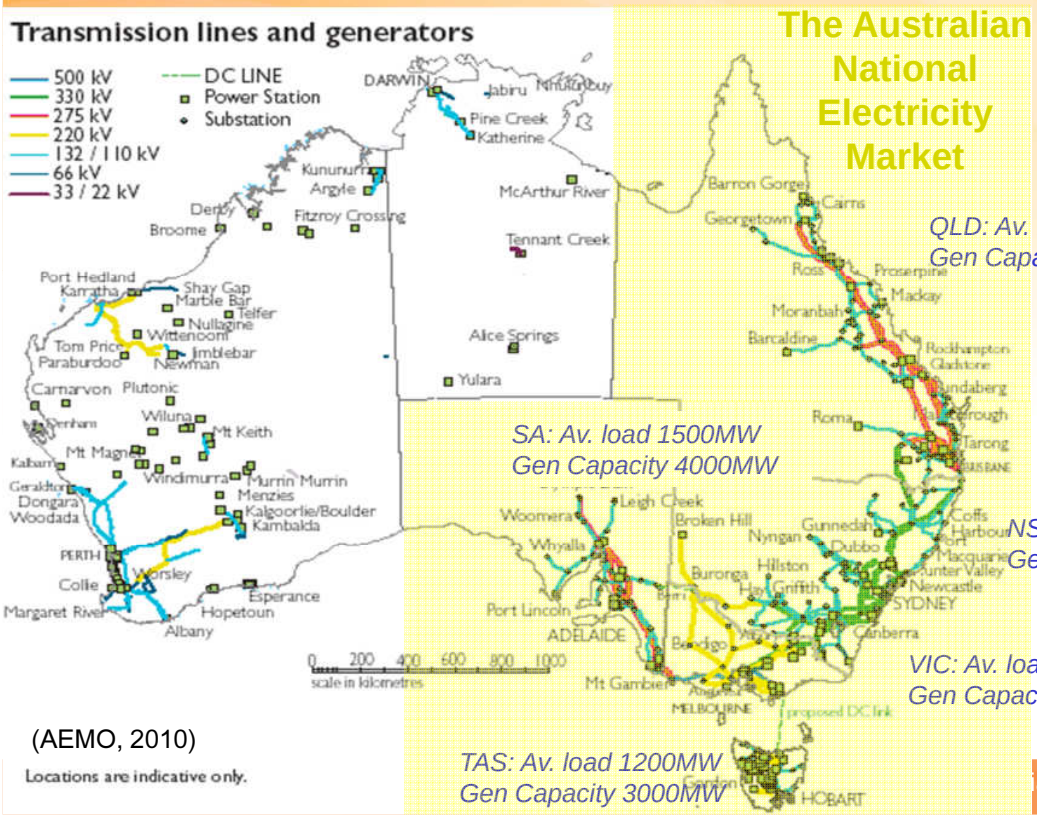
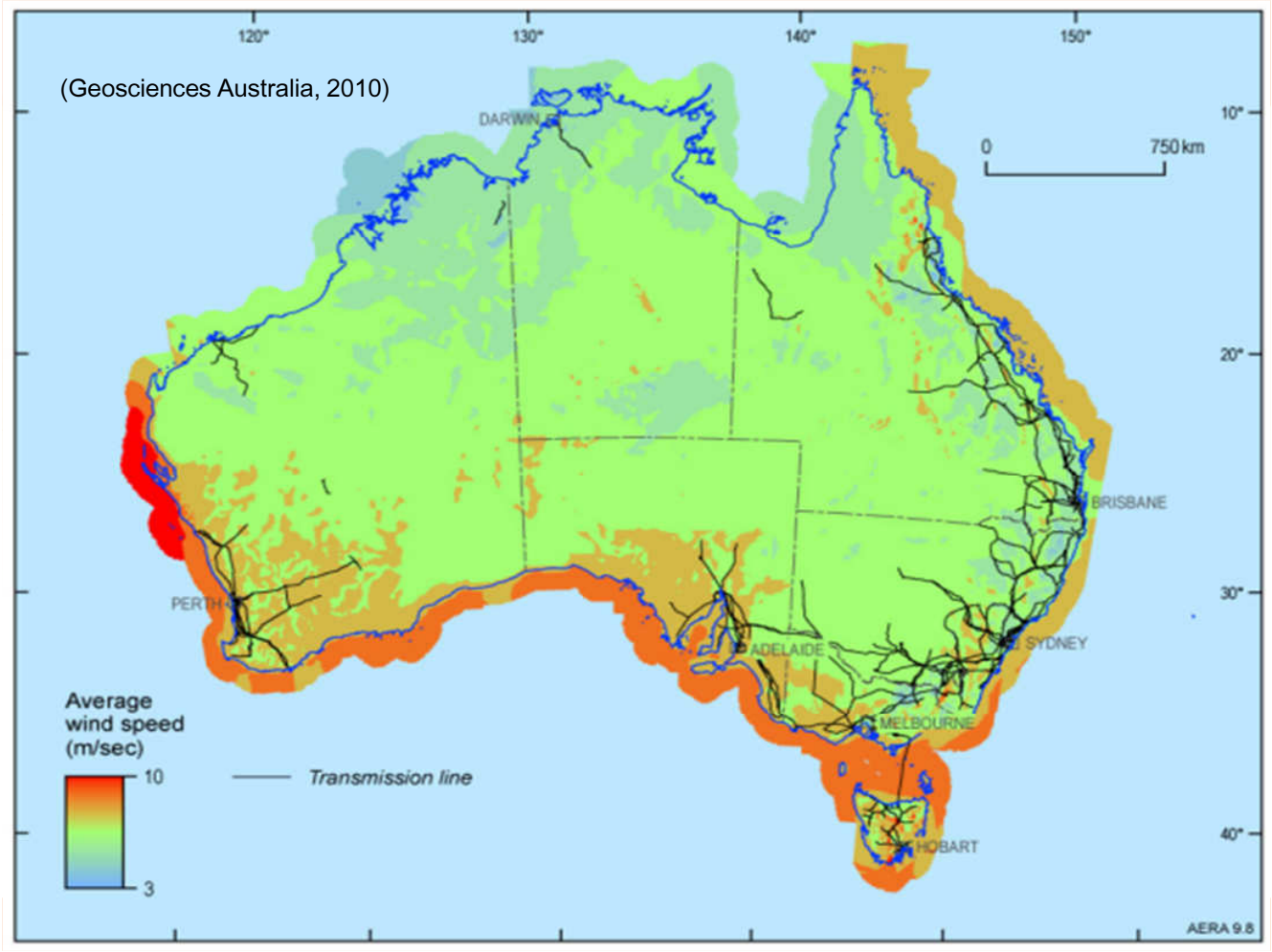
The Australian National Electricity Market





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(ESIPC, 2009)

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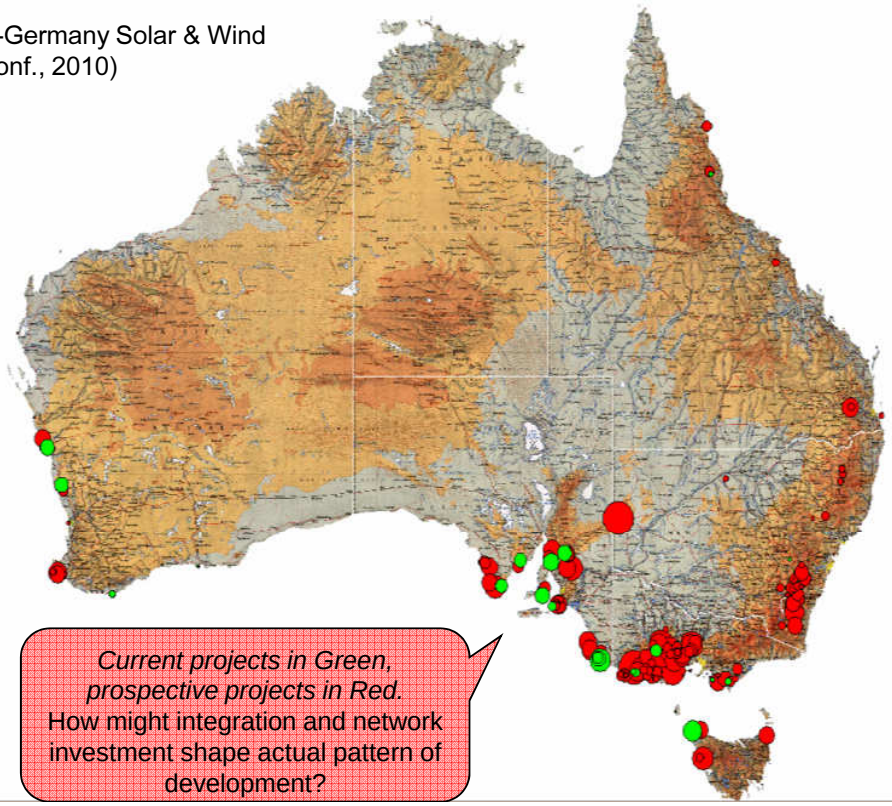
Current & prospective wind projects

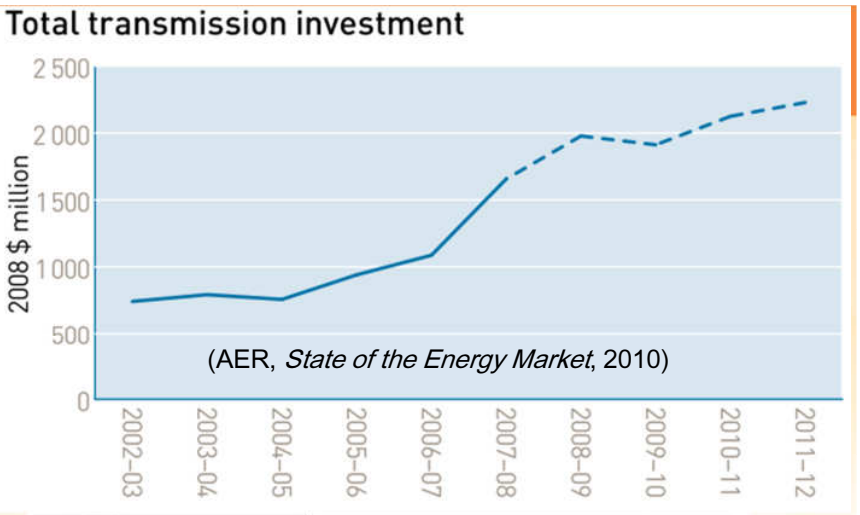
(Epuron, Australia-Germany Solar & Wind Energy Industry Conf., 2010)

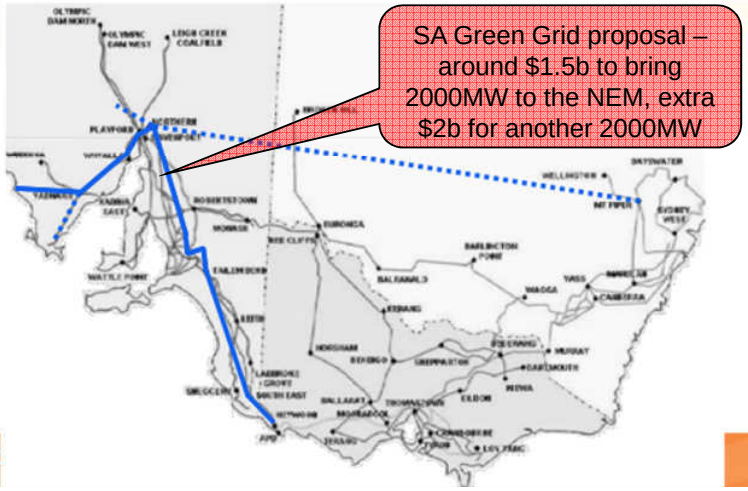


Current projects in Green, prospective projects in Red.
How might integration and network investment shape actual pattern of development?

Tx investment significant… and growing

- Growing efforts on the potential needs of renewable generation….
- New NEM rules for investment under development
- … and emerging proposals for major grid extensions





The question and methodology

- What are the potential implications of transmission constraints on wind farm economics
  - How much wind generation might be lost?
  - What might be the foregone value of that generation?
- Research methodology
  - Use actual wind farm generation and regional spot price data from South Australian wind farms
  - Simulate potential oversizing of these wind farms with respect to their transmission link capacity – could be installing more MW wind capacity than available existing Tx link; or building a lower cost
  - Estimate the economic implications on wind farm revenue
    Note that we do not estimate the Tx cost savings from either avoiding augmentation or building a lower capacity link – very context specific

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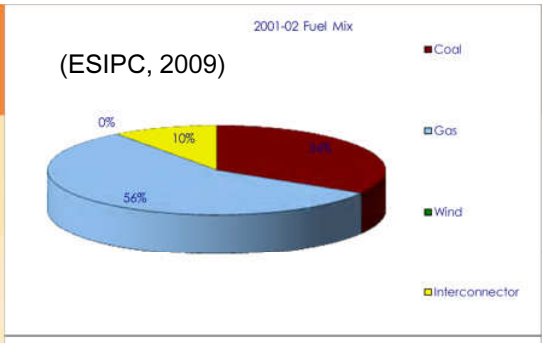
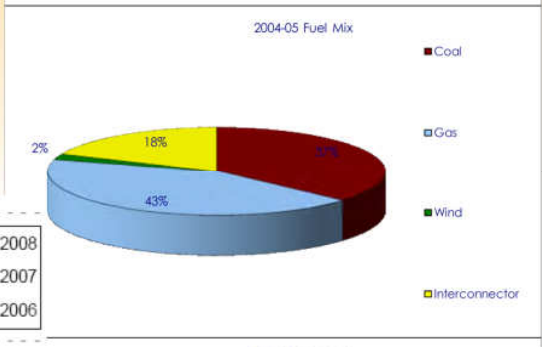
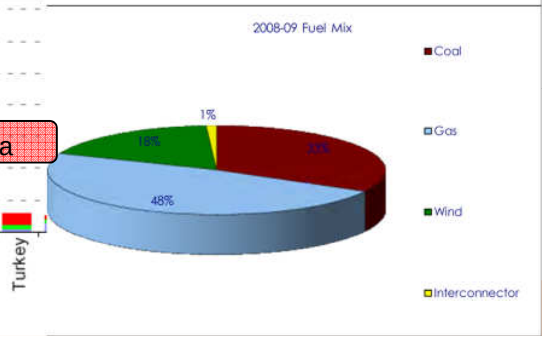
South Australia

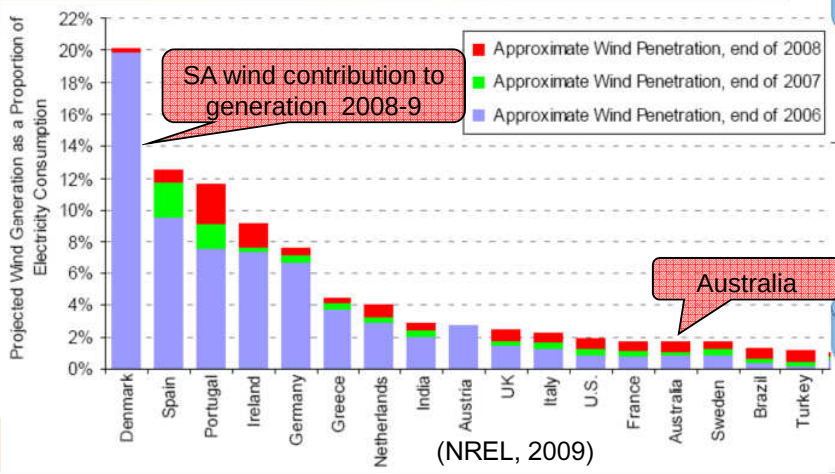
- A world leading jurisdiction for assessing wind integration challenges and options
  - A large and rapid deployment
  - High wholesale spot/ancillary service market transparency

(ESIPC, 2009)









(NREL, 2009)

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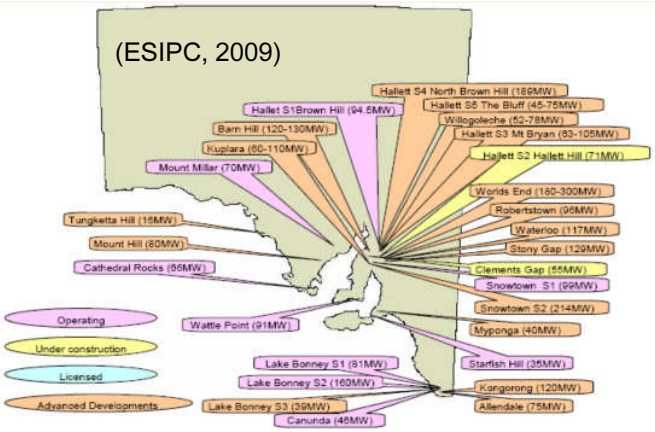
Current and prospective wind in SA

(ESIPC, 2009)

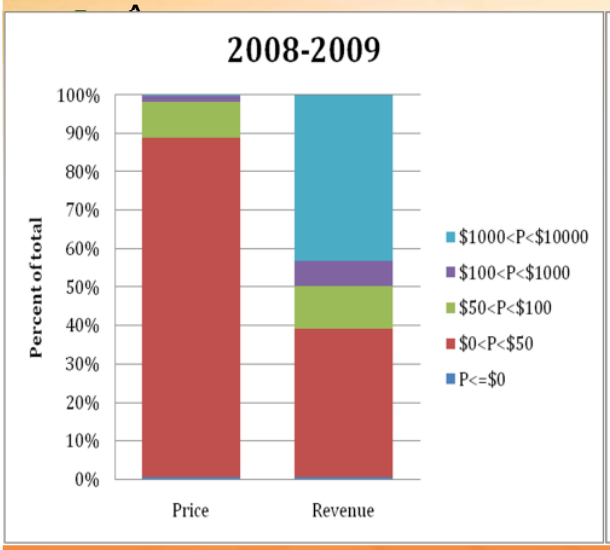


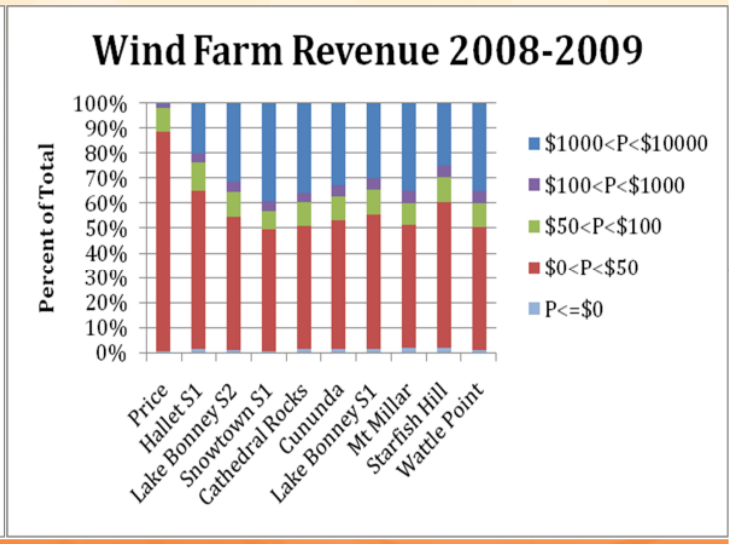
Note the very different performance between wind farms. *Caution: some plants progressively installed over 2008-9, others operating under Tx constraints for some period of this time.*

Wind Farm	Original Capacity (MW)	Maximum Output (MW)	Original Capacity Factors	Original Ave Price per MWh	Ave Income (Ave$/hr/MW installed capacity)
Snowtown S1 (1)	99	98.11	39.3%	$ 48.97	$ 19.22
Wattle Point	90.75	92.03	32.9%	$ 51.82	$ 17.04
Hallet S1	94.5	94.37	40.3%	$ 40.54	$ 16.33
Cathedral Rocks	66	60.24	32.6%	$ 47.34	$ 15.42
Mt Millar (2)	70	71.24	27.2%	$ 54.09	$ 14.73
Cununda	46	43.48	29.5%	$ 44.01	$ 12.99
Starfish Hill	35	34.34	28.7%	$ 44.46	$ 12.77
Lake Bonney S1	80.5	79.07	25.9%	$ 44.80	$ 11.59
Lake Bonney S2	160	154.68	21.9%	$ 46.89	$ 10.28

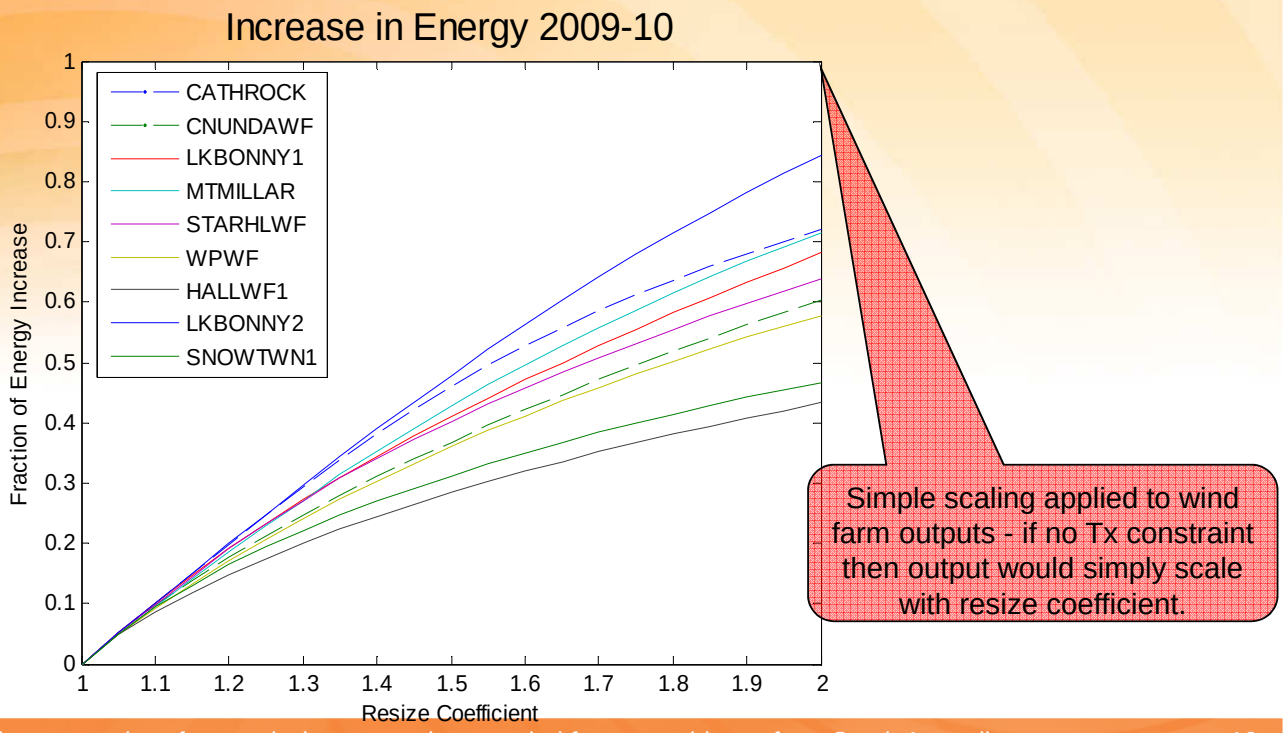
Some challenges for price analysis in the NEM

- Significant spot market revenue arises from very infrequent and challenging to model and unpredictable price excursions – *an element of luck in wind farm revenues*
- Limited transparency in the derivative markets which have major impacts on spot price implications for generators



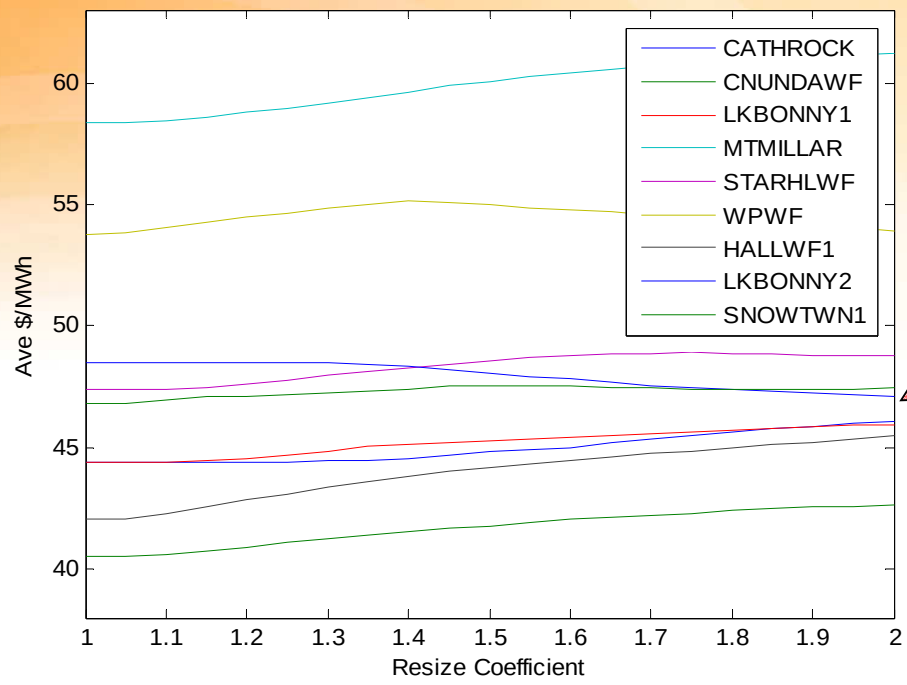


Increased energy production with oversizing



Average spot price earned $/MWh

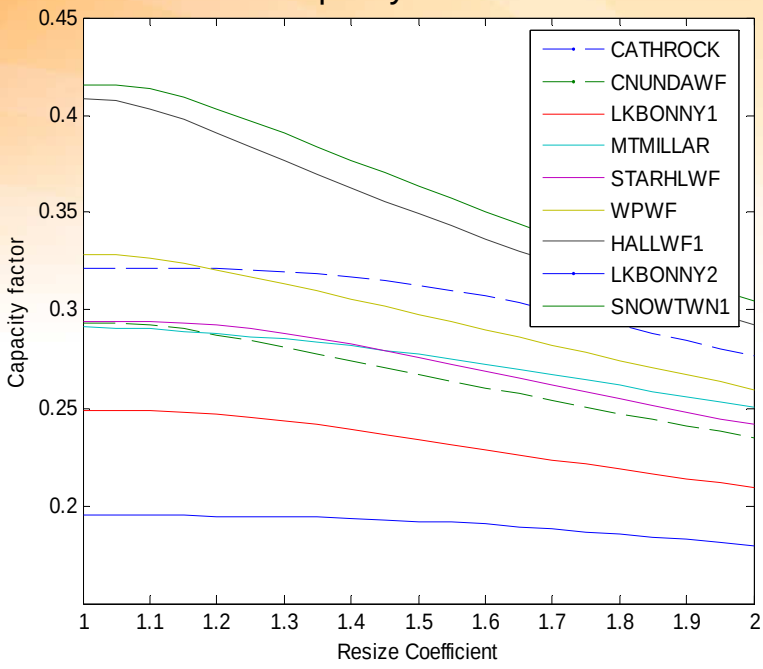
Wind farms Average Price 2009-10



Generally increasing average prices highlight that the 'lost' wind energy with oversizing generally has lower than average value – a key finding

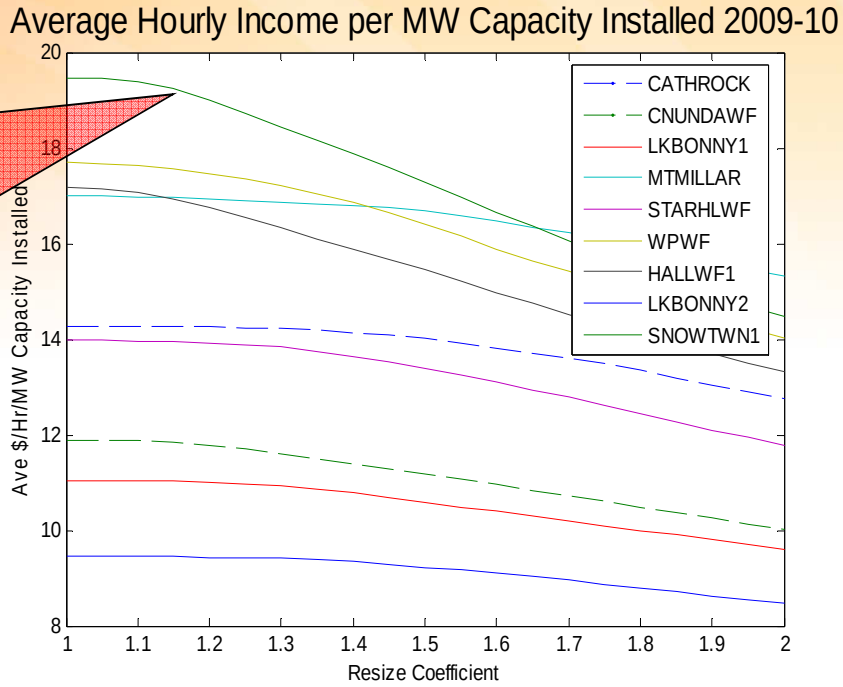
Implications for capacity factors

New Capacity factor 2009-10

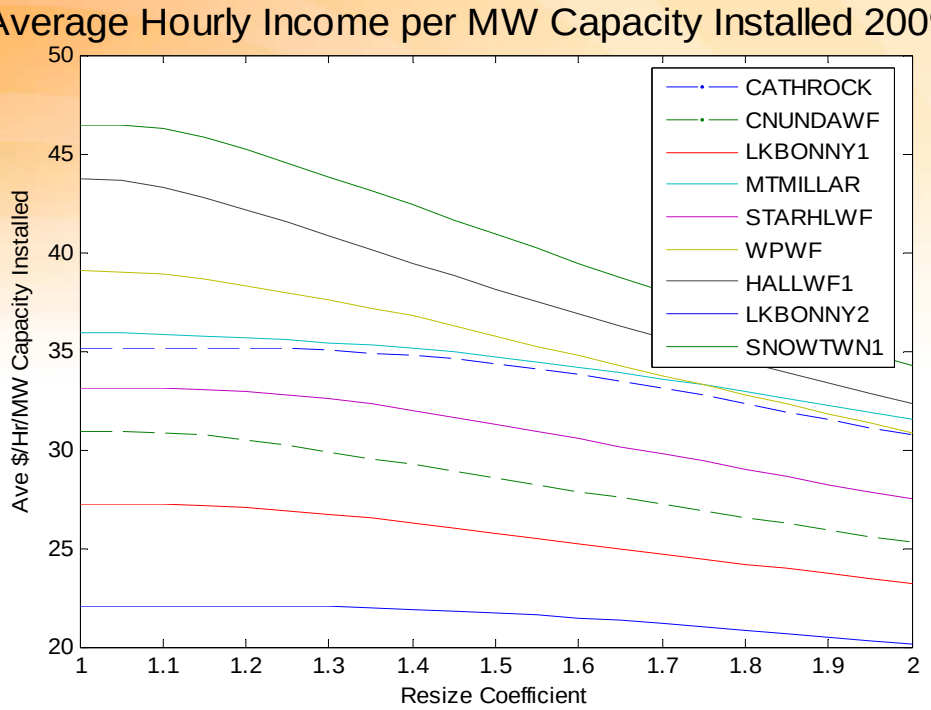


Implications for revenue - energy

For all wind farms, possible to oversize by 10-20% before any significant impact on revenue per MW installed… and note that likely 'additional' capacity will have lower per MW costs to install as fixed costs already covered



Implications for revenue – energy & RECS



Conclusions

- Wind turbine and wind farm design already involves economic optimisations on the value of 'lost' wind
  - eg. rotor sizing to set min. wind speed for rated mechanical operation
- Wind farms operate at rated output only occasionally
  - Note potentially considerable variation possible between wind farms
- Tx $ an increasingly important part of wind farm economics
  - High wind speed sites near existing Tx are increasingly hard to find
- Oversizing wind farm capacity wrt existing or augmented Tx
  - May involve only limited amounts of lost energy
- …. and if oversizing in regions with high wind penetrations
  - that 'lost' wind generation might only have earned low energy prices
- *However, don't forget the benefits of wind energy that are forgone when 'spilling' wind, and those RECs!*

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Thank you… and *questions*

Comments, suggestions and corrections regarding this presentation are all welcome. Please contact Iain at i.macgill@unsw.edu.au