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Auswind'07
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The role of wind in a sustainable energy future for Australia

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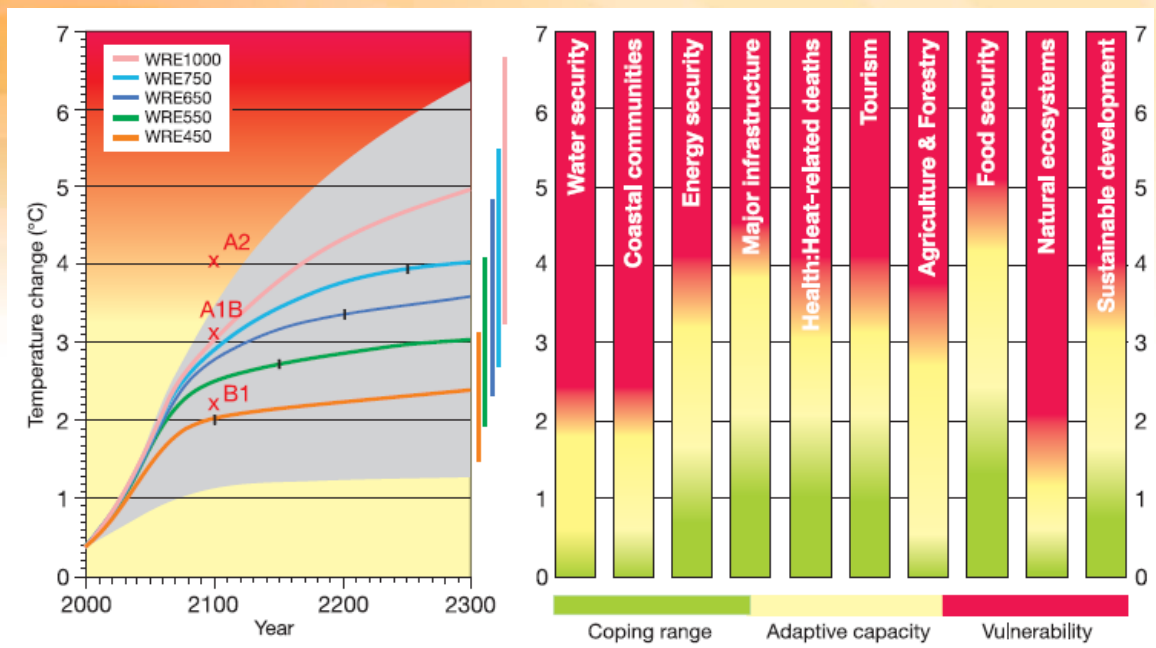
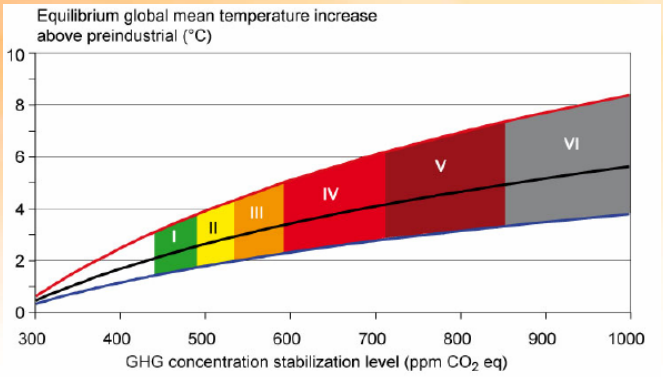
Global warming scenarios and our vulnerabilities

(IPCC WGII, 2007)



Global stabilisation scenarios for mitigation



(IPCC WGIII, 2007)

Table SPM.5: Characteristics of post-TAR stabilization scenarios [Table TS 2, 3.10][a)]

Category	Radiative Forcing (W/m^2)[2)]	CO_2 Concentration[c)] (ppm)	CO_2-eq Concentration[c)] (ppm)	Global mean temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity[b), c)] (°C)	Peaking year for CO_2 emissions[d)] (year)	Change in global CO_2 emissions in 2050 (% of 2000 emissions)[d)] (%)	No. of assessed scenarios
I	2.5 – 3.0	350 – 400	445 – 490	2.0 – 2.4	2000 - 2015	-85 to -50	6
II	3.0 – 3.5	400 – 440	490 – 535	2.4 – 2.8	2000 - 2020	-60 to -30	18
III	3.5 – 4.0	440 – 485	535 – 590	2.8 – 3.2	2010 - 2030	-30 to +5	21

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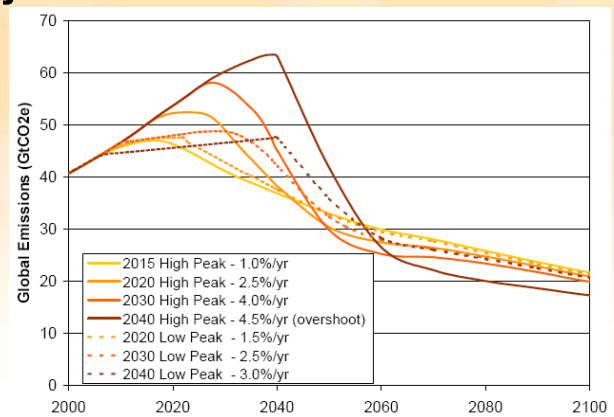
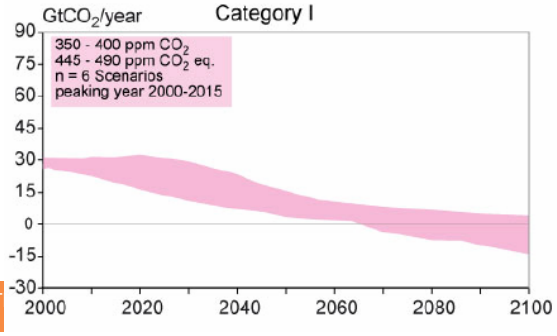
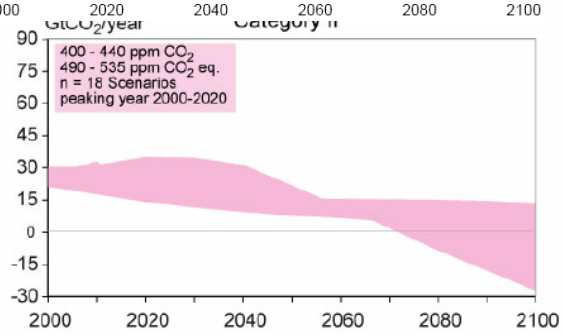
…. and possible trajectories

- Note high 'price' of delay
  - Waiting 20 years to act requires emissions to fall 3-7 times faster to a lower level

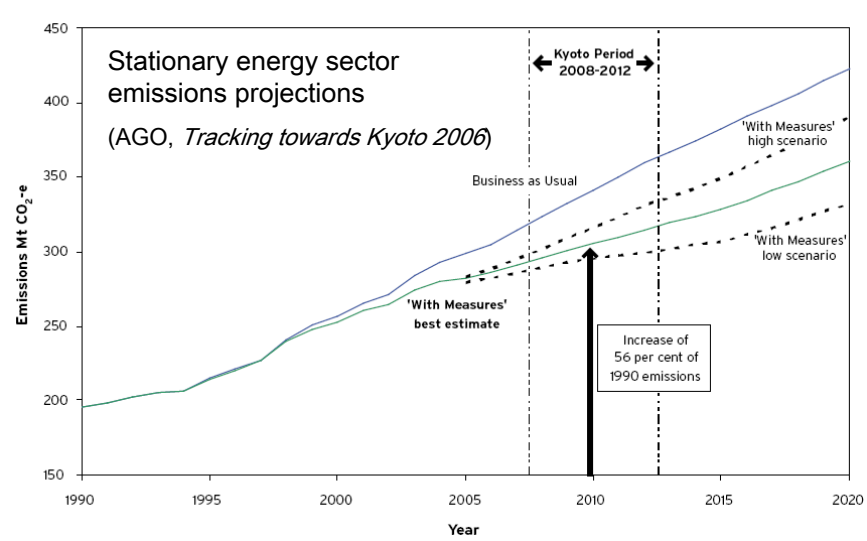






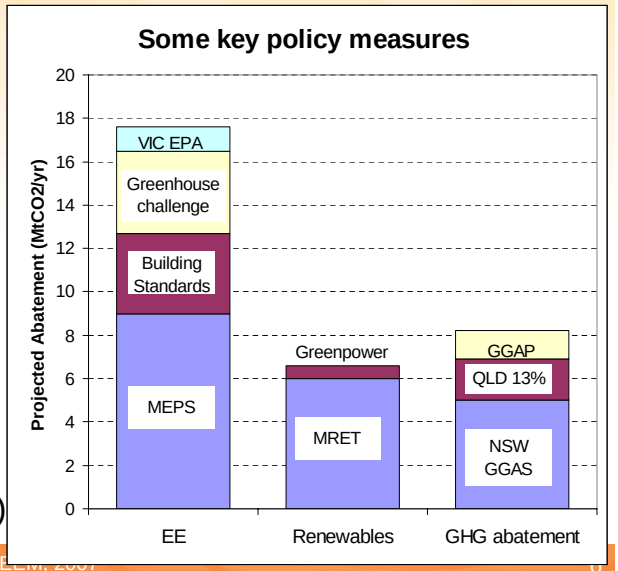
Australia's context for climate policy

- The world's highest per-capita emissions
- Energy-related emissions climbing – 70% of total
  - Estimated +35% over 1990–2004, projected +56% in 2010 and approx. +85% in 2020 under current policy measures



Current Australian Policy efforts

- Major proportion of energy-related abatement expected with current Federal policies from EE and renewables
  - Wind around 25-33% of MRET
- Coming Federal measures
  - National Emissions Trading with initially 'modest' caps below BAU growth, offsets + low penalty fee for exceeding target
  - Clean Energy Target for 2020 approx. 3X current MRET
  - NFEE expansion (stage II?)
  - R&D & Demonstration of low-emission techs focused on Carbon Capture & Storage(CCS)



Criteria for assessing our options for quick, large & sustained emission reductions from Aust. EI

- Technical status: unproven ⇔ mature
  - Implications for assessing potential costs, speed & scale of deployment
- Delivered emissions reductions
- Costs
  - Present costs where known … & possible future costs including full costs of delivering energy services such as integration costs
  - Implications for speed & scale of deployment
- Potential speed of deployment
  - Institutional & industrial capabilities: niche ⇔ widely deployed
- Potential scale of deployment
  - Possible physical, technical + cost constraints
- Other possible societal outcomes
  - eg. other environmental impacts, energy security, social acceptance

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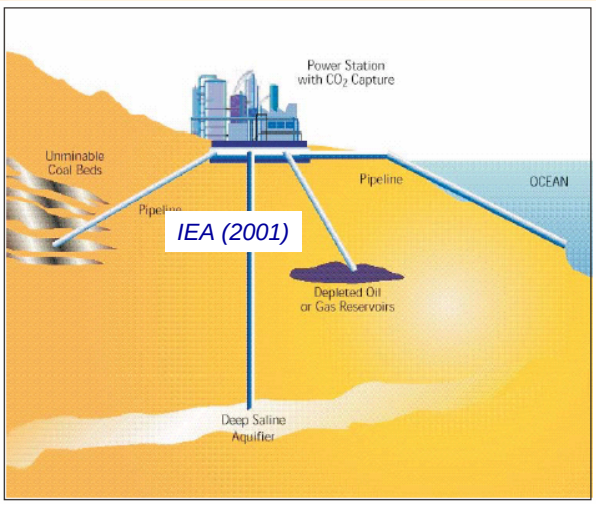
Technical status of our options

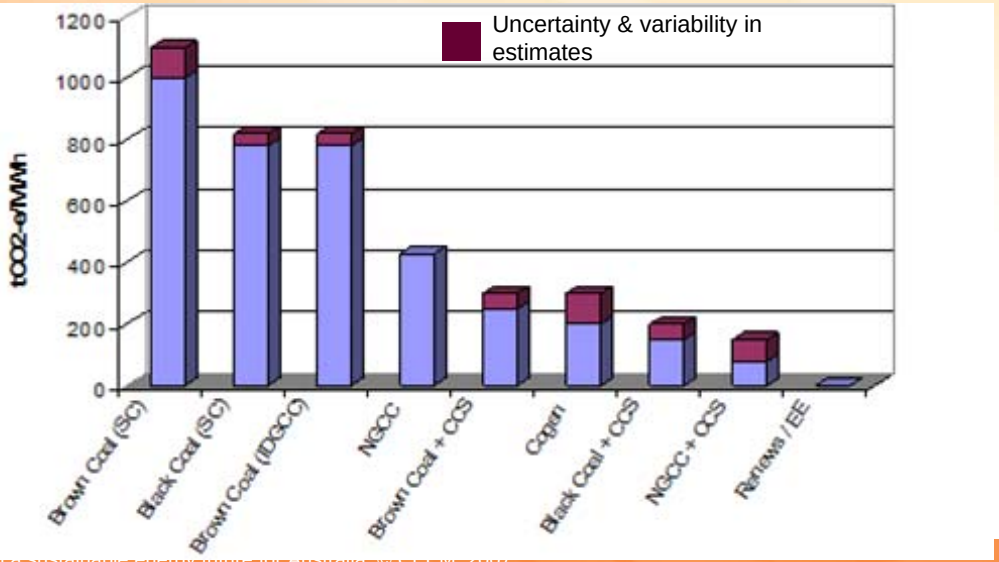
- Many commercially available & well established EE, CCGT & CHP/Cogen & renewable technologies
- Nuclear power well established although new plant designs still unbuilt or First-of-Kind, Gen IV decades away
- CCS not yet demonstrated at scale or integrated for electricity generation with coal or gas
  - Classifying & confirming reservoirs may take decades
  - Still unclear what generation technology or capture approach is most appropriate
- *Wind technology well established but continues to evolve rapidly*



IEA (2001)

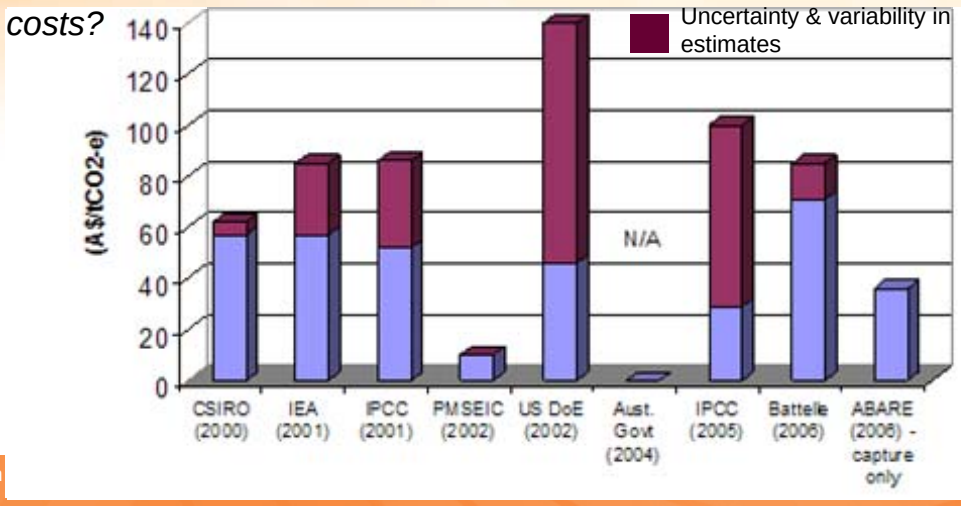
Delivered emissions reductions

- Off-the-shelf EE, Cogen & renewable options with emissions similar or lower to those of prospective CCS plants probably decades away



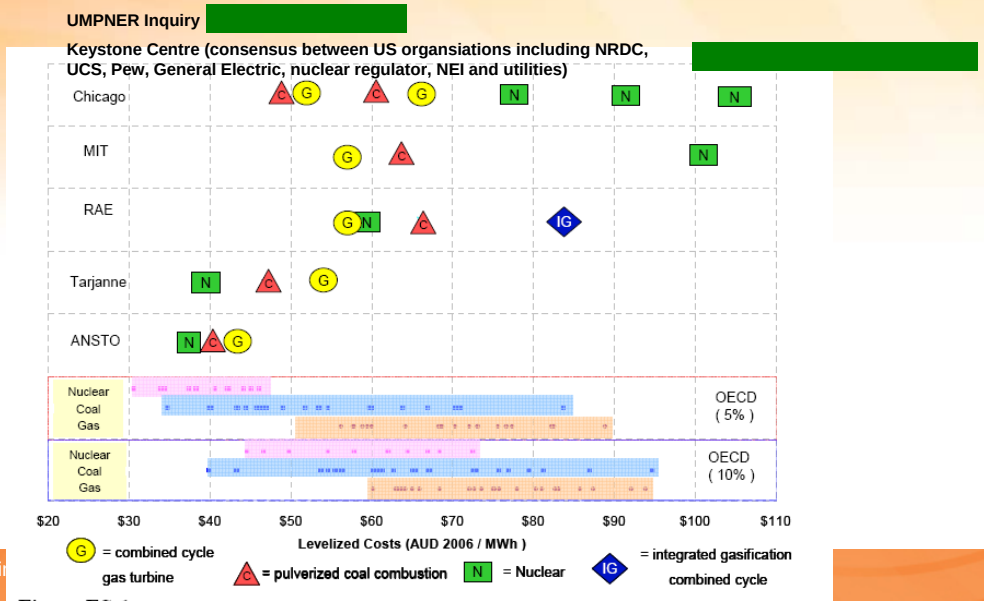
Estimated costs for our options

- Many challenges in cost estimations … particularly for technology systems that don't yet exist
- Many highly cost-effective EE options.. & more if energy costs go up
- CCGT / Cogen costs highly dependent on gas prices
- Many renewables affordable & well-understood costs *incl. wind*
- *CCS costs?*



Some nuclear cost estimates….

- Little agreement on nuclear costs – hard to price uncertainties & evolving plant techs
- EPRI estimates Australian nuclear costs 10-15% more than US with its well established nuclear industry, UMPNER cost estimates difficult to justify in this context
- A nuclear energy future for Australia likely incompatible with present electricity-intensive industry development objectives – other nukes countries will have competitive advantage



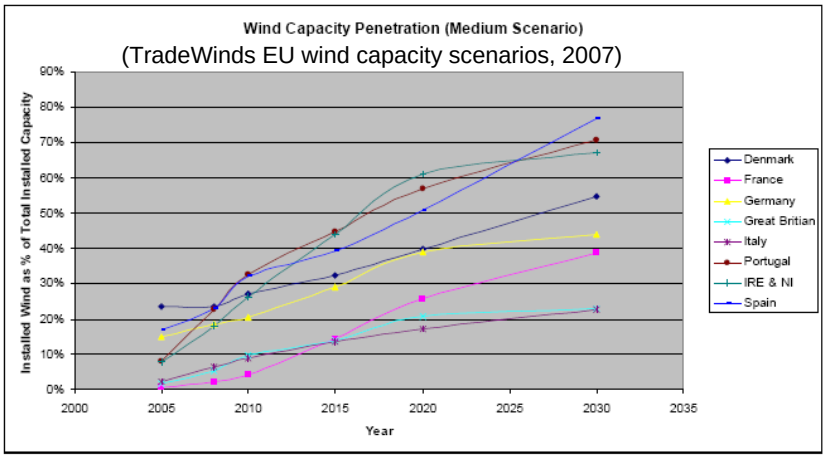
Potential speed of deployment of options

- Many EE options, CCGT & Cogen could be rapidly deployed
- Key renewables *incl. wind* currently undergoing challenging industry growth from relatively small base
- Nuclear in Australia appears very unlikely prior to 2020
  - No institutional capacity, global industry already stretched
- CCS?

Study scenario	Approximate period where significant deployment of CCS in electricity generation begins
PMSEIC (2002)	2005
IEA (2004)	2010
DoE (2004)	2020
IPCC (2005) MiniCAM MESSAGE	 2015-20 2040
ABARE (2006)	2015
CO2CRC (2006)	2030
Battelle (2006)	2025

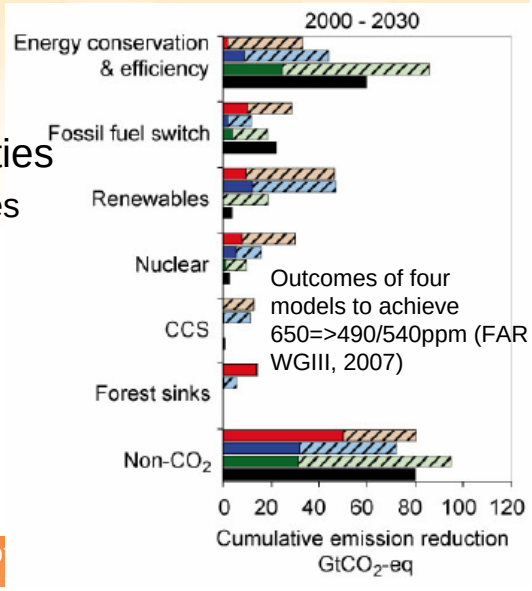
Potential scale of deployment of options

- Estimates of cost effective EE in Australia large … but inherent limits
- CCGT & Cogen deployment scale limited by low-cost gas availability
- CCS storage potential appears large but region specific (NSW options?)
- Nuclear scale-up potential has been questioned (eg. US DoE, 2005)
- Wind scale-up potential a question of economics, social acceptance & integration challenges: some regions planning for very high penetrations



Some conclusions

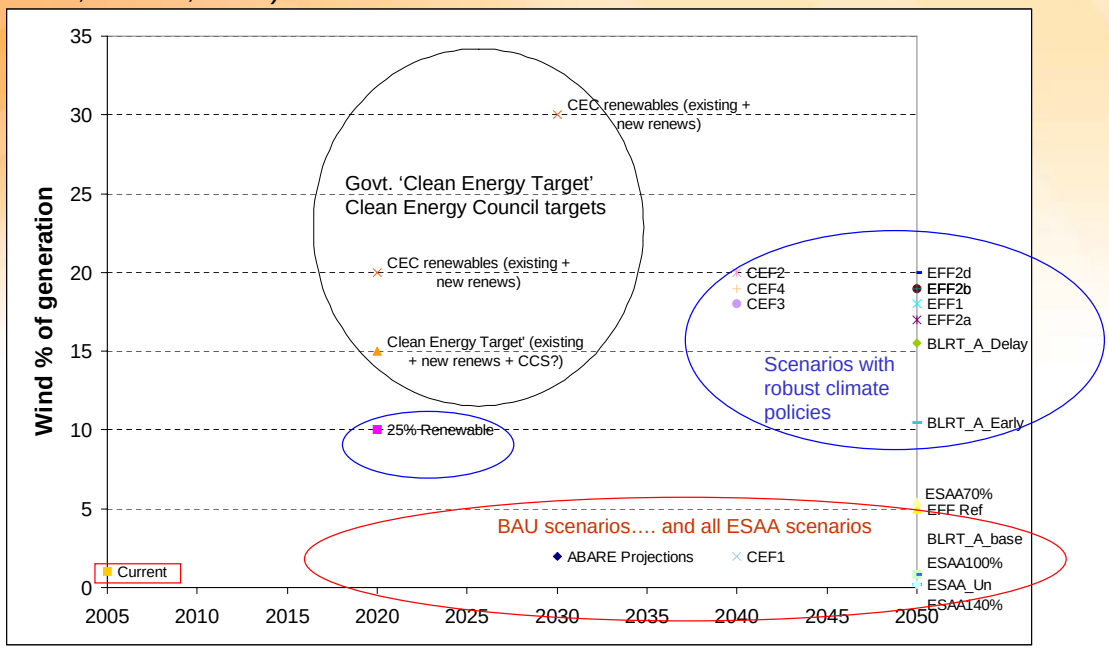
- Policy priorities: quick & large emission reductions
  - EE & conservation our highest priorities
  - CCGT & Cogen have vital early role
  - Commercial, scaled-up & moderate cost renewables have vital early role **wind is the key renewable**
- CCS & nuclear lower policy priorities
  - Need to deploy EE, gas & renewables to buy them time to be developed up / institutional capacity established
- International context varies but largely suggests similar policy conclusions



Outcomes of four models to achieve 650=>490/540ppm (FAR WGIII, 2007)

Some scenarios of Aust.'s wind energy future

(Morris, UNSW, 2007)



CANA, Clean Energy Futures, ESAA, Energy Futures Forum, Business Leaders Round Table, ABARE, Clean Energy Council

The policy challenge for wind

- Facilitating wind energy to make its appropriate contribution to quick & large emissions reductions
- Key issues
  - Policy framework with intent to drive quick & large reductions
    - Modest Emissions Trading alone entirely inadequate
  - Major renewables energy target has a vital role
  - Development of industrial & institutional capacity to support rapid expansion of wind industry: requires coordinated effort
    - Industry development initiatives – facing global competition
    - Social consensus building – planning processes
  - *Facilitation of wind integration into electricity industry*
    - *Increasing challenges with increasing penetrations*
    - *Energy value will be increasingly important part of wind's value as energy costs rise, financial support falls with reduced cost differences given carbon markets*

Facilitating high wind penetrations in the EI

- Physical realities
  - All loads, generators + network elements have electrical flows that are variable, not completely controllable + somewhat unpredictable
  - *Wind differs only by degree… but a significant degree*
- Economic perspectives
  - All supply options have integration costs
    - Eg. coal plant typically large unit sizes & relatively inflexible operation (minimum load and ramping rates). Nuclear potentially even more problematic
  - Other relevant 'externality' costs incl. water, air pollution need consideration
  - Energy value of an option depends on overall industry operation incl. other supply & demand techs and their interactions
    - Eg. wind & gas generation have useful synergies
    - CCS & nuclear when available might face integration challenges in EI with major demand reductions from EE as well as high penetrations of renewables & gas
- Commercial perspectives
  - Worldwide moves towards EI restructuring with mixed success
  - Wide range of choices in design + structure of restructured industries
  - Electricity industry infused with short to long-term risks that are difficult to commercialise (correctly allocate to industry participants)

Facilitating high wind penetrations in NEM

- Present renewable policy support *design* reasonable
  - MRET style approaches expose projects to energy market signals
    - Energy mkt value a key part of overall cashflow unlike eg. feed-in tariffs
    - However, details matter & only part of coherent policy framework required
- NEM design reasonable.. especially compared to some others
  - Wholesale prices somewhat reflect electricity's real time, location & contingency varying value & have high transparency
  - Appropriately manages some of inherent uncertainty within industry
    - Ancillary, spot & derivative markets allow short => longer-term commercial responses to changing circumstances eg. 5 min. rebidding by any gen
  - For wind energy projects
    - AWEFS an opportunity for world-leading wind forecasting facilitating higher wind penetrations by supporting security, commercial decision-making
    - Already see many of NEM (admittedly imperfect) commercial signals
    - Are being more formally bought into dispatch arrangements
- NEM a good platform for progress… but more work required

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Thank you… and questions

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