ROAM CONSULTING
ENERGY MODELLING EXPERTISE

Impacts of Electricity Markets on Solar Revenues

10th Nov 2011 **Dr Joel Gilmore** **ICEM 2011**

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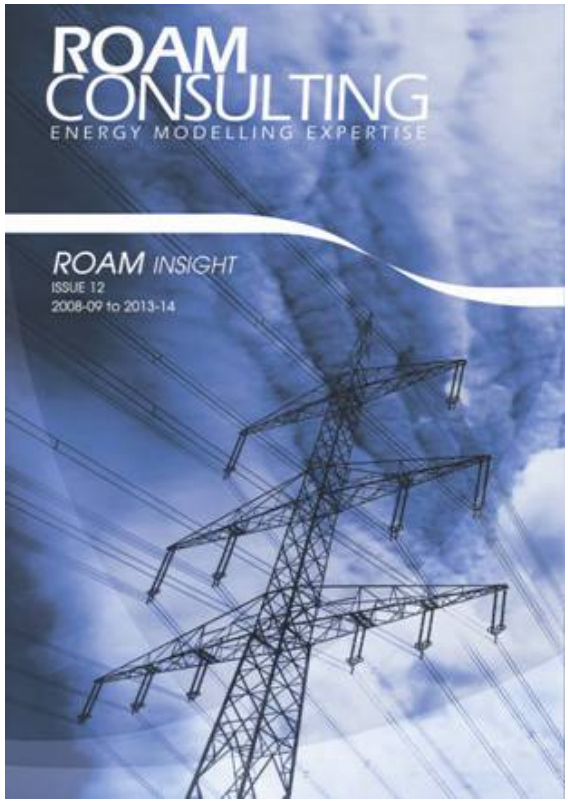
ENERGY MODELLING EXPERTISE

ROAM Consulting

- Energy modelling
  - Renewable energy
  - Carbon pricing
  - Transmission & reliability
- Focus on detail
- Clients:
  - AEMO (Australian Energy Market Operator)
  - Commonwealth Treasury
  - Private industry (wind *and* coal)



Solar plants

- Solar plants will sell electricity into the grid
  - "Price takers"
- Solar plants will sell their LGCs (RECs)

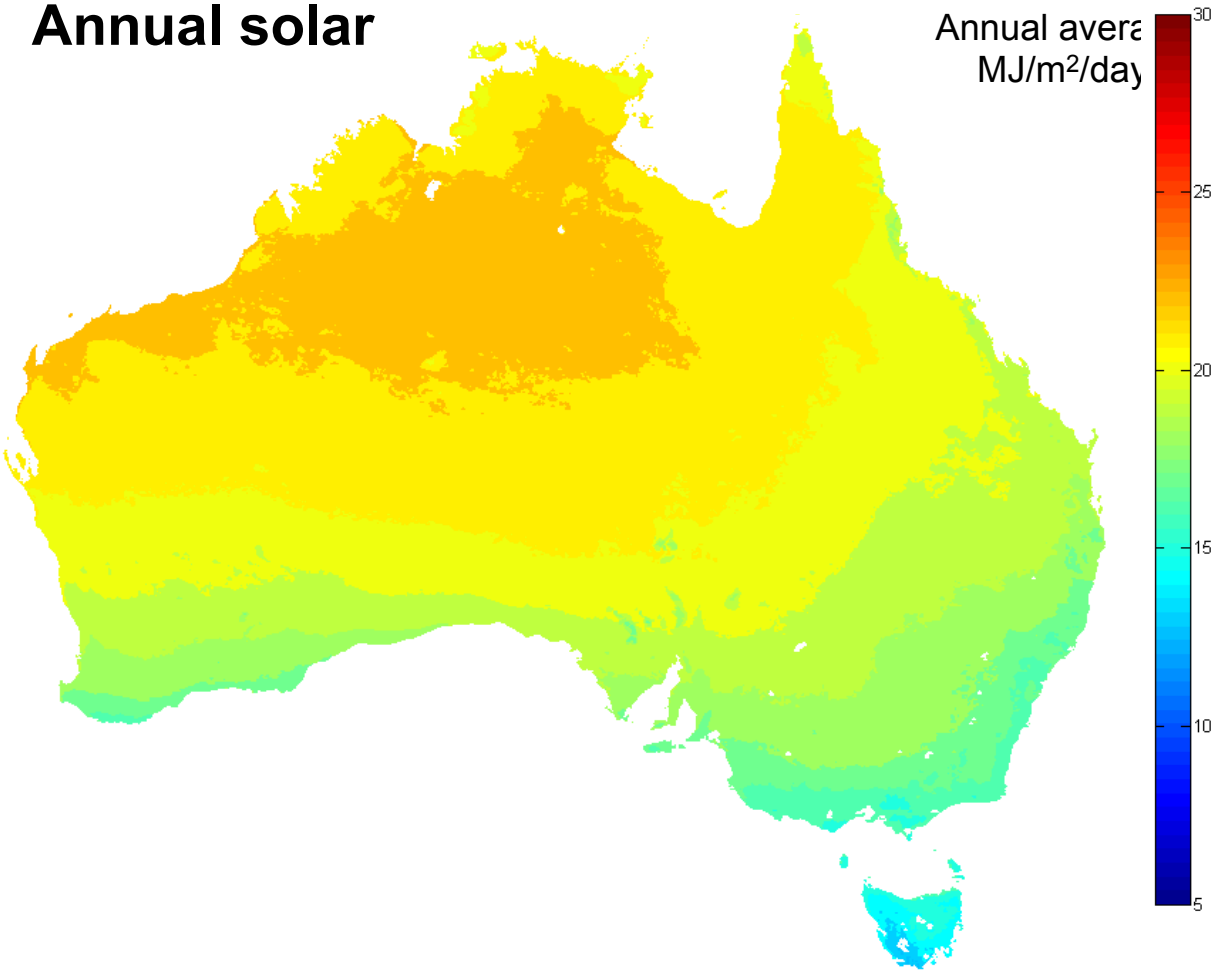
Where should you build to maximise revenue?

Location trade-offs

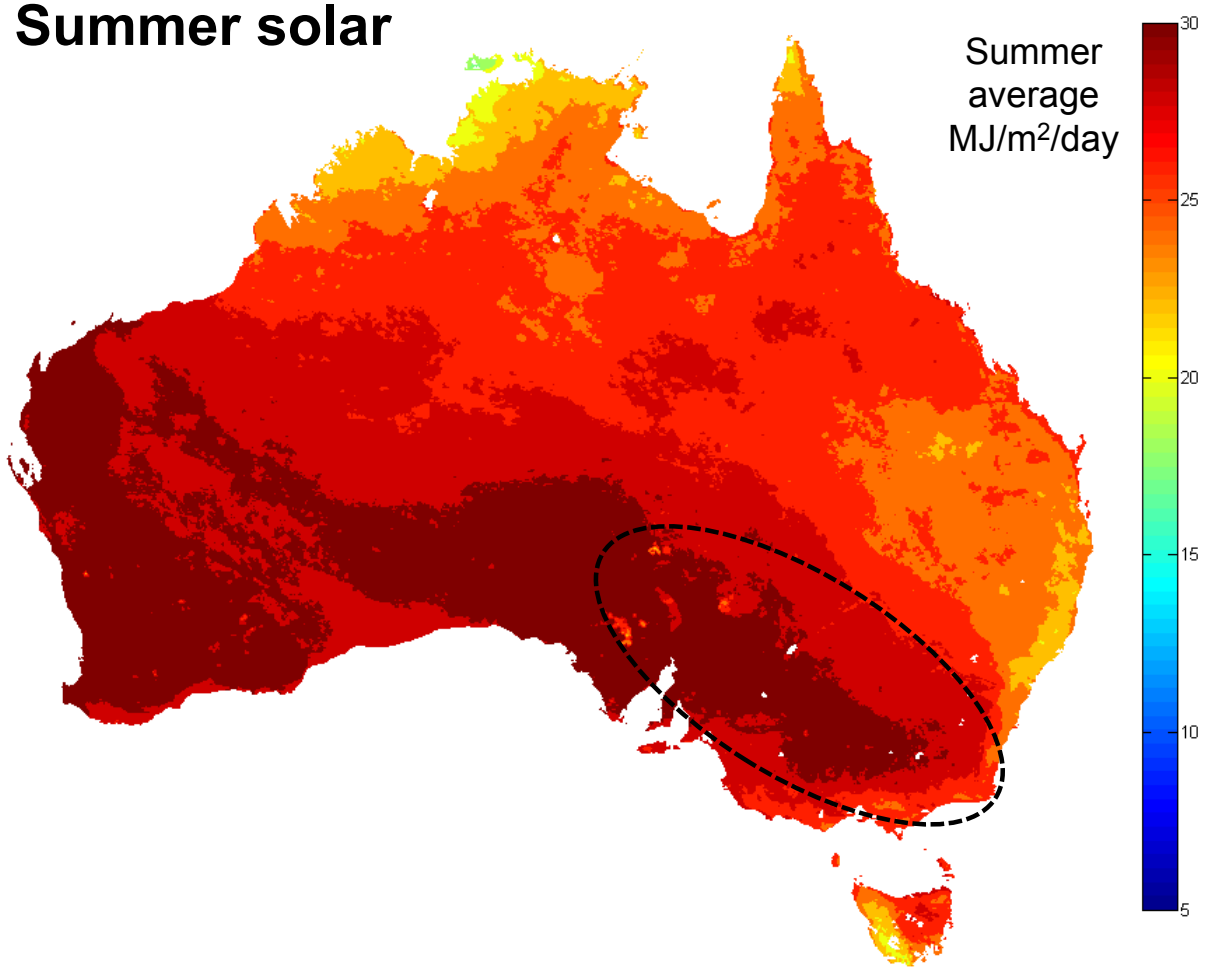
- Solar irradiance
- Electricity prices
- Correlation between the two

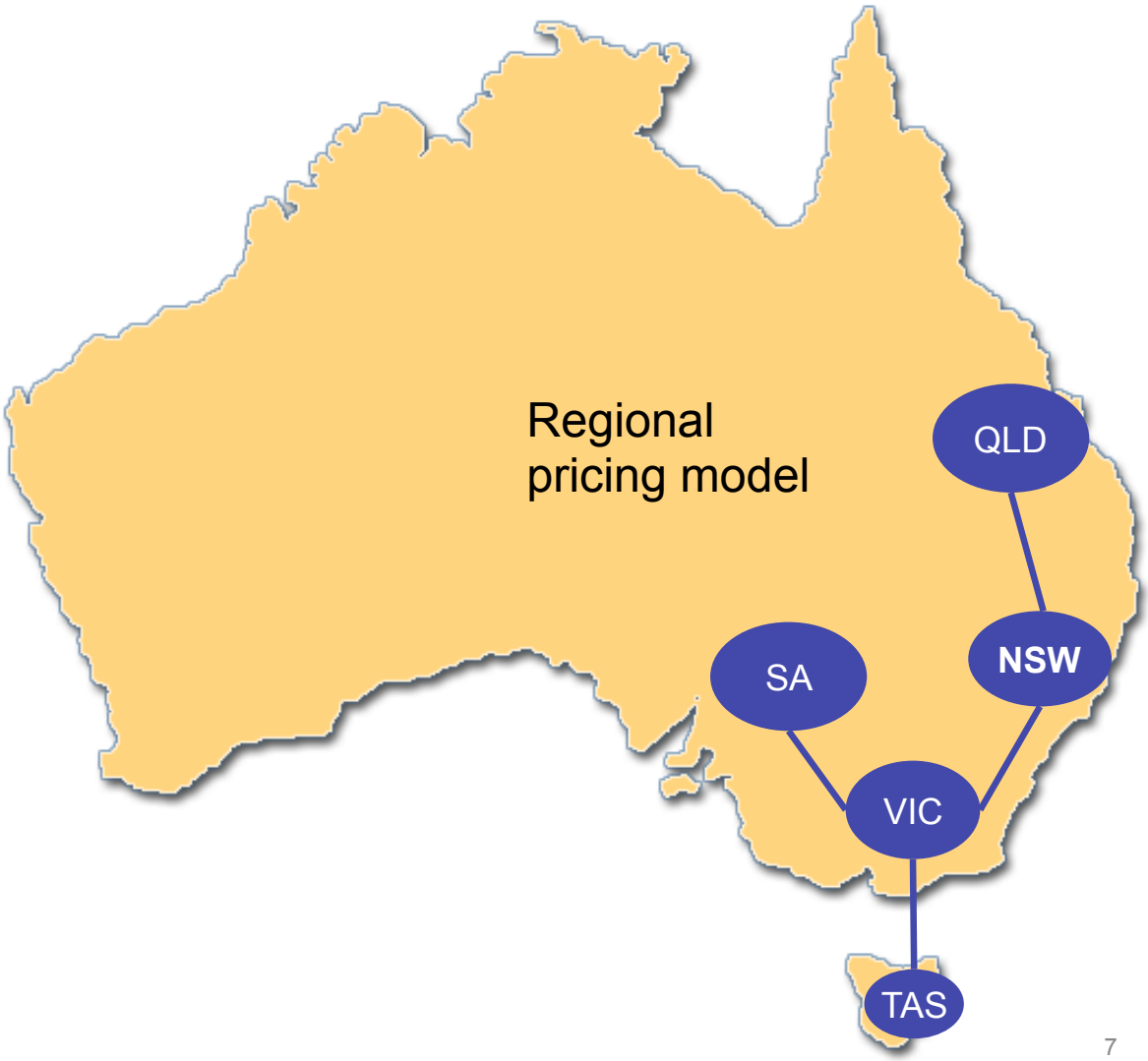
- Local initiatives
- Transmission
- Land access

Annual solar



Summer solar





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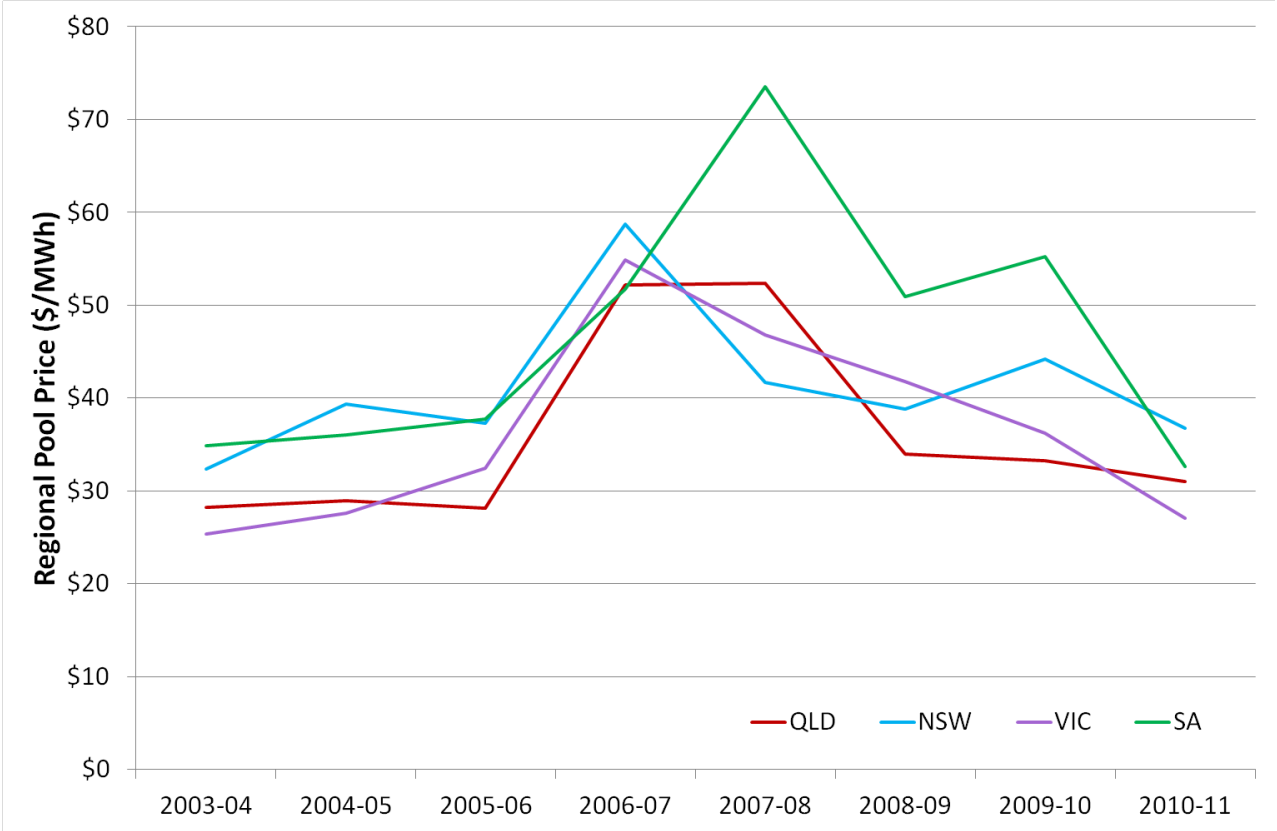
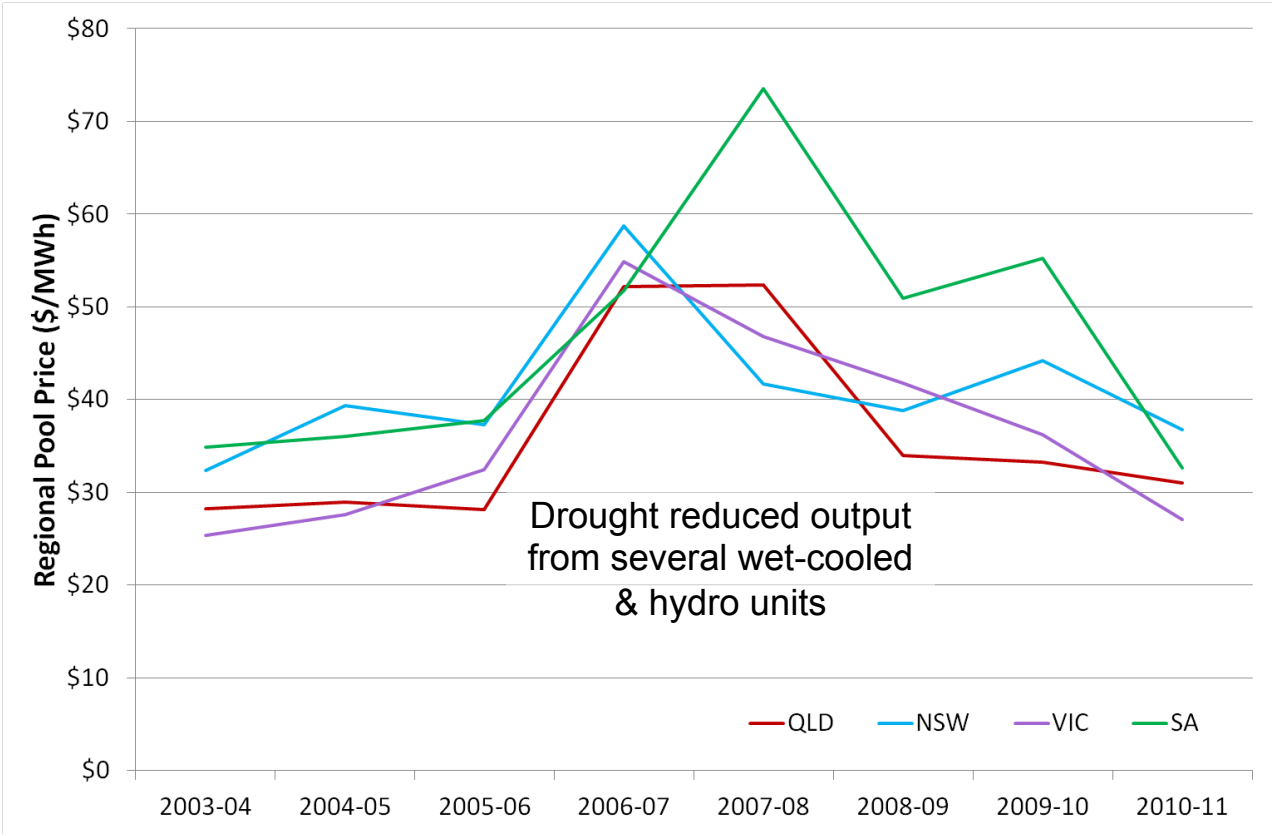
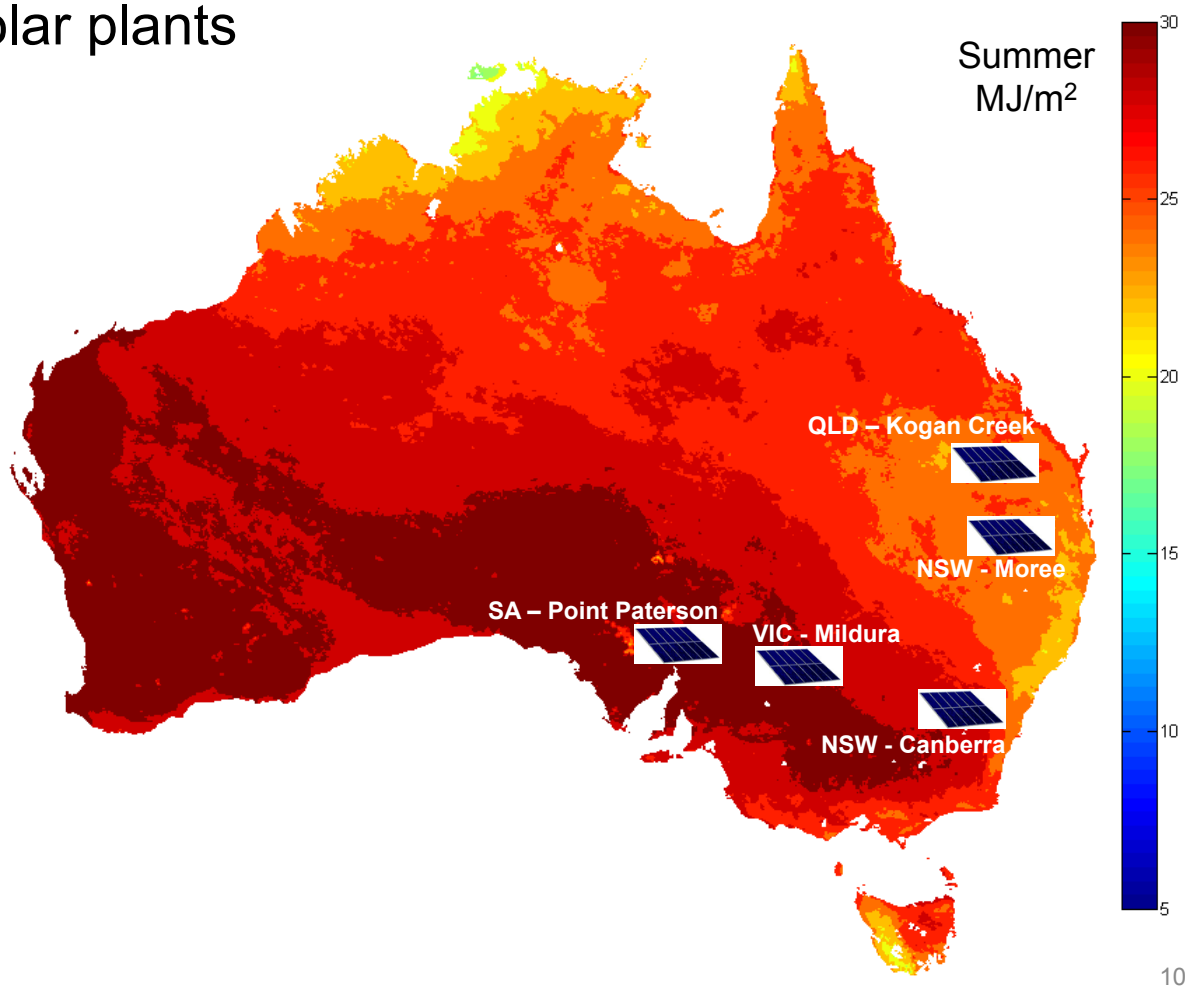
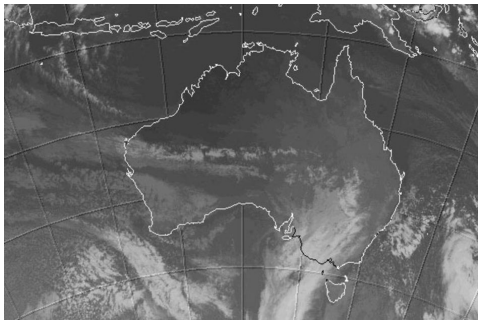


Historic pool prices

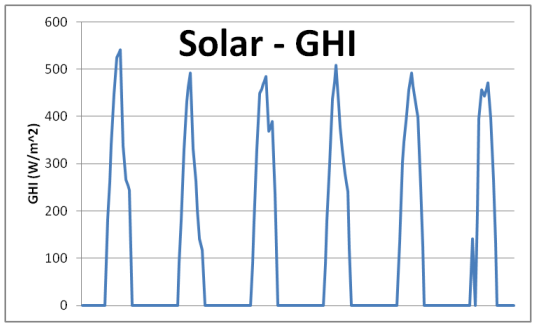


Evaluation of hypothetical historical solar plants

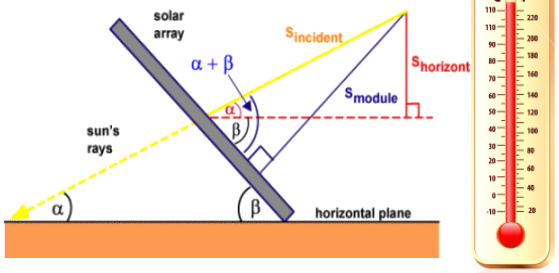


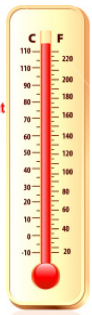


BOM Satellite data

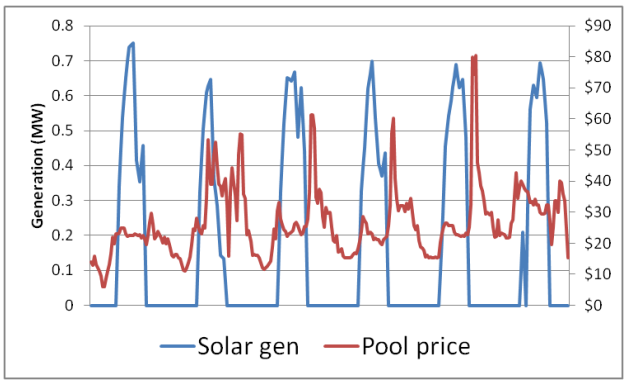


Hourly insolation trace:
8 years, 5km grid

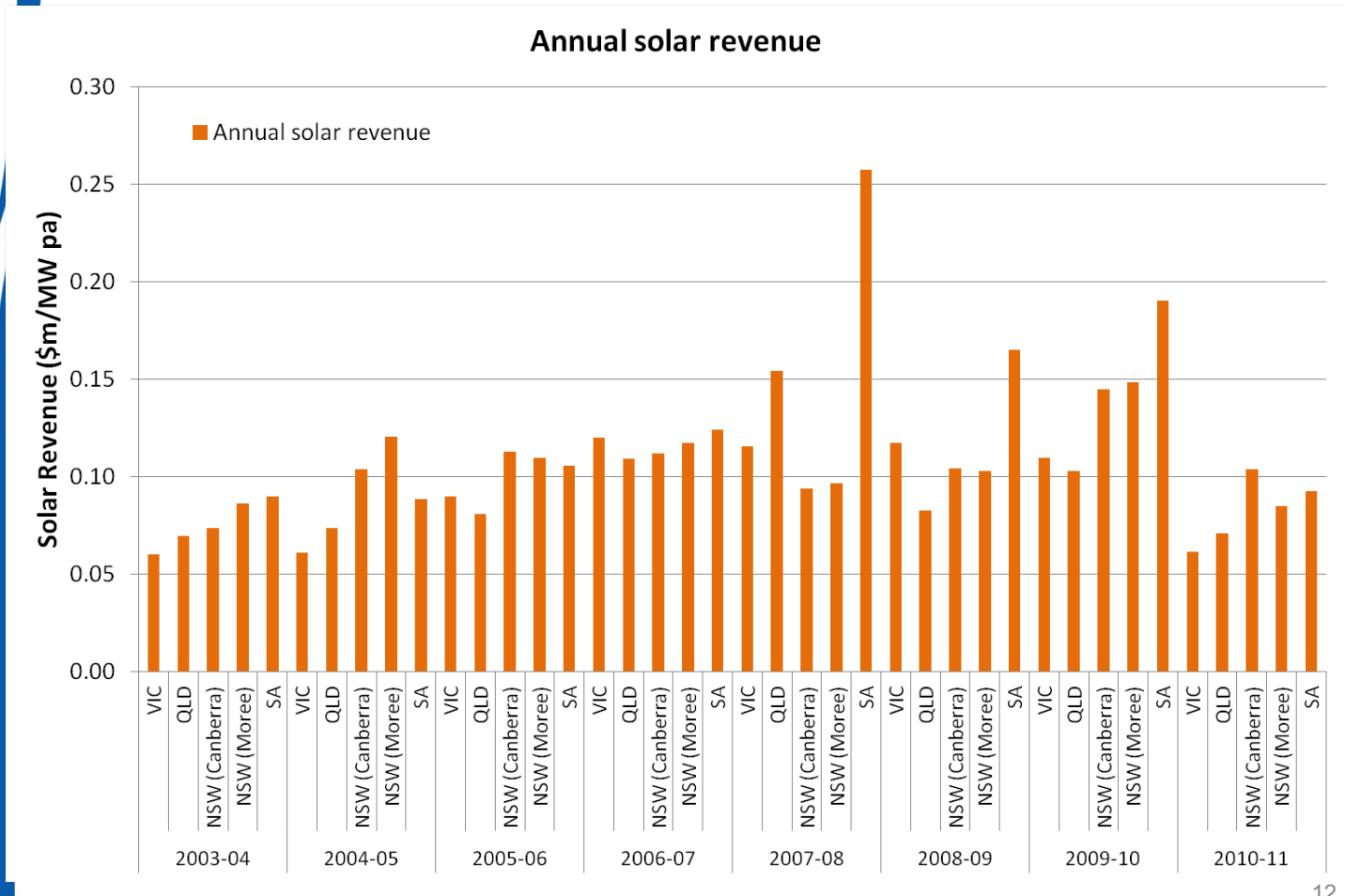




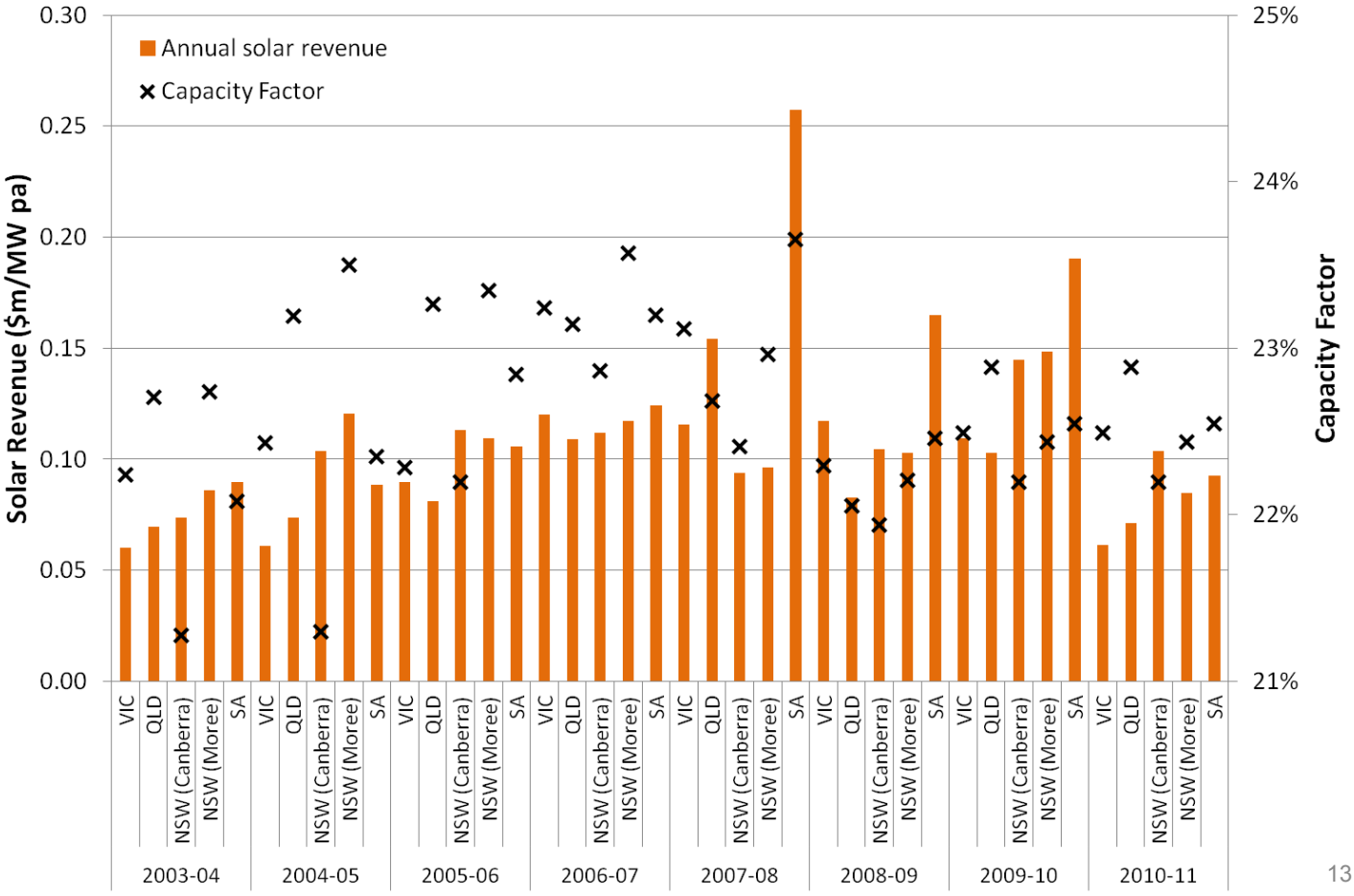
1MW geometric model
Cell temperature model



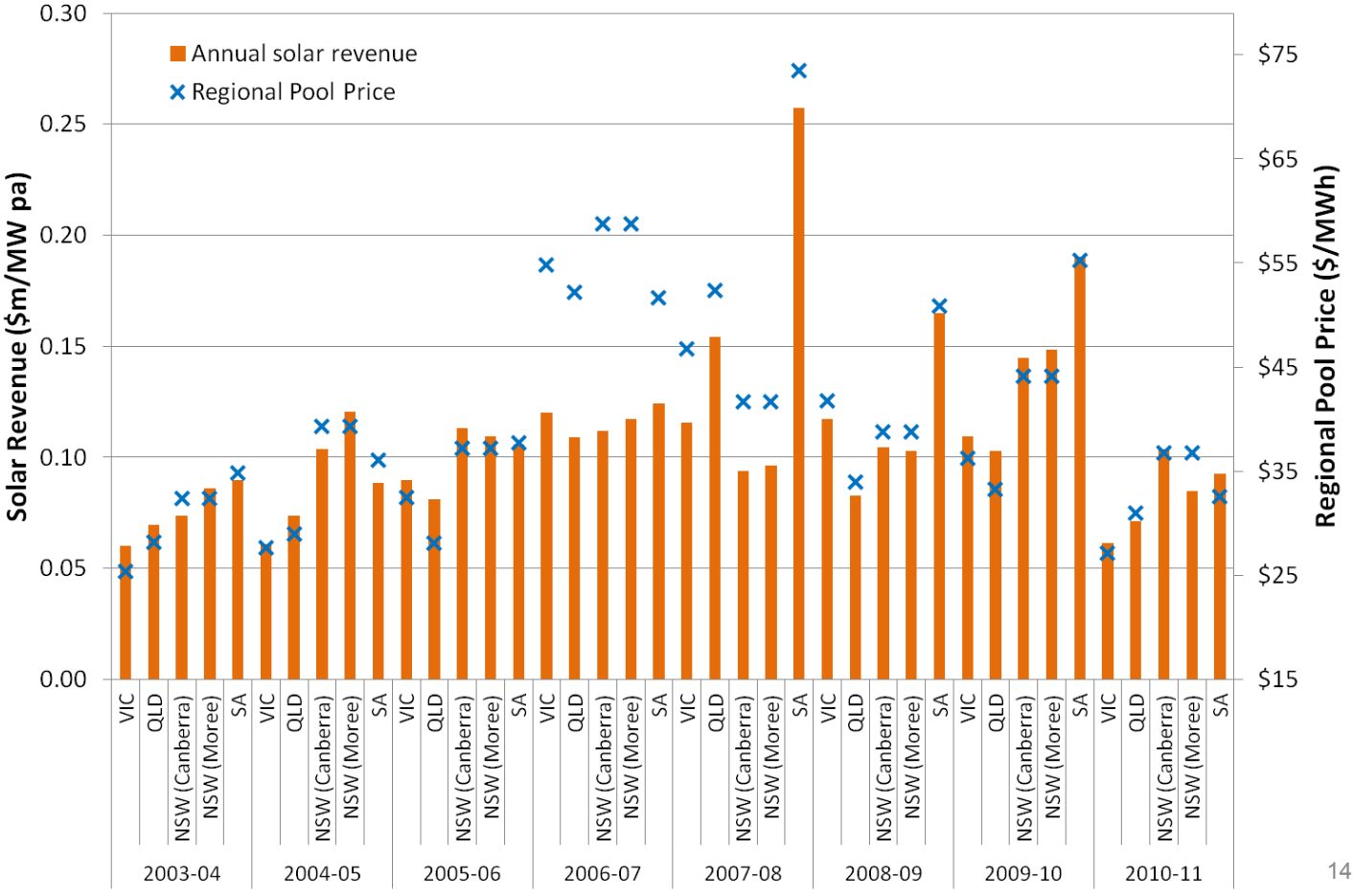
Use historical pool prices
Calculate revenue



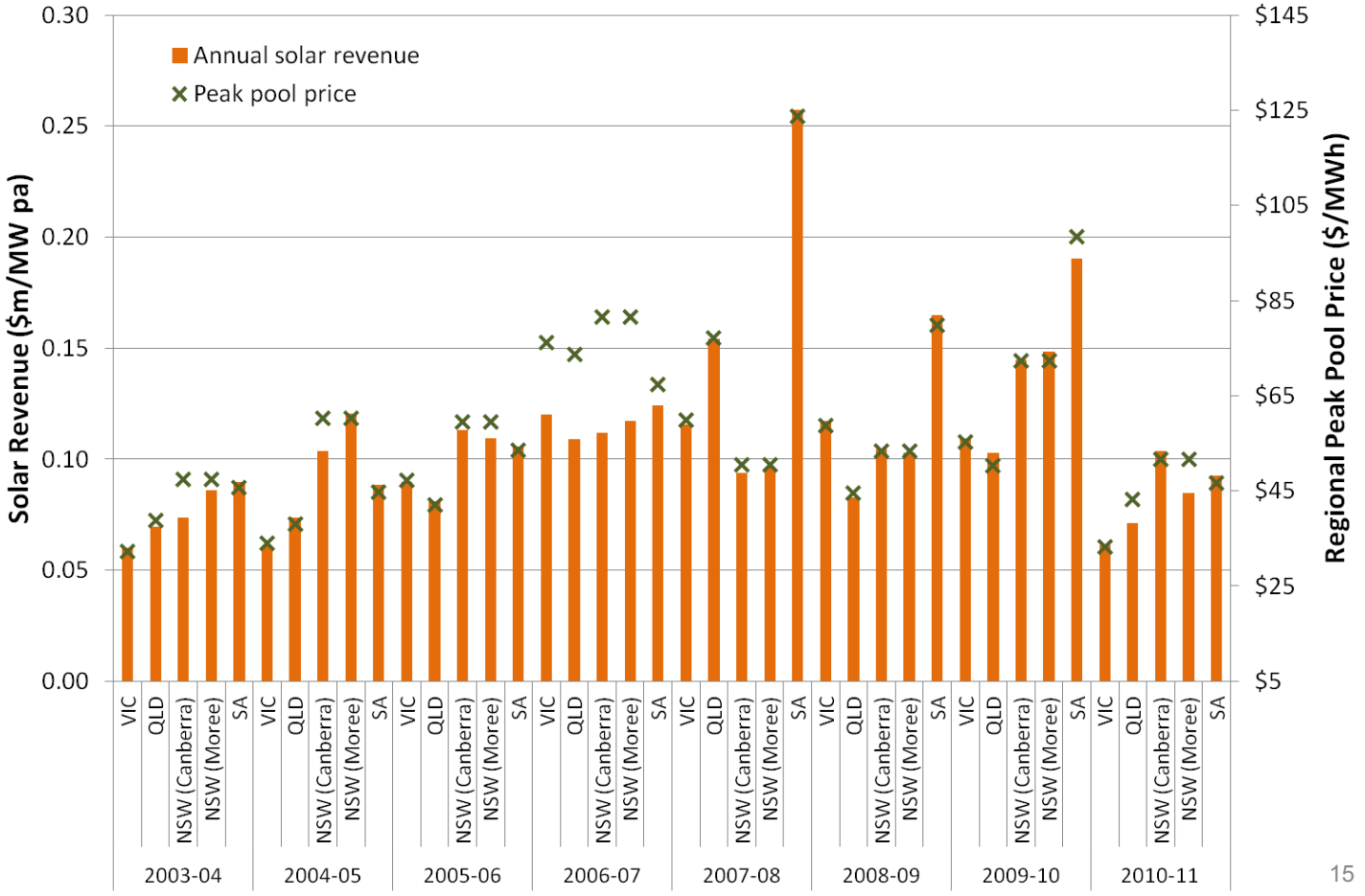
- Annual capacity factor is a poor indicator of annual revenues

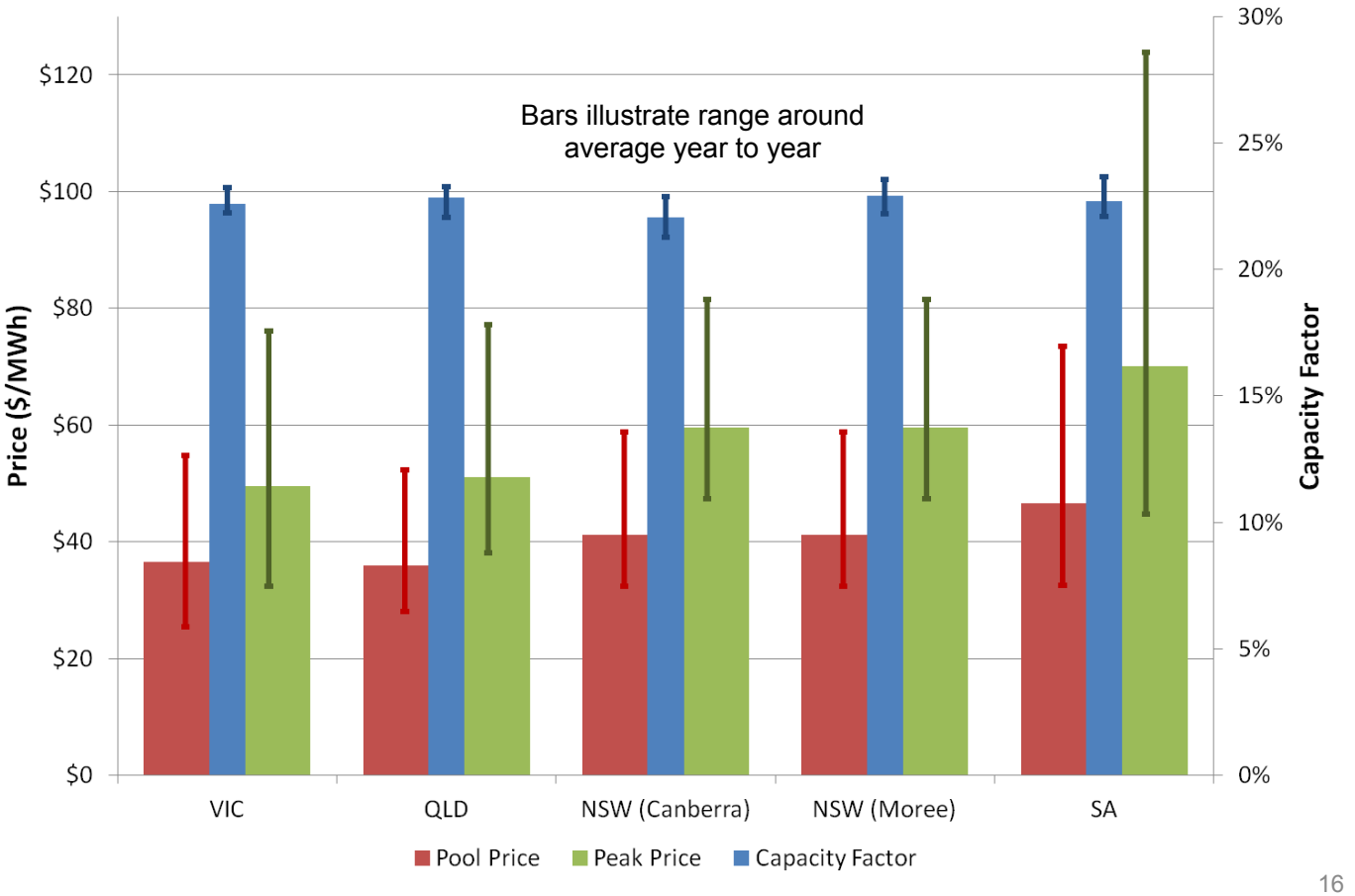


- Price is more important than solar resource
  - Regional pool prices provide a stronger predictor of solar revenues than capacity factor



- *Peak* price (8am-6pm) is a very strong indicator of solar revenues





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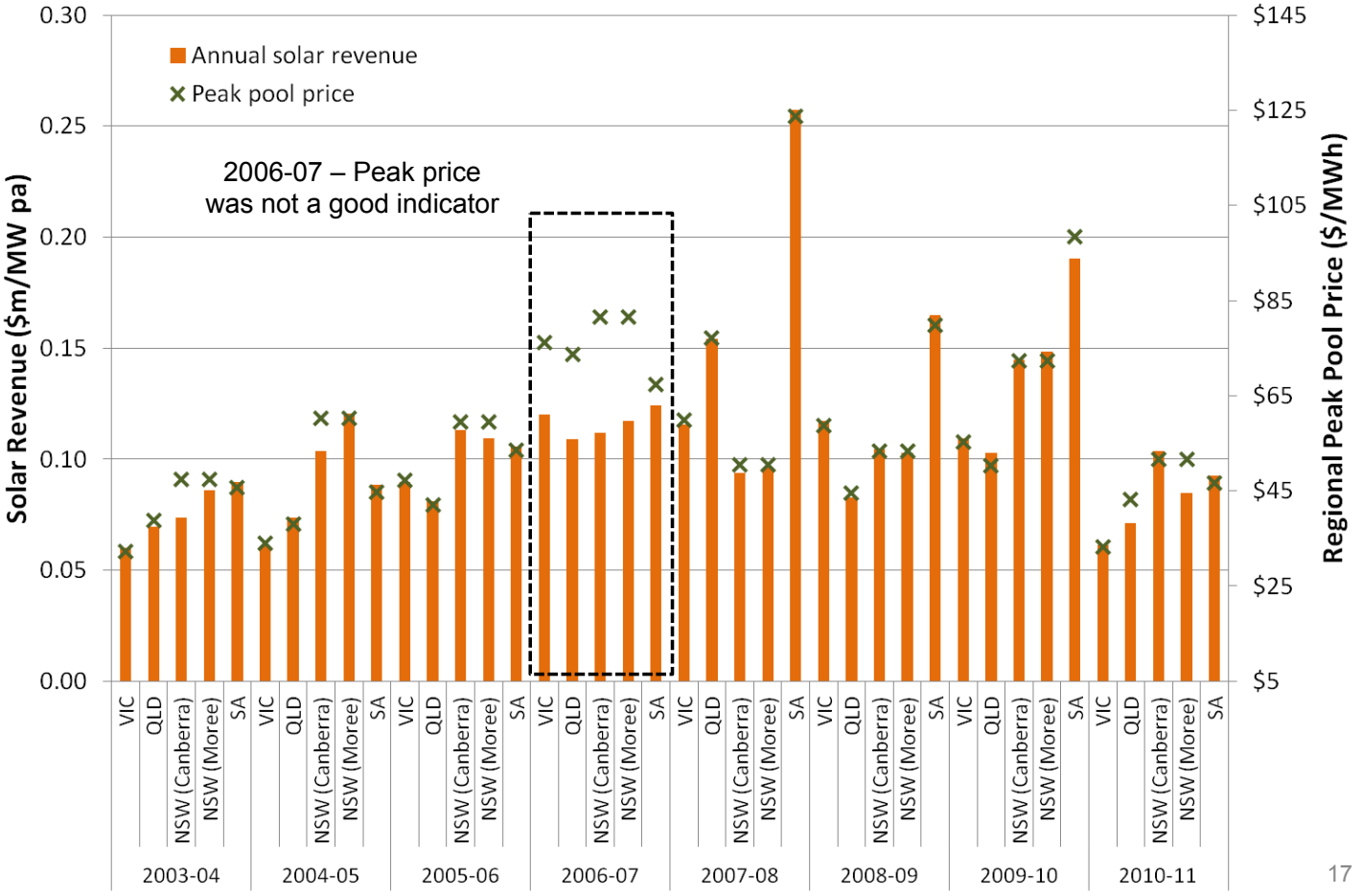
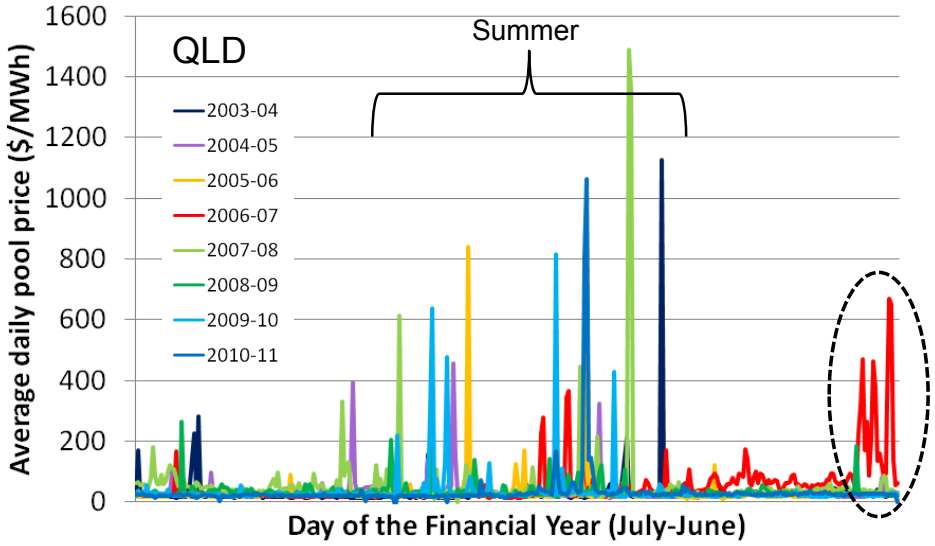
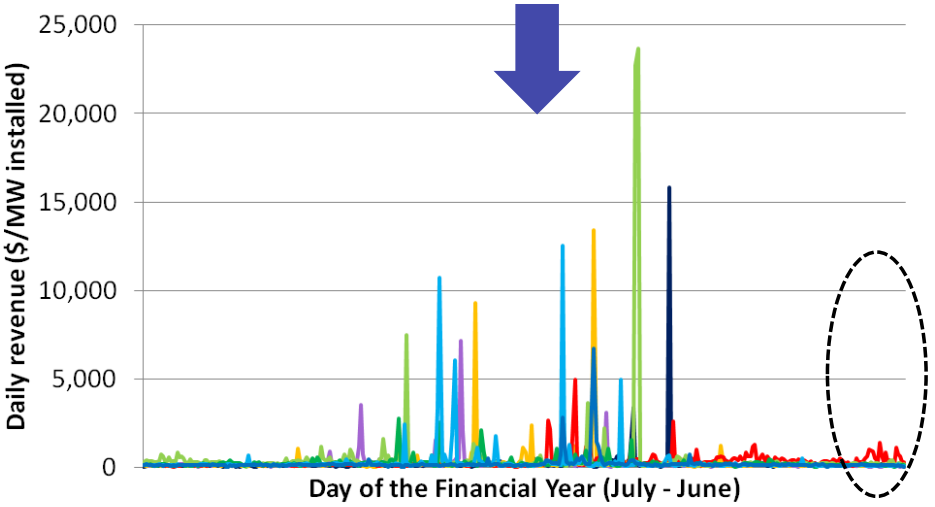




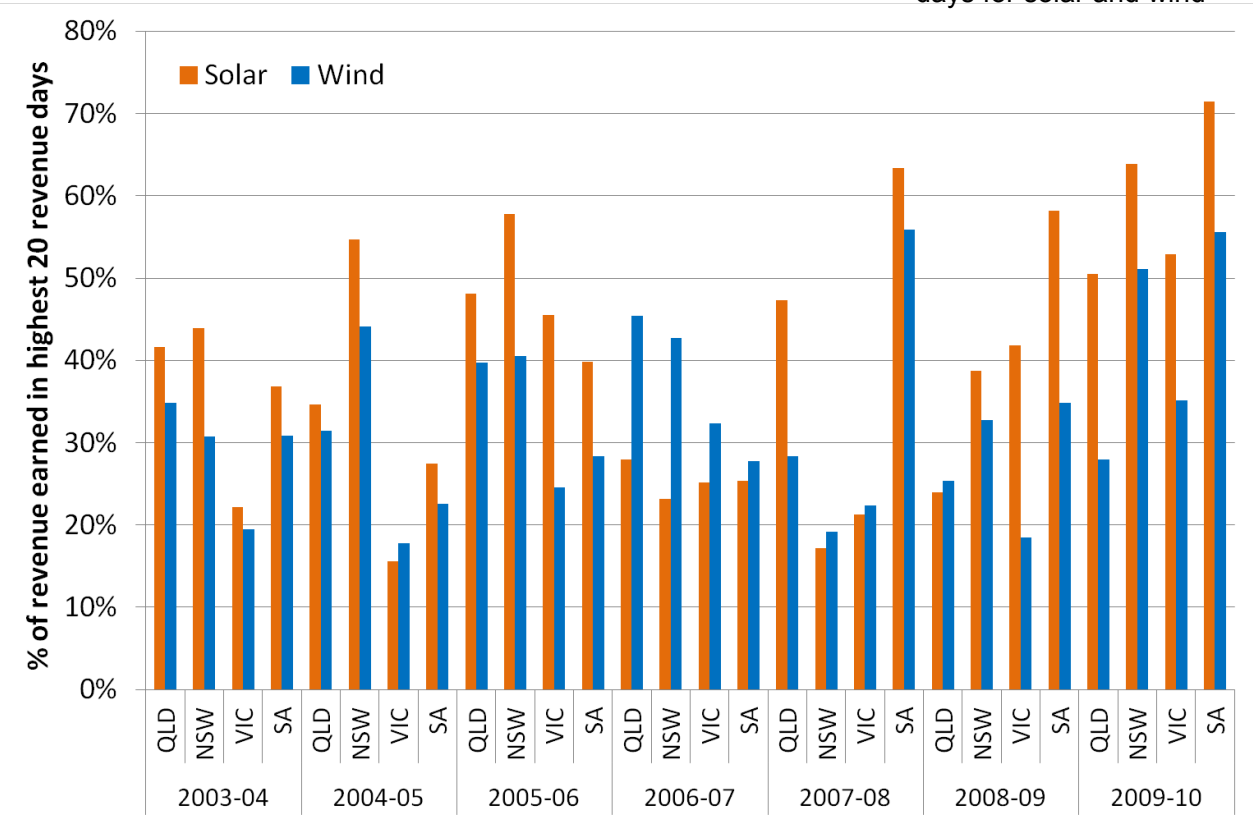


- Price spikes during summer
- Cause revenues spikes for solar plant
- Unusual winter spikes
  - Unusual weather
  - Generating plant withdrawn due to drought
- Did not translate to revenues
  - Low solar insolation during winter
- Emphasises revenue is driven by *summer* generation

Peak demand and extreme event forecasting will be important to solar generators (financing)

	% of revenue earned on single highest day	% of revenue earned on highest 20 days
Solar	12%	40%
Wind	8%	33%

Not necessarily the same days for solar and wind



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What about the future?

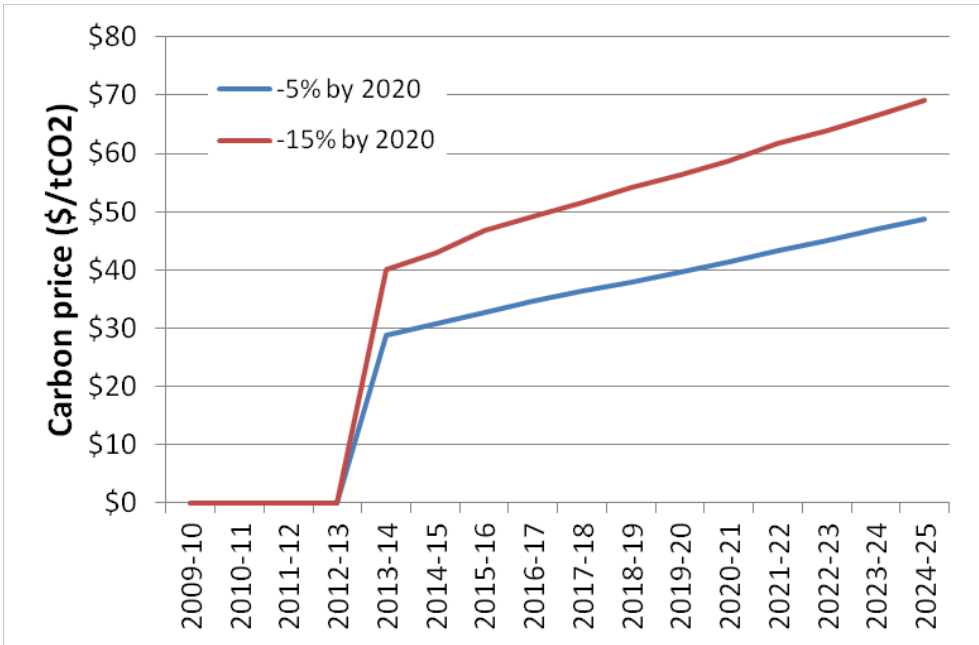
- Pool price relativities are likely to change
- Impact of carbon price
- Solar must compete with wind power

Pool price forecast

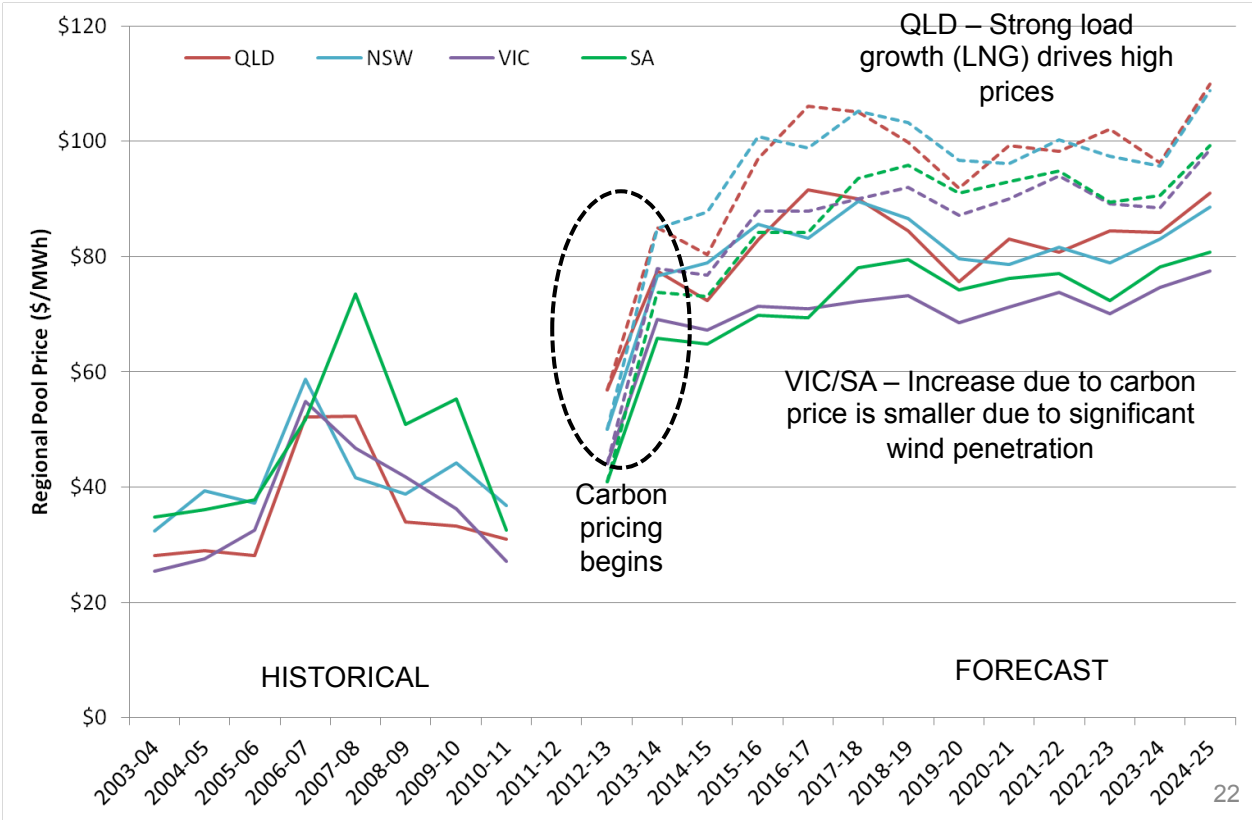
- ROAM's proprietary dispatch model (*2-4-C*)
- Includes network congestion
- 25 iterations with Monte Carlo thermal plant outages

Assumptions:

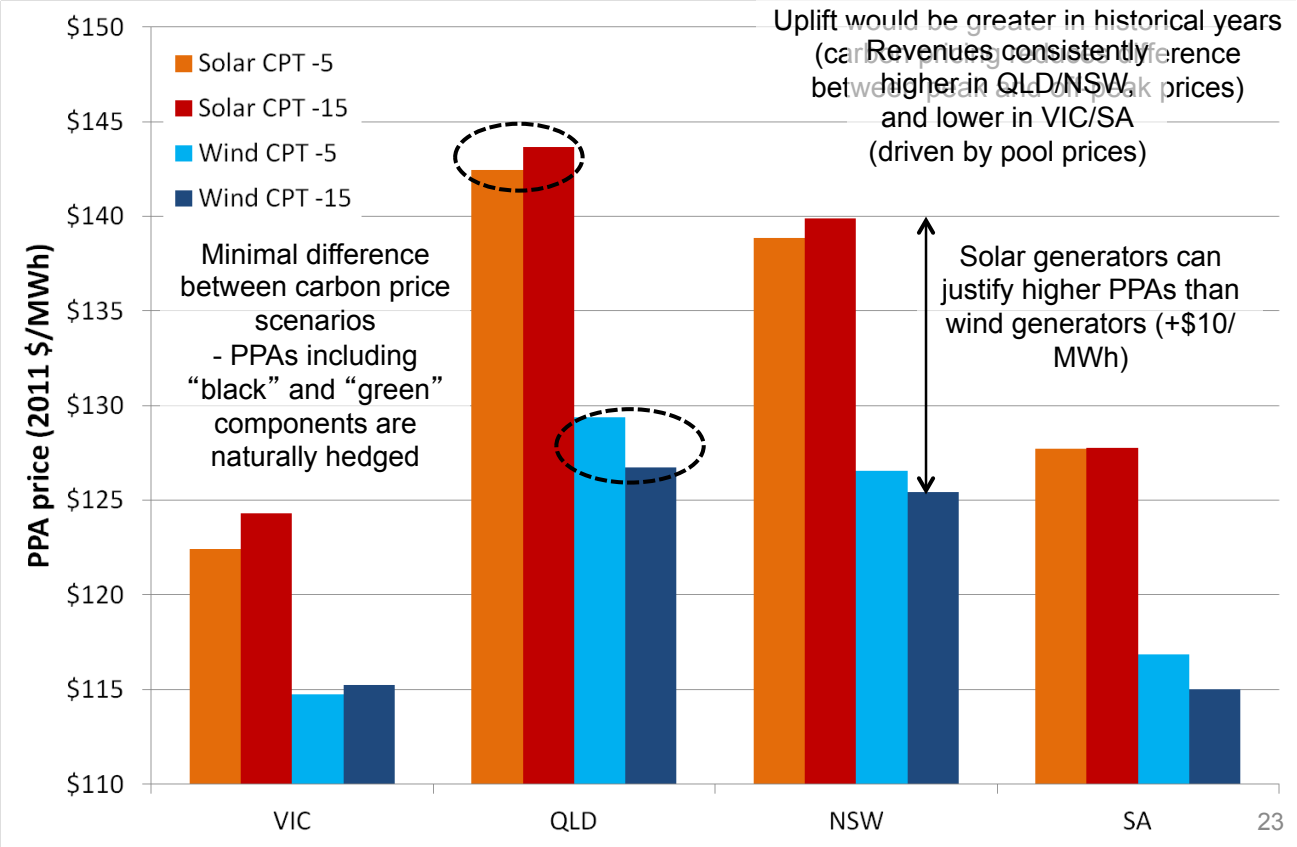
- Medium economic growth, weighted 50%/10% POE
- 2 carbon price projections:
  - -5% by 2020 (from 2000 levels)
  - -15% by 2020 (from 2000 levels)



- Relativities depend upon range of uncertain input assumptions
  - Wise investors will select sites robust to a range of likely input assumptions



- Most renewable generators negotiate Power Purchase Agreements (PPAs)
- Calculated PPA contract price for each generator
  - Flat price with equivalent net present value (NPV) over 10 years
  - Includes pool revenue & LGC revenue



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Summary

- Peak pool price drives revenue
  - Capacity factors of secondary importance
  - Generation during summer is particularly important
- QLD and NSW may have higher prices in the future
- Solar generators should be able to achieve higher revenues than wind generators

I have copies of our paper with more details, and would love to chat more!

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