



Integrating High Levels of Renewables: Implications for the Australian National Electricity Market

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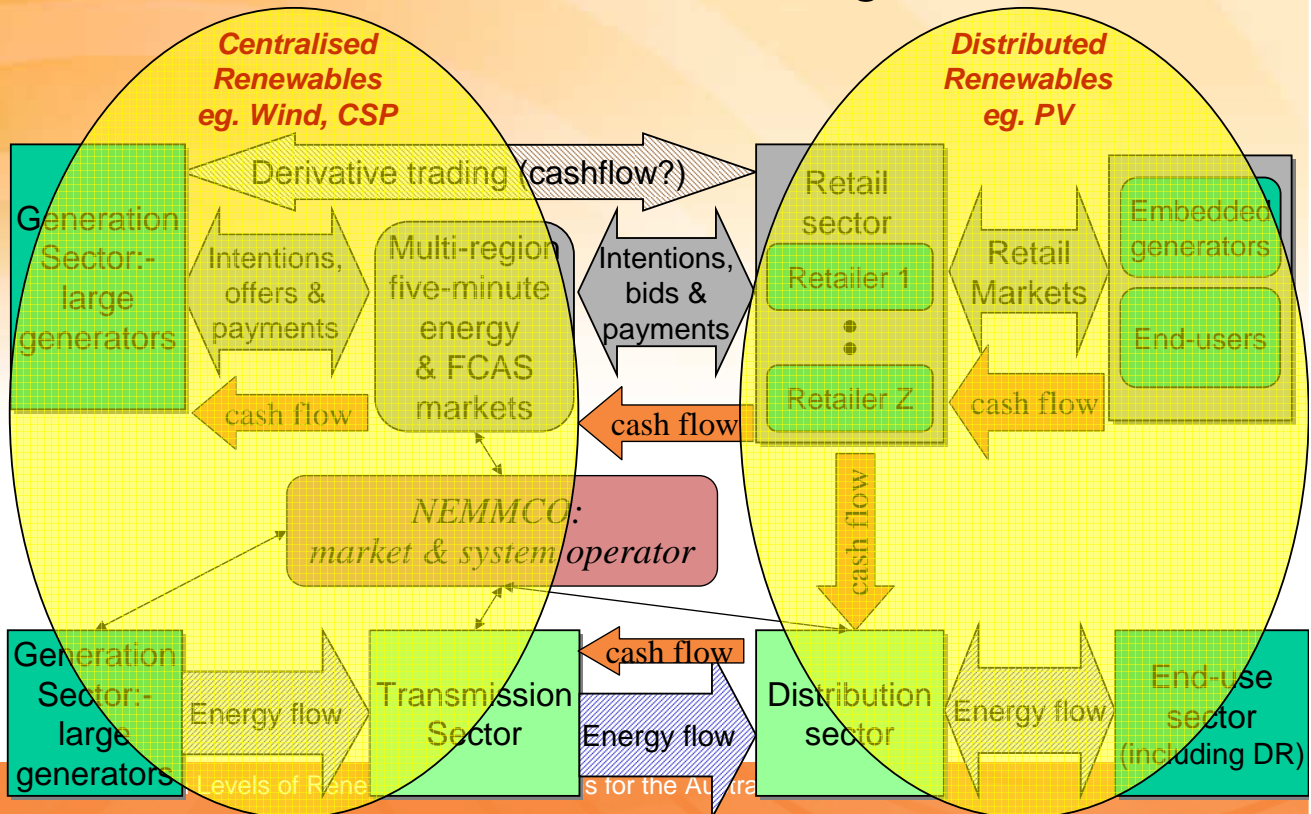
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The renewables integration challenge

- Maximise the contribution of our renewable energy options towards overall energy, environmental + social values
- For high penetrations, maximising energy value can get harder
 - More challenging sites, increasingly significant integration costs
 - *network connection + management*; match of renews with existing Tx + Dx assets, yet also potential network value for larger deployments
 - *security*; particularly wrt possible large + unexpected swings in generation
 - *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
 - *For example, Wind the first significant intermittent generation: now testing the adequacy of industry arrangements & governance around the world*
 - Interactions with specific renewable policy support measures

Two 'worlds' for renewables integration in NEM

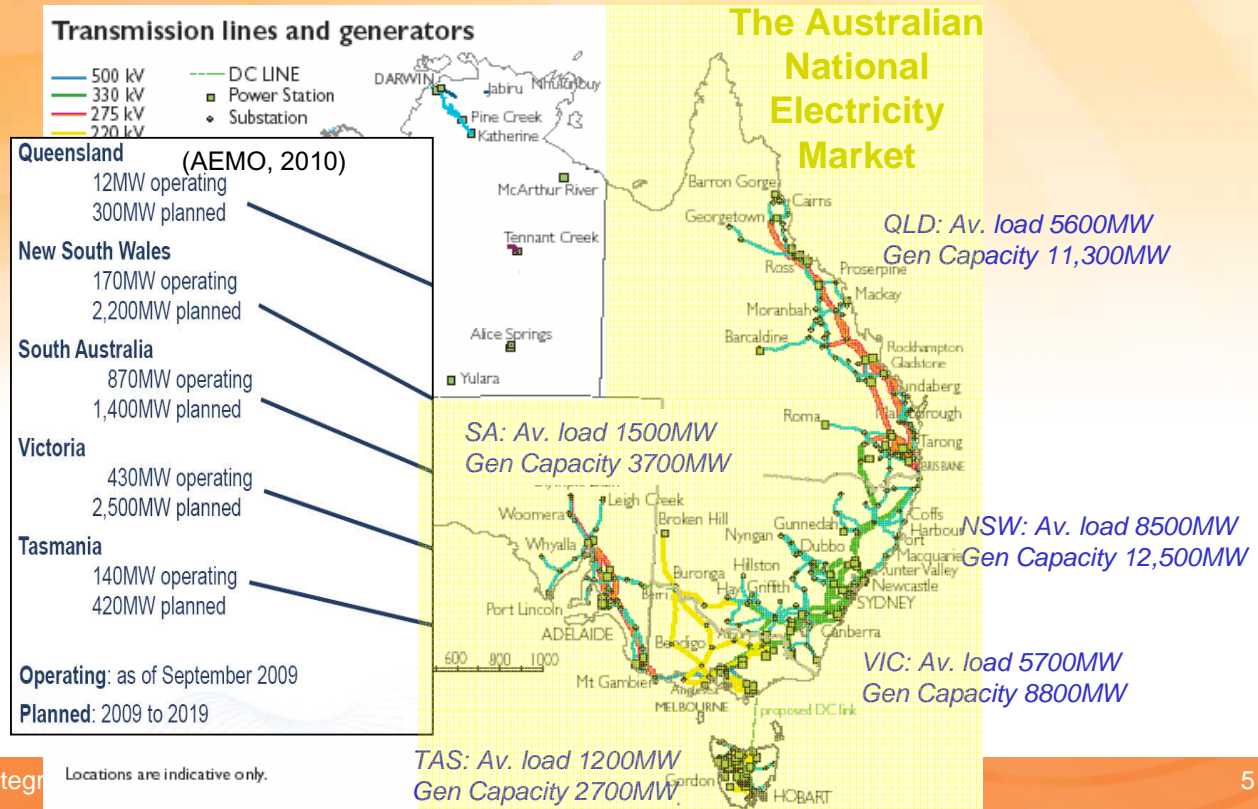


Relevant current + proposed CEEM work within context of decision-making regimes for NEM (Outhred, 2008)

Governance regime	<ul style="list-style-type: none"> Formal institutions, legislation & policies
Security regime	<ul style="list-style-type: none"> Responsible for core integrity on local or industry-wide basis, with power to override
Commercial regime	<ul style="list-style-type: none"> Coordinate decentralised decision-making according to commercial criteria Includes designed markets
Technical regime	<ul style="list-style-type: none"> To allow connected industry components to function as industry-wide machine

- CEEM / ICCLP / IES *Facilitating major RE deployment* (Betz, MacGill, Leary, Healy, Diesendorf, Twomey)
- ARC Discovery *Impacts of ETS on NEM, Robust climate and energy policy mixes, EERH funding Impacts of CPRS and eRET on NEM* (Betz, MacGill, Twomey, Outhred, Passey, Cutler, Anderson)
- CSIRO Grant *Economics of Distributed Energy, WA Study on Grid-connect PV, IEA Task 14 on High PV penetrations* (Passey, MacGill, Watt, Outhred, Bruce, Spooner)
- AEMO Wind forecasting (Cutler, Outhred, MacGill)
- Ongoing standards work for PV (Spooner)

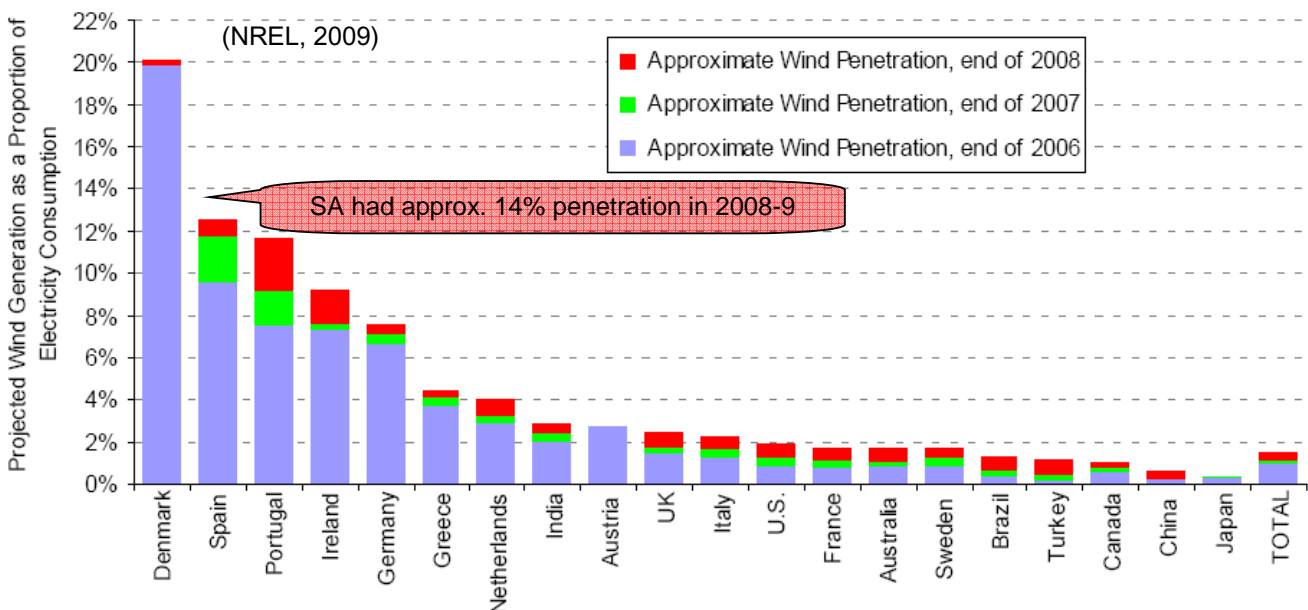
The NEM... and current and planned wind



Integr

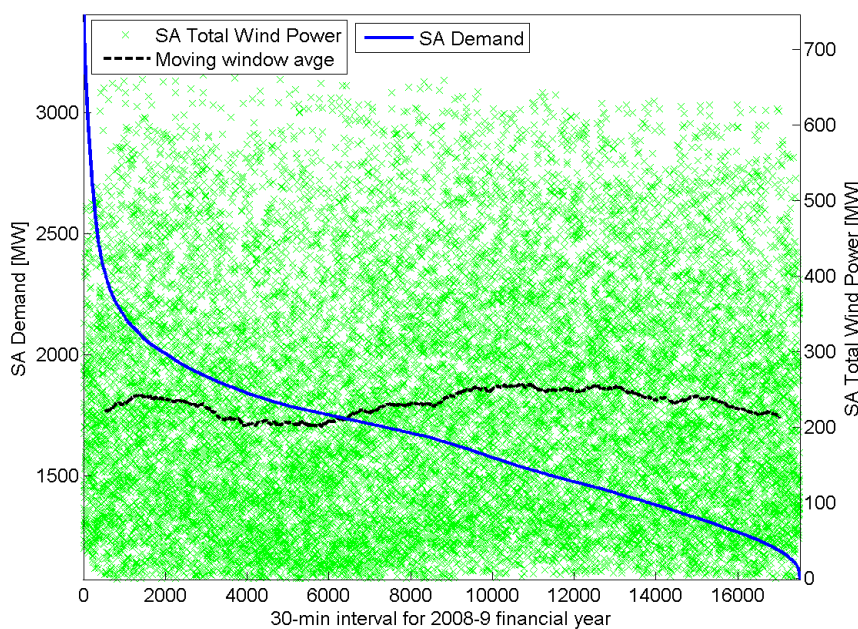
Locations are indicative only.

Current SA wind penetration significant



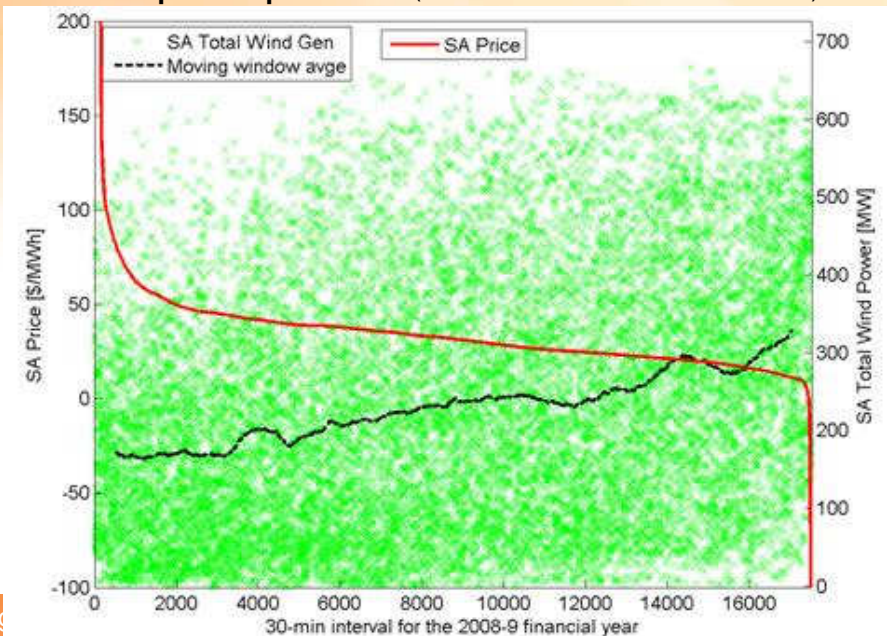
Q: Does wind generation occur at times of high demand when most needed?

- Not always, but generally at least some wind generation at times of peak demand (Cutler, MacGill and Outhred, 2009)



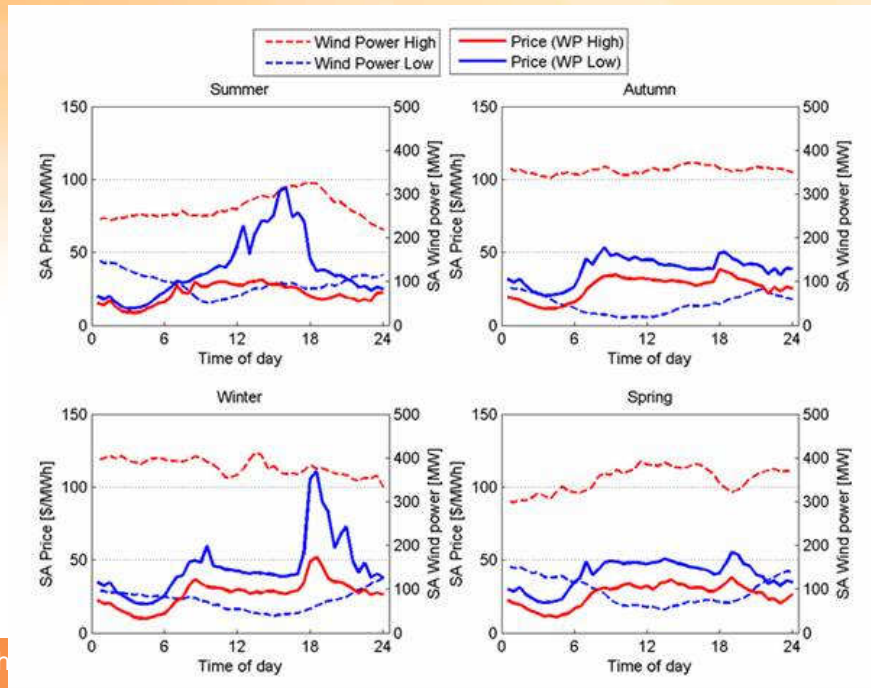
Q: Does wind generation occur at times of high electricity prices when most valuable?

- Not always, but generally at least some wind generation at times of peak prices (Cutler, MacGill and Outhred, 2009)



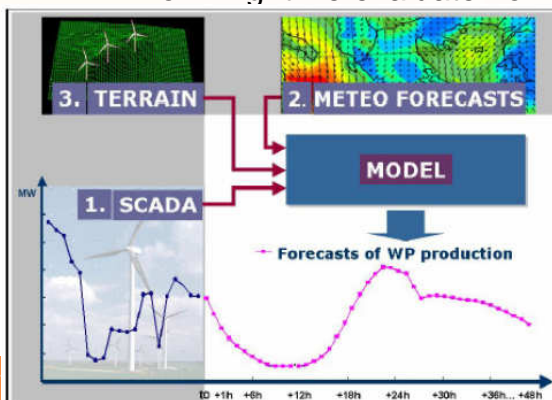
Q: Does wind generation appear to be impacting on prices?

- **Yes** eg. Av. week-day prices in SA for 2008-9 for high + low wind days



Wind forecasting – what, how & for whom?

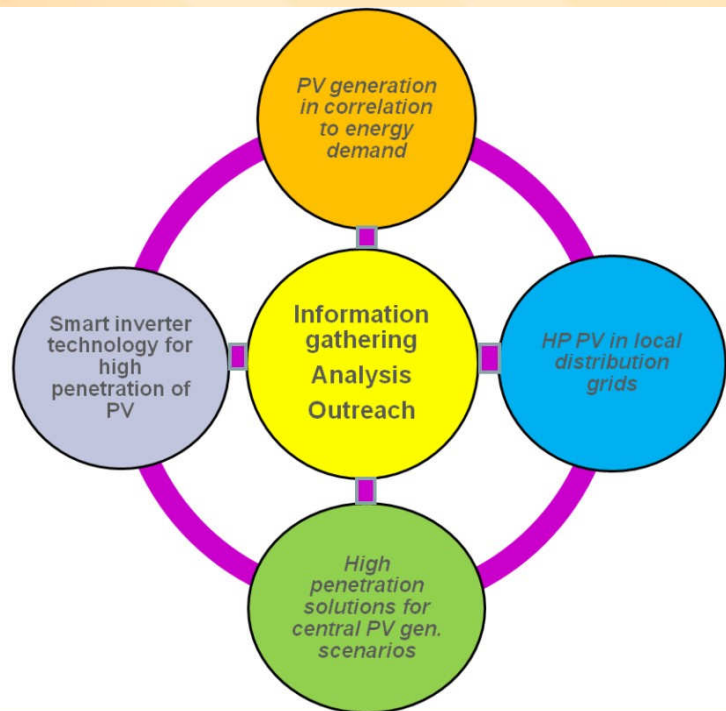
- A forecast is an incomplete set of information that aims to reduce future uncertainty by reducing “reducible uncertainty” & characterising remaining uncertainty (Outhred, 2009)
- produced by a forecasting system that should be designed with the interests of the forecast user in mind
- Where a forecast user is a decision-maker
 - What kinds of decisions need to be made?
 - What type of forecast information might help?
 - How might we evaluate how well we are helping?





IEA PVPS Task 14 – high penetrations of PV in electricity grids

- Running from 2010-14
- Current Australian involvement includes APVA, CEEM, Ergon Energy... *seeking additional partners*
- Five proposed subtasks



Integrating High Levels of Renewables: Implic



Thank you... and questions

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

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