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The Australian National Electricity Market

Iain MacGill (Joint Director, Engineering)

EVN Training Program

UNSW, September 2007

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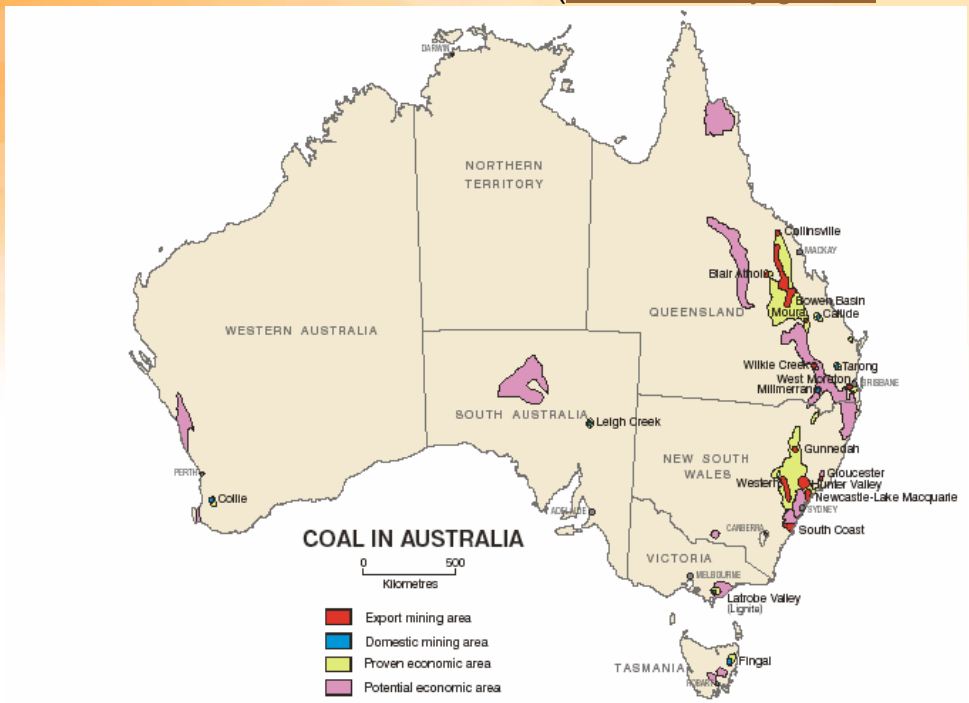
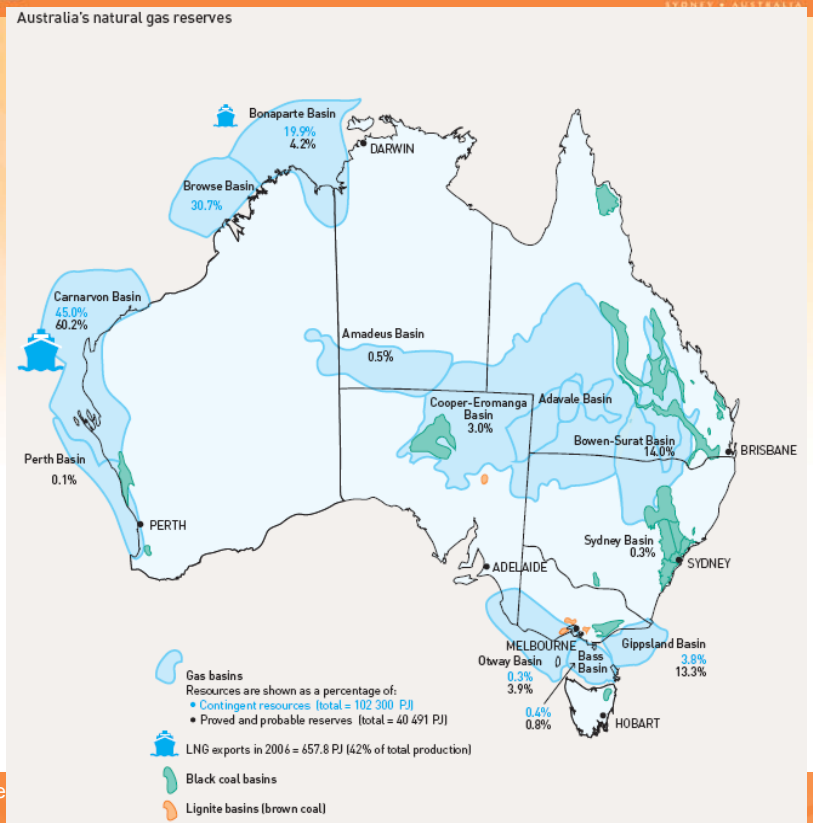
CEEM established …

- *to formalise* growing shared research interests + interactions
  - Faculties of Engineering, Business (Economics and Management), Arts and Social Sciences, Science, Institute for Environmental Studies...
- *through UNSW Centre*
  - aiming to provide Australian research leadership in interdisciplinary analysis + design of energy and environmental markets
- *Current research efforts*
  - Facilitating wind integration in the NEM
  - Renewable energy policy support options in restructured industries
  - Market design for restructured electricity industries
  - Emissions Trading Schemes + options for Australia
  - Technology assessment for sustainable energy options
    - Including Carbon Capture and Storage, Nuclear power
  - Economic modelling of Distributed Energy
  - Energy efficiency policy – regulation, financial mechanisms
  - Policy frameworks for technology innovation

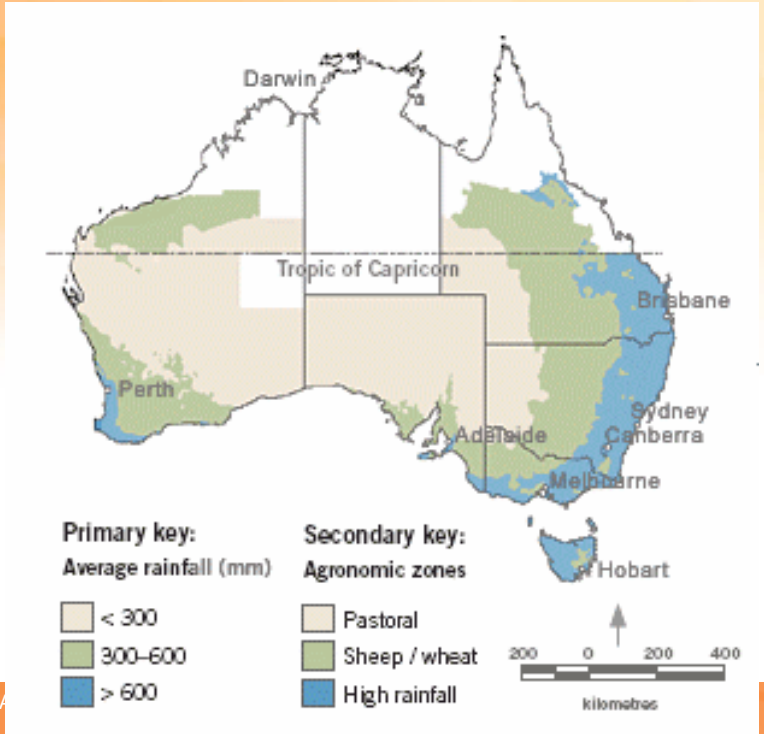
Australia's coal resources (www.industry.gov.au & SKM)



Australian gas resources

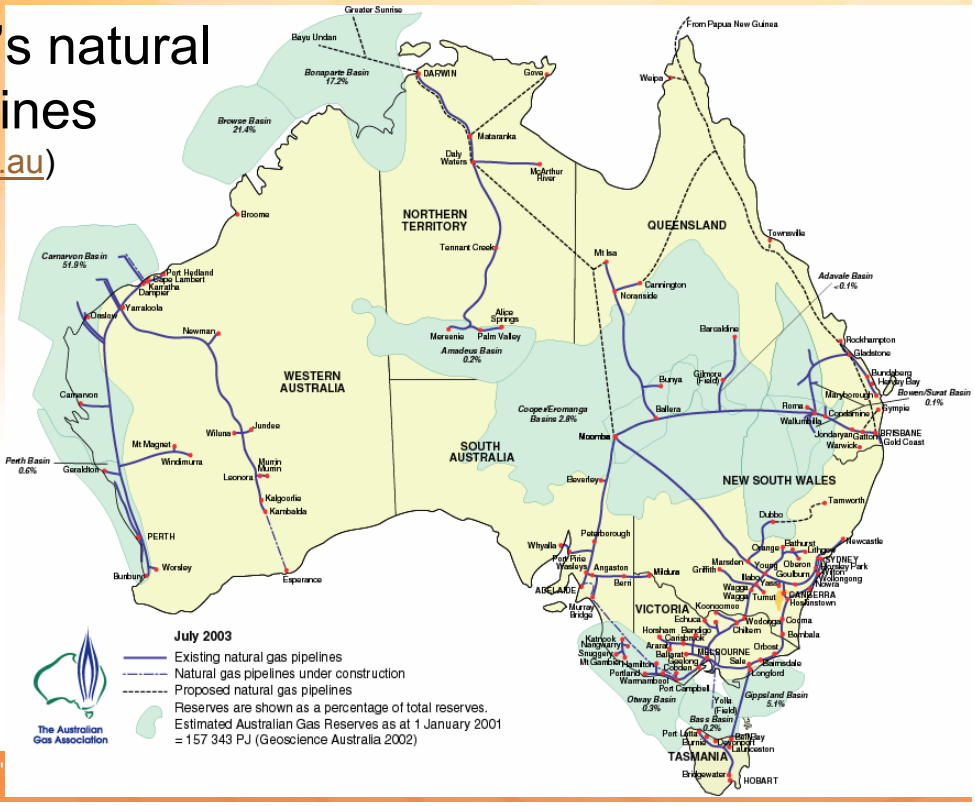


Australian hydro resources



Australia's natural gas pipelines

(www.aga.asn.au)



Australian electricity demand + supply

Western Australia
~12 TWh/yr (7%)

Northern Territory
~1.5 TWh/yr (1%)

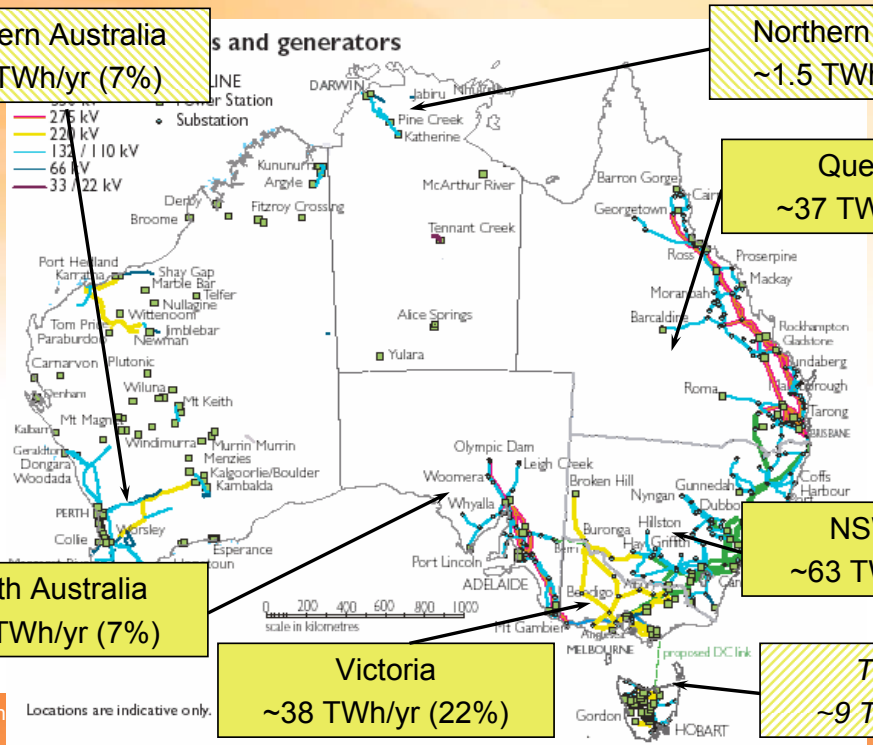
Queensland
~37 TWh/yr (21%)

NSW & ACT
~63 TWh/yr (36%)

South Australia
~11 TWh/yr (7%)

Victoria
~38 TWh/yr (22%)

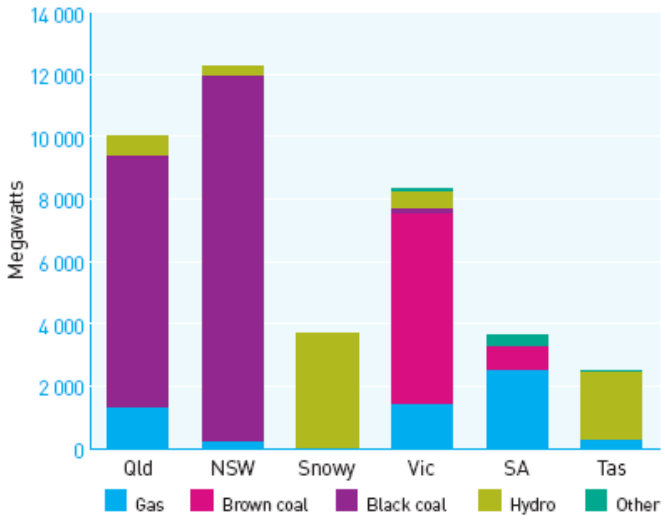
Tasmania
~9 TWh/yr (6%)



Locations are indicative only.

Current NEM generation mix

Figure 1.7
Regional generation capacity by fuel source, 2007



Note: Excludes power stations not managed through central dispatch.
Data source: NEMMCO

Australia's coal dependence for elec. gen

Table 1: Percentage of electricity generated from coal in selected countries

Country	Year	Percent of electricity from coal	Trend since 1990
Poland	2000	96	Steady at saturation
South Africa	2000	about 92	rising slightly towards saturation
Australia	2000	78	Steady
PR China	1999	75	small increase over the decade
India	1999	75	small increase
Czech Republic	2000	73	Steady
Germany	2000	53	fallen slightly
USA	2000	52	Steady
Denmark	2000	47	big decline as gas and wind increase
Korea	2000	42	big increase
UK	2001	37	big decline since 1986
Japan	2000	22	big increase
Thailand	1999	18	small decrease
Vietnam	1999	12	big decrease

(WWF, *Coal-fired electricity and its impact on global warming*, 2003)

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Traditional Australian EI model

- As seen in many parts of the world:
  - Statutory authorities supervised by a Minister or State Owned Corporations (SOCs):
    - Mainly vertically integrated monopolies
    - Separate State Networks and jurisdictions
  - Decision making political, "behind closed doors":
    - Few formal procedures for decision making
    - Politicians negotiate tradeoffs

Evolution of EI restructuring in Australia

- Development of COAG process in late 80's
  - Formal interface between Federal & State governments
- National Competition Policy, *1993 Hilmer Report*:
  - Facilitate competition where effective & pro-competitive regulation where not; Treat public & private firms equally; uniform market rules of conduct where possible; access regimes for essential facilities
  - **Highlighted potential value of energy industry 'reform'**
- Competition Reform Act, *1995*
  - Amended TPA + new Competition & Consumer Commission (ACCC):
- *Now well over a decade of energy industry restructuring*
  - *National Electricity Market (NEM) incorporating NSW, QLD, VIC, ACT, SA (+ now TAS) established in 2000*
  - *More limited changes in Gas industry*
  - *A mix of national + jurisdictional (State + Territory) roles*

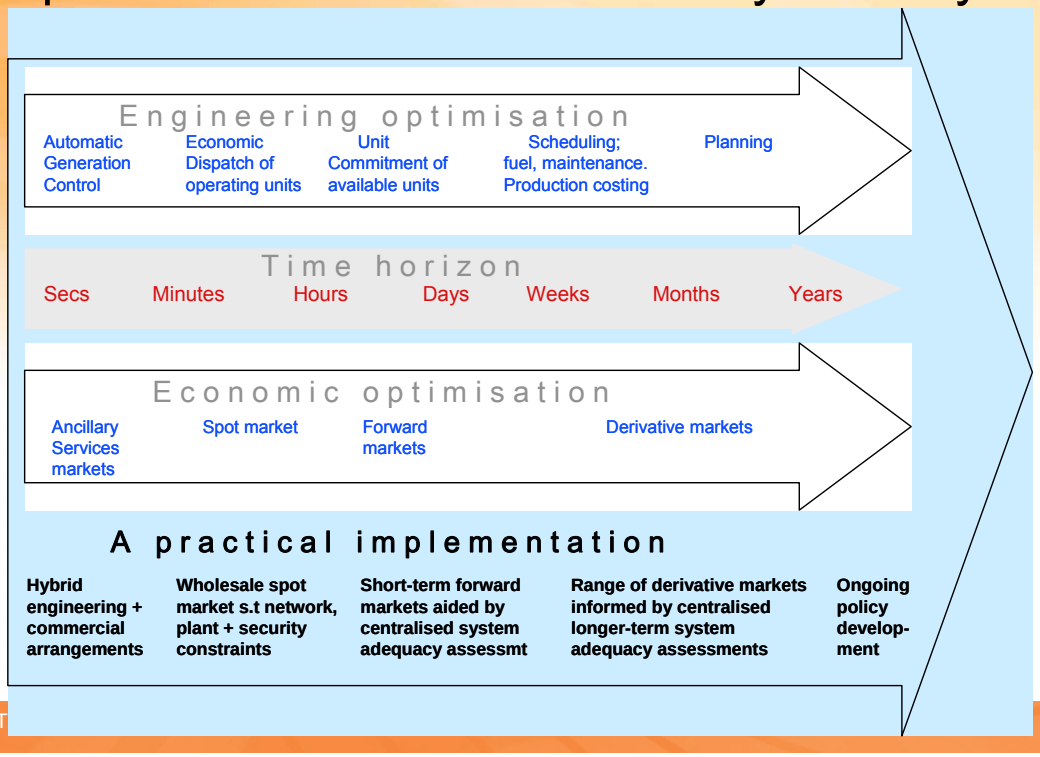
Major objectives of Australian Energy Market Reform

Established during 1990's, See Energy Market Review, Issue paper, March 2002

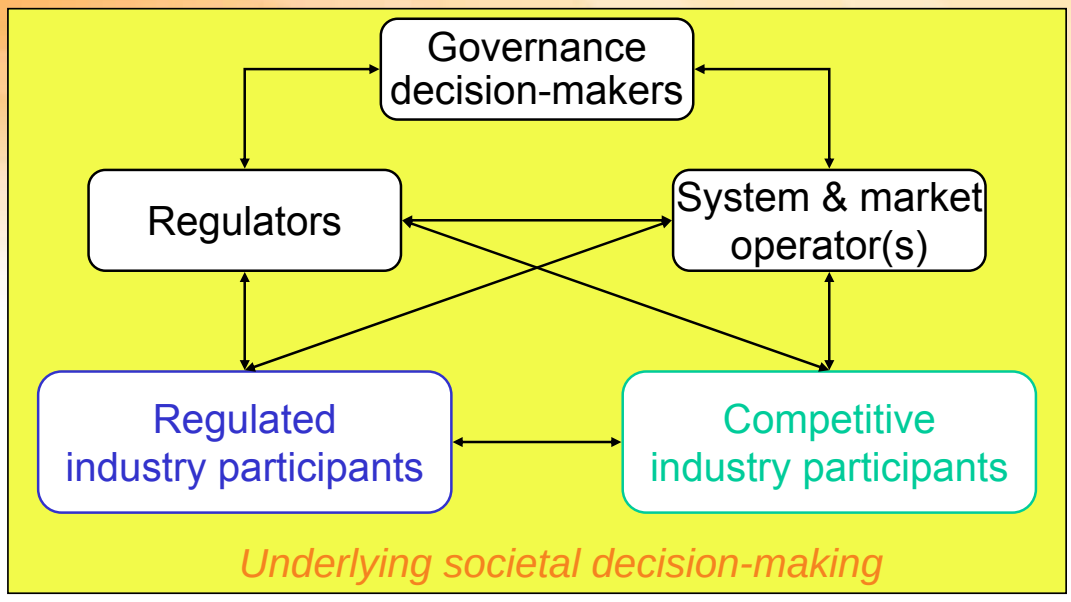
Reform Objectives

- Restructuring government-owned utilities
- Removing barriers to inter-state and intra-state trade of energy
- Establishing a transparent, wholesale spot market for electricity to enable competition among generators and retailers in the eastern states
- Establishing open access to electricity networks and third-party access to natural gas networks, and economic regulation of transmission and distribution networks to ensure efficient and transparent pricing of network services
- Enabling customer choice down to the smallest retail customer
- Achieving competitive neutrality in relation to fuel sources, between incumbents and new entrants and between government-owned and privately-owned businesses

A possible restructured electricity industry



Decision-making framework for a restructured electricity industry



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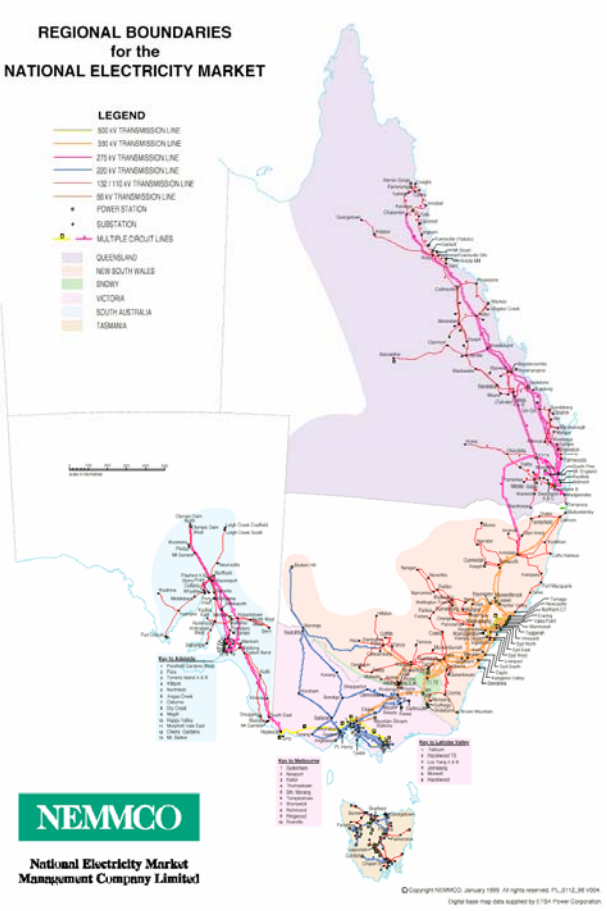
The NEM

- Queensland
- New South Wales & ACT
- Victoria
- South Australia
- Tasmania

Commenced operation in 1999



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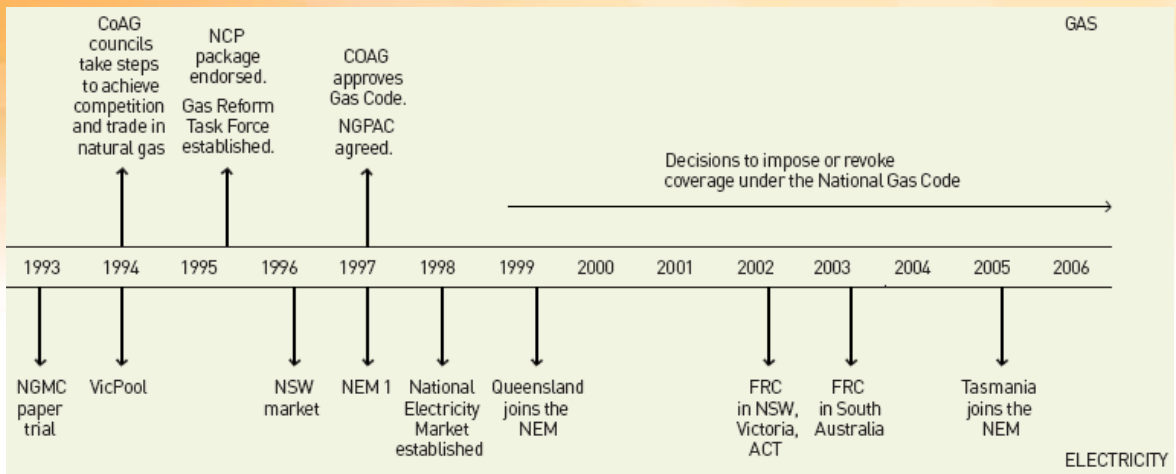
NEM timeline



NEM overview

Table 2.1 NEM at a glance

Participating jurisdictions	NSW, Qld, Vic, SA, ACT, Tas
NEM regions	NSW, Qld, Vic, SA, Snowy, Tas
Registered capacity	43 130 MW
Number of registered generators	263
Number of customers	7.7 million
NEM turnover 2006–07	$13 billion
Total energy generated 2006–07	206 TWh
National max winter demand 2006–07 (21 June 2007)	32 688 MW
National max summer demand 2006–07 (5 February 2007)	31 796 MW

Features of National Electricity Rules (NER)

- NEM covers all participating states:
  - A multi-region pool with intra-regional loss factors
  - Ancillary services, spot market & projections
  - Auctions of inter-regional settlement residues
  - Operated by NEMMCO (owned by states)
- Compulsory participants in NEM:
  - All dispatchable generators & links > 30 MW
  - Network service providers & retailers
- Contestable consumers may buy from NEM

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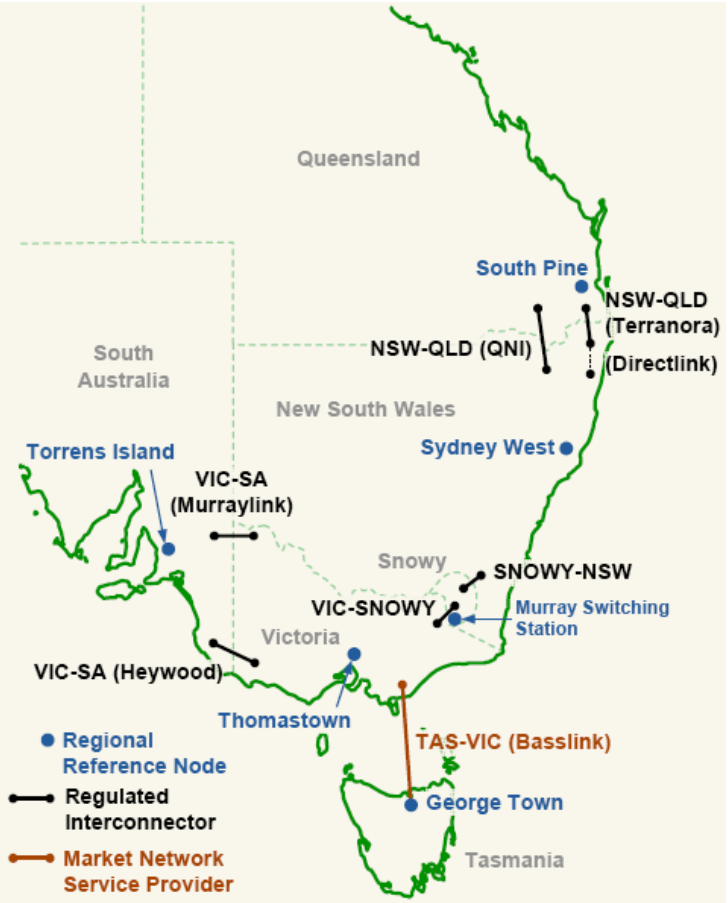
NEM regions

(NEMMCO SOO, 2006)



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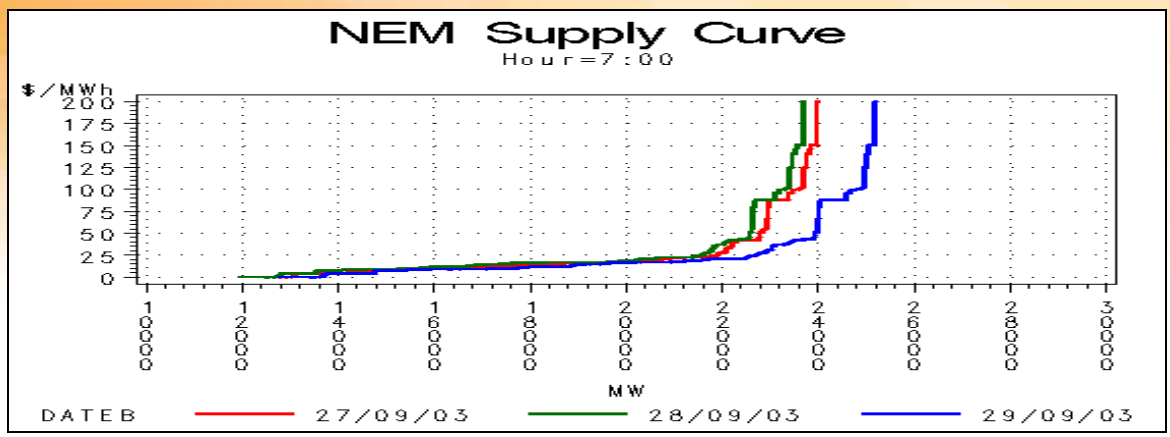
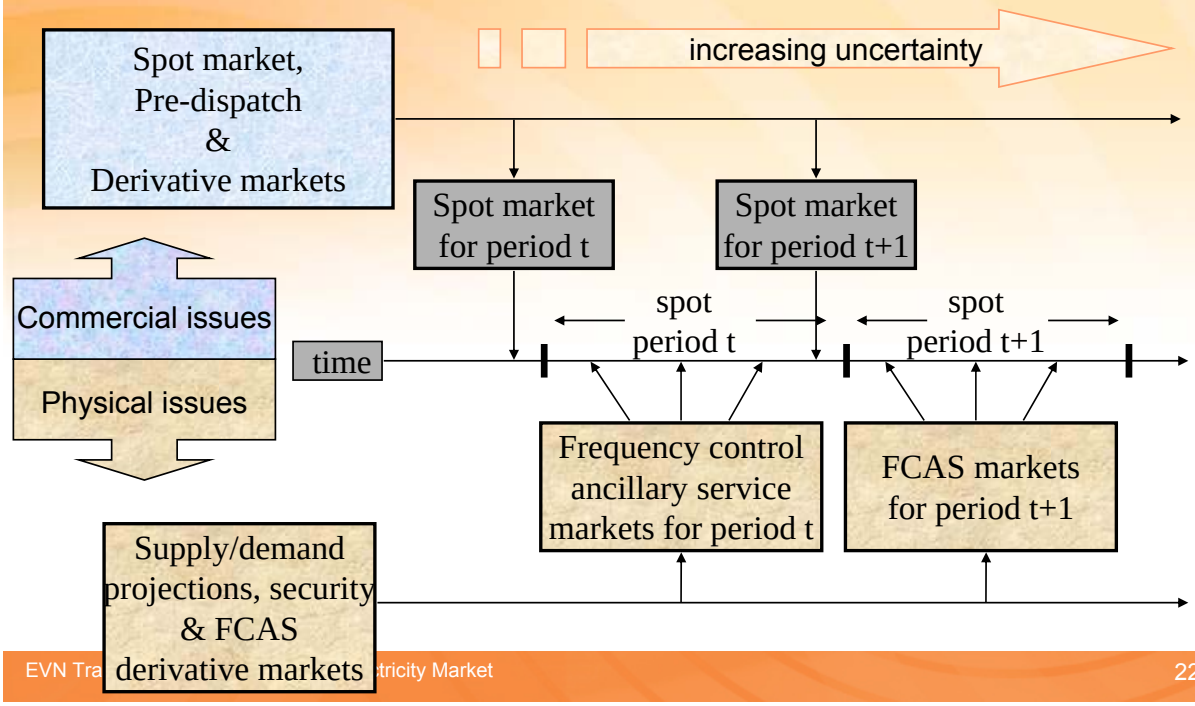
Spot market offers & bids

- Generators, retailers & direct end-users:
  - Price-quantity curve (sell or buy) for each half hour:
    - ≤ 10 daily prices, quantities changeable until dispatch
  - 5-minute demand forecast is bid at $10,000/MW (VoLL)
- Dispatchable links between regions:
  - Flow offer curve based on price difference
- Bids & offers ranked to give dispatch stack:
  - Considering loss factors & inter-tie constraints
  - Operating levels are set for all dispatchable resources
  - 5 minute price(s) set by marginal dispatchable resource:
    - Half-hourly averages are calculated in ‘real time’

NEM Supply curve at 7am on 27, 28 & 29 September 2003 (Saturday-Monday) (T Baker, Delta)



Managing supply-demand balance in NEM



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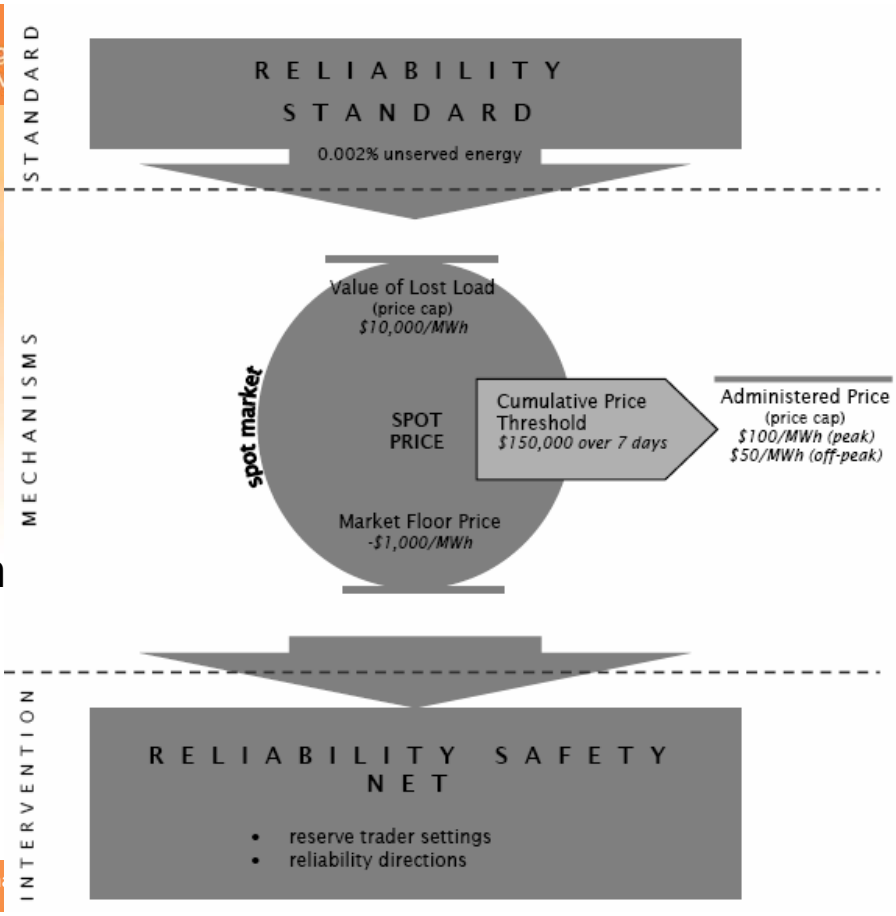
NEM transmission level reliability target, spot market mechanisms & intervention to meet it (AEMC Reliability Review, 2006)



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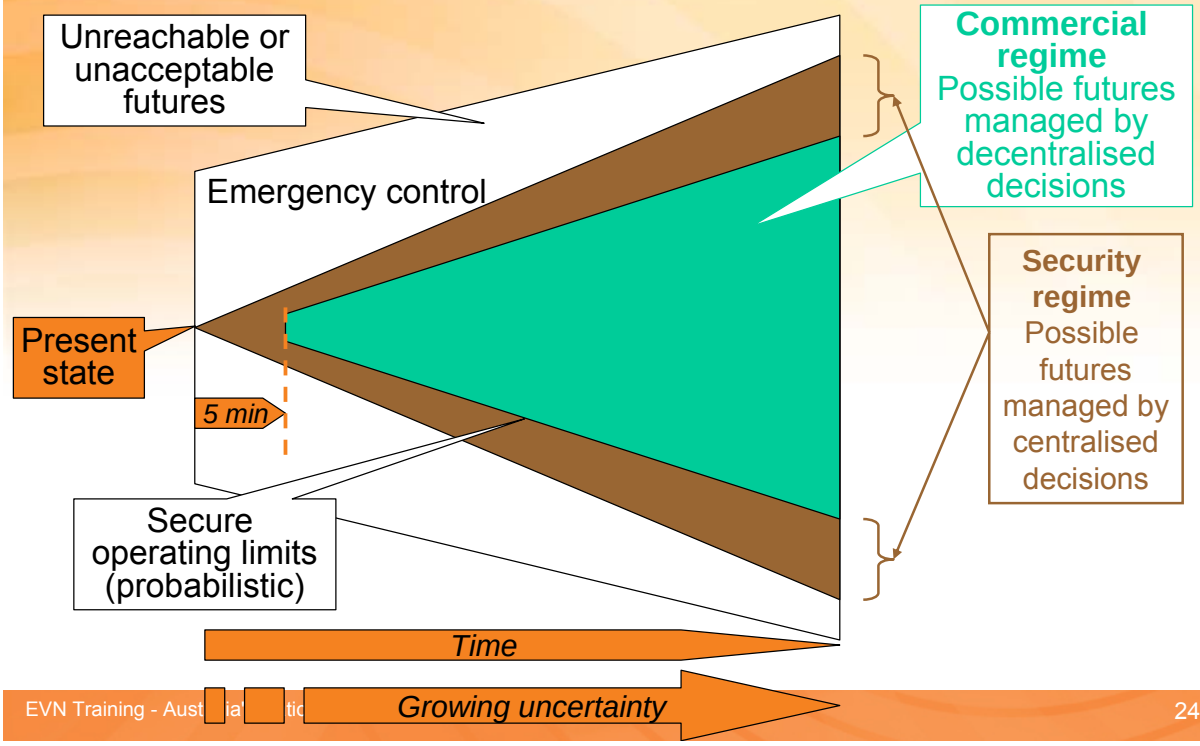
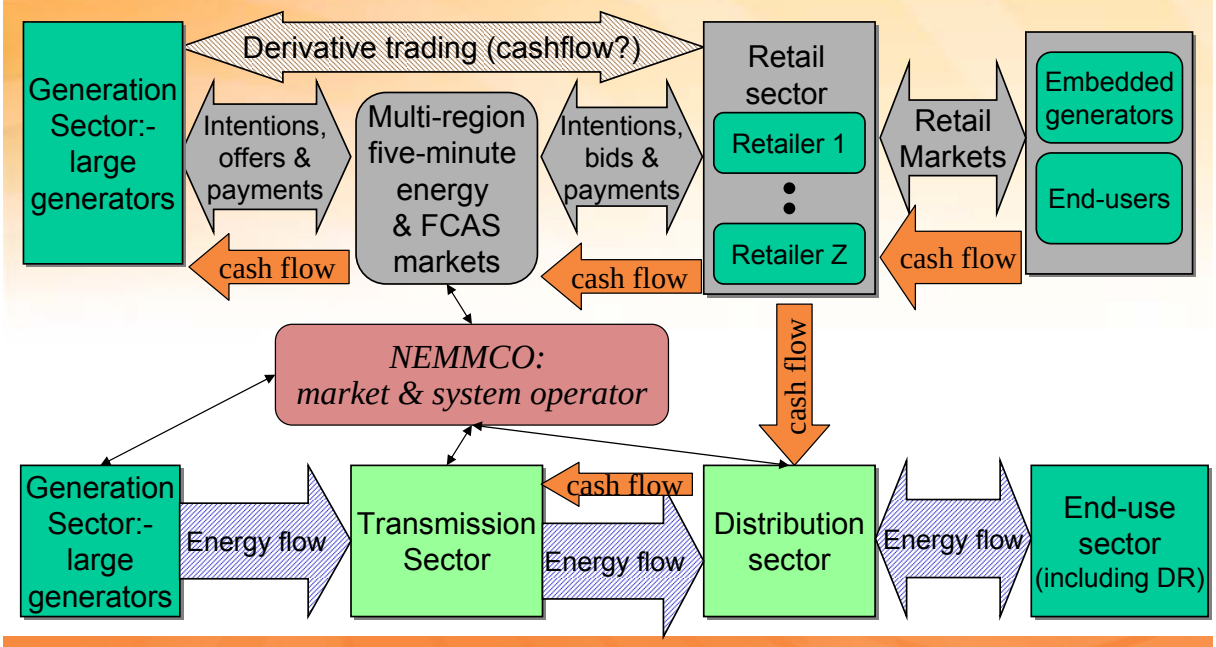
Security & commercial regimes (global & local)

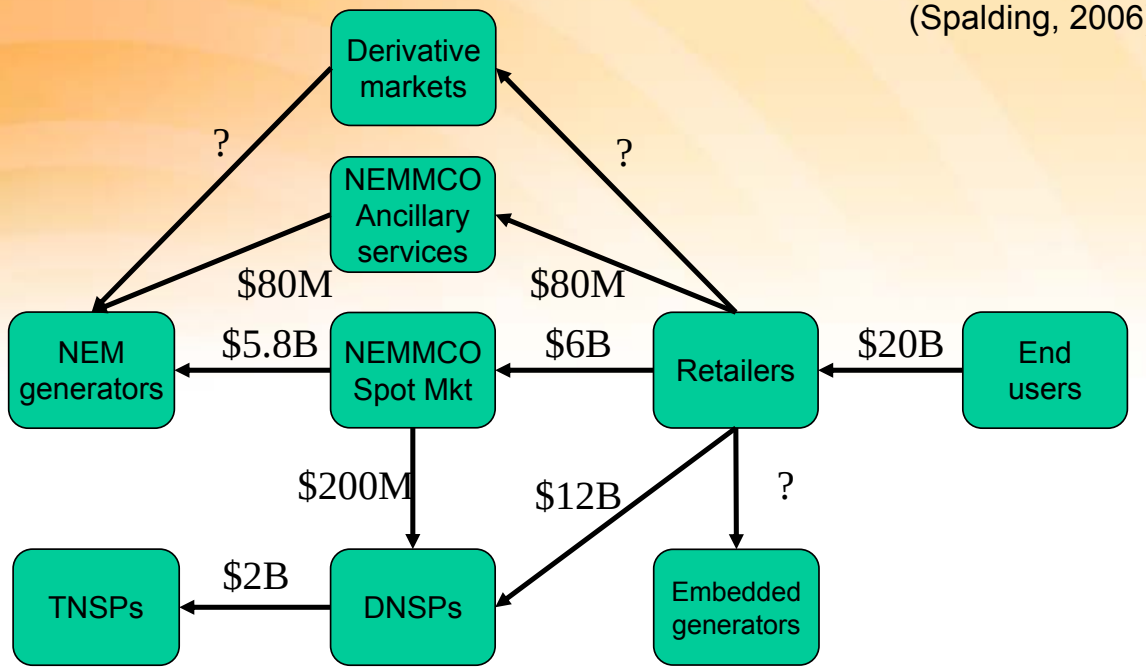


Industry structure & decision-making in the NEM



Cash flow in SE Australia electricity industry

(Spalding, 2006)



Current ownership status of the Australian electricity supply industry

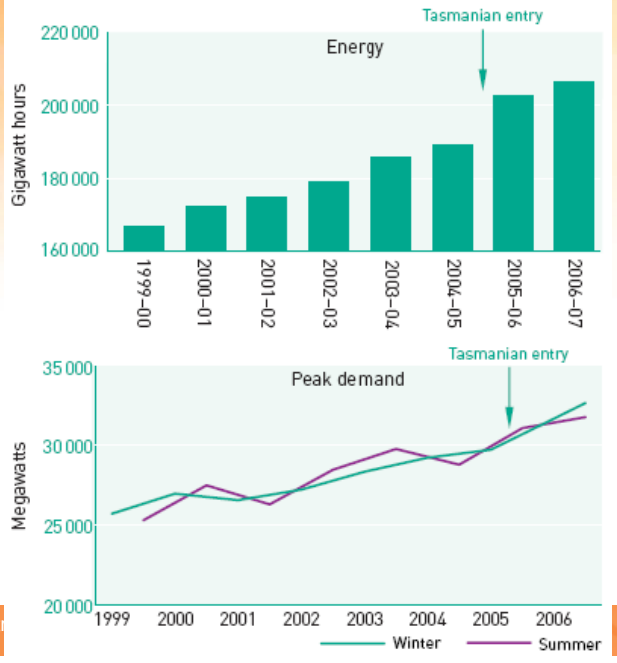
Public ownership	Private ownership
Most in NSW, Tasmania, WA & NT	• Victoria: all privately owned • South Australia: all leased • Queensland: private retailers

- There are privately owned retailers in most states:
  - Qld recently sold Energex retail & part Ergon retail
- There are concerns about existing or potential concentration of ownership in most states:
  - Snowy sale was cancelled
- Tallawarra NSW 400MW CCGT will be privately owned
- End-use is largely privately owned.

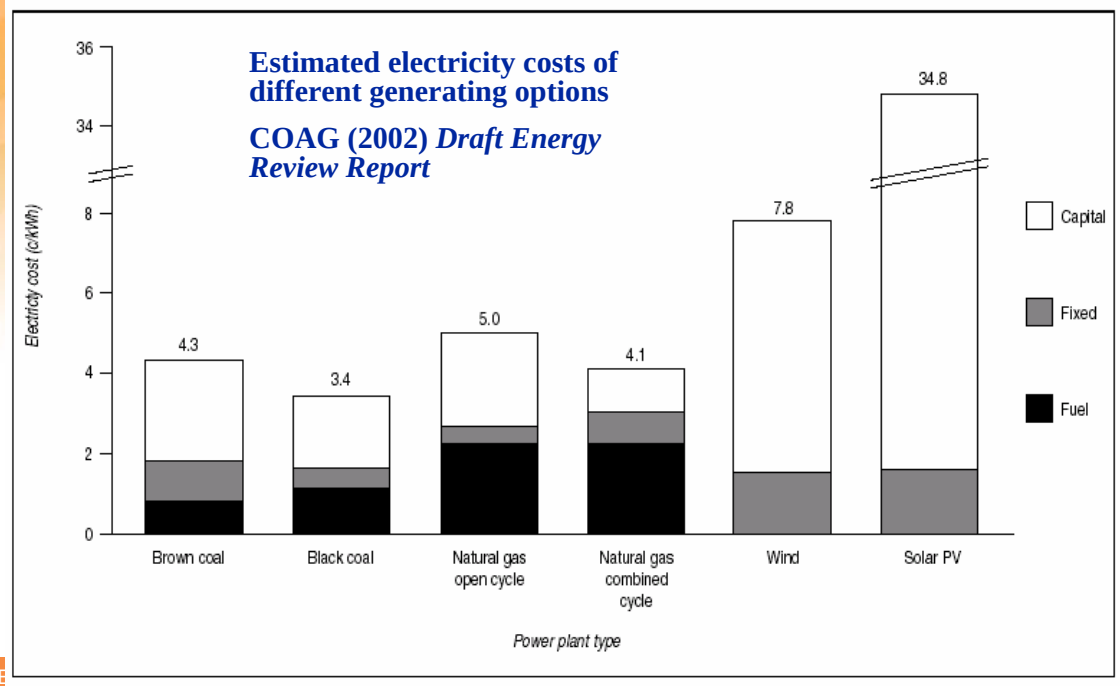
NEM energy and peak demand growth

Figure 2.3a and b

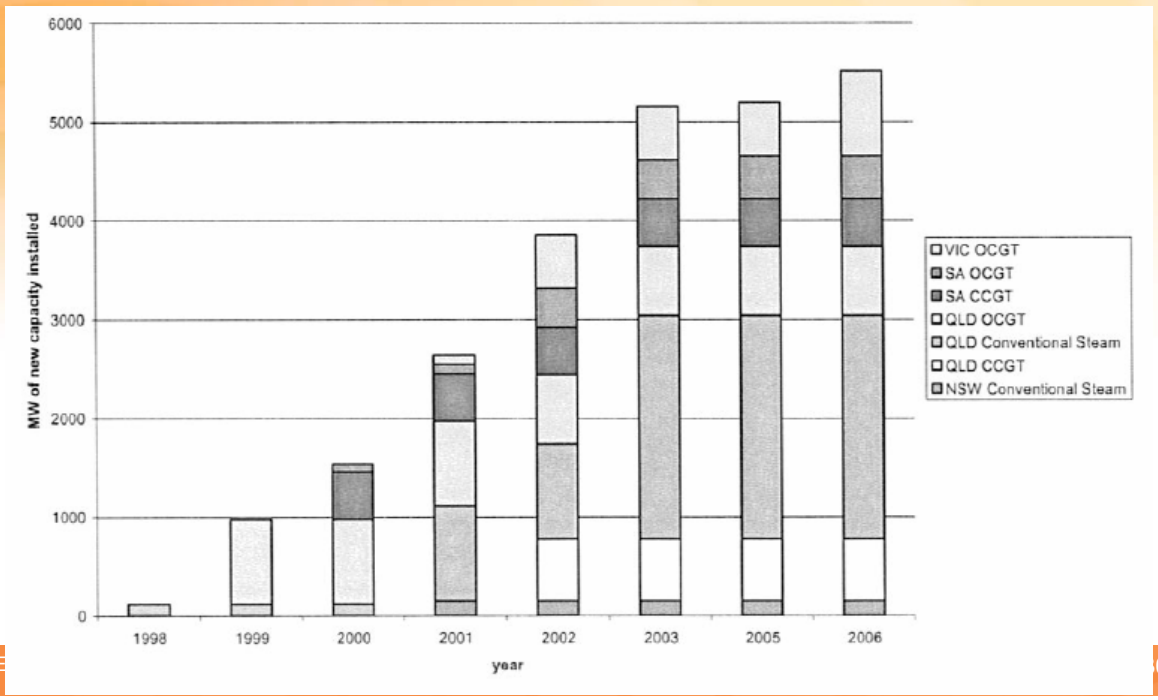
NEM energy consumption and peak demand since 1999



Generating plant costs in Australia



Generation commissioned in NEM 98-06
(ESIPC, 2006)



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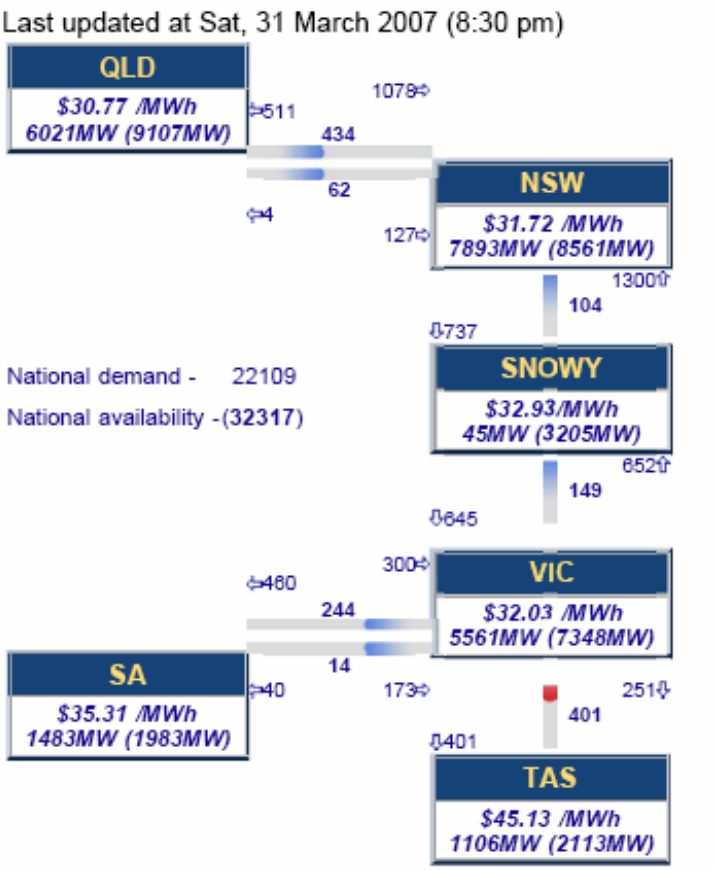
NEM spot market snapshot

(AER, 31/3/07)



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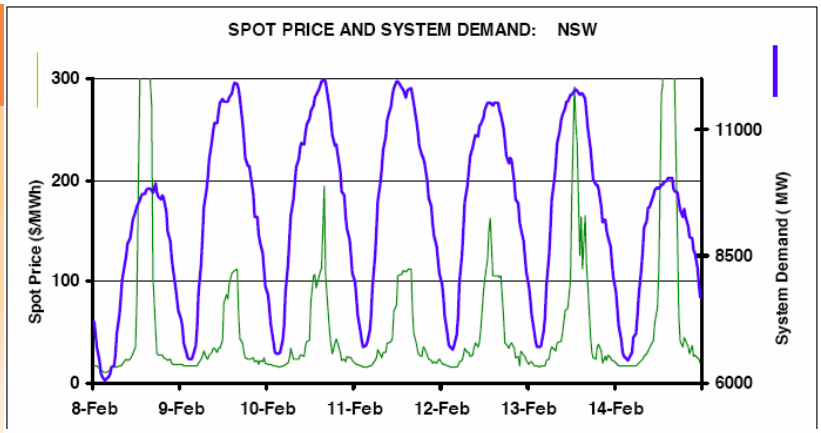
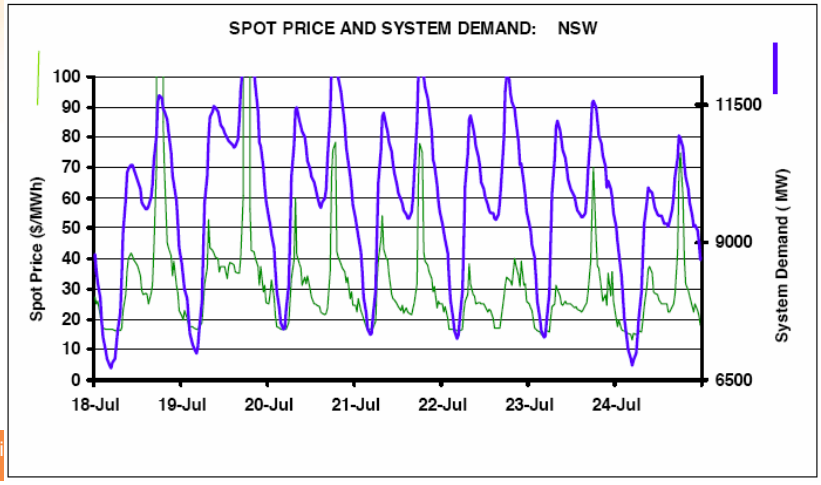
NEM NSW region demand & price, summer & winter peaks 2004

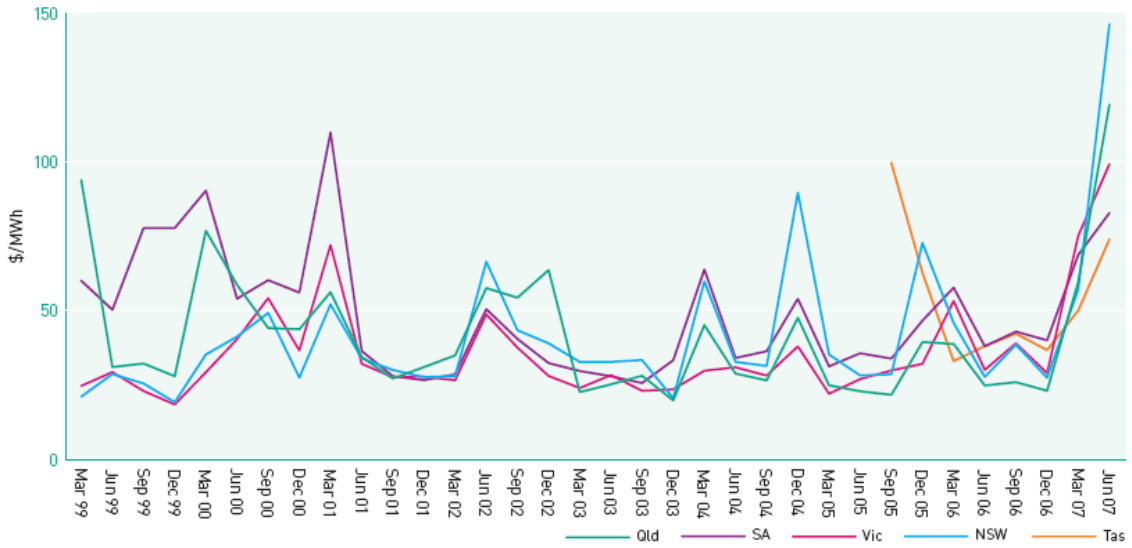
(NEMMCO, 2004)





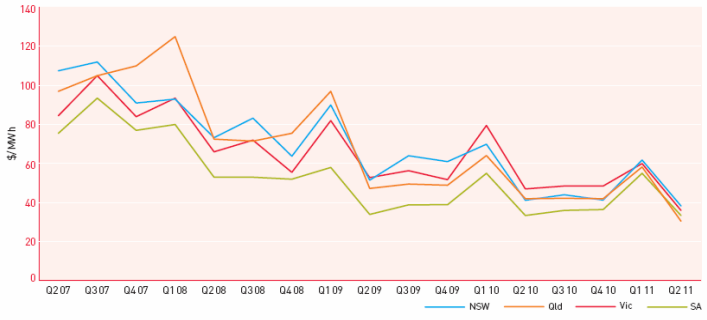
NEM average spot prices (quarterly)

Figure 2.9
Quarterly volume weighted average spot prices in the National Electricity Market



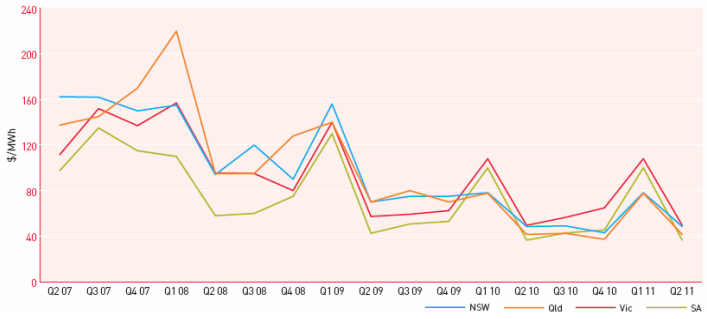
SFE base + peak prices to 2011

Figures 3.17
Base futures prices at 25 June 2007



Source: d-cyphaTrade

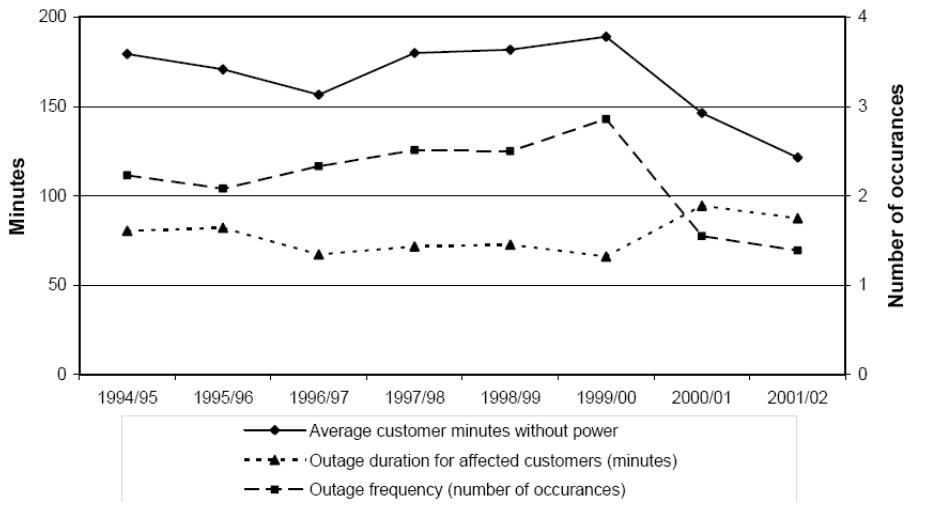
Figures 3.18
Peak futures prices at 25 June 2007



Electricity supply reliability outcomes (PC, 2005)

- Some general improvement

Figure 4.2 **Electricity supply reliability, Australian average**

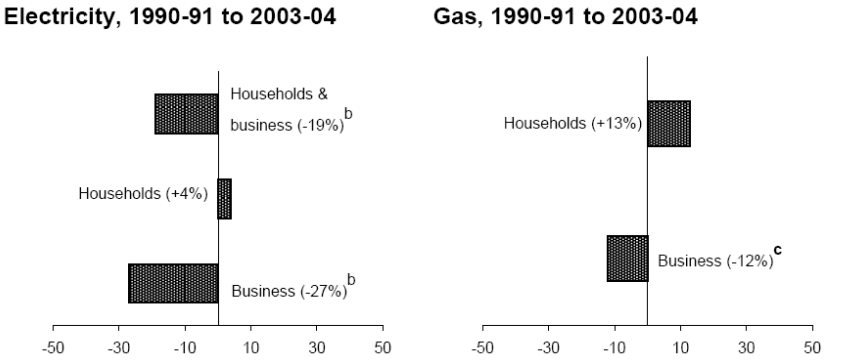


Some outcomes of restructuring to date

- Improved economic efficiency
  - But still questions regarding future outcomes given capital intensive nature of industry, starting point for restructuring
  - *Most modeling exercises estimating industry + wider economic benefits of only limited value*
  - Largely supply-side focussed efficiency improvements
- Security + reliability reasonably well managed
  - But ongoing challenges for commercial arrangements + attempting to manage low-risk/high-consequence events
  - and diversity between + within jurisdictions
- Equity + environmental outcomes?

Equity outcomes

Figure 4.1 **Real price changes in infrastructure services[a]**



- At least part of this divergence intentional – reduction of cross subsidies
- For vulnerable consumers, "Limited amount of evidence suggesting that:
  - price rises for households in regional areas may have been somewhat higher than for their counterparts in metropolitan areas; and
  - increases in household prices .. have generally been greater for households with low demand and often lower incomes" (PC, 2005)
- *Different jurisdictions have had markedly different outcomes*
  - Different policy + regulatory positions; CSO arrangements, other support mechanisms

Climate change outcomes

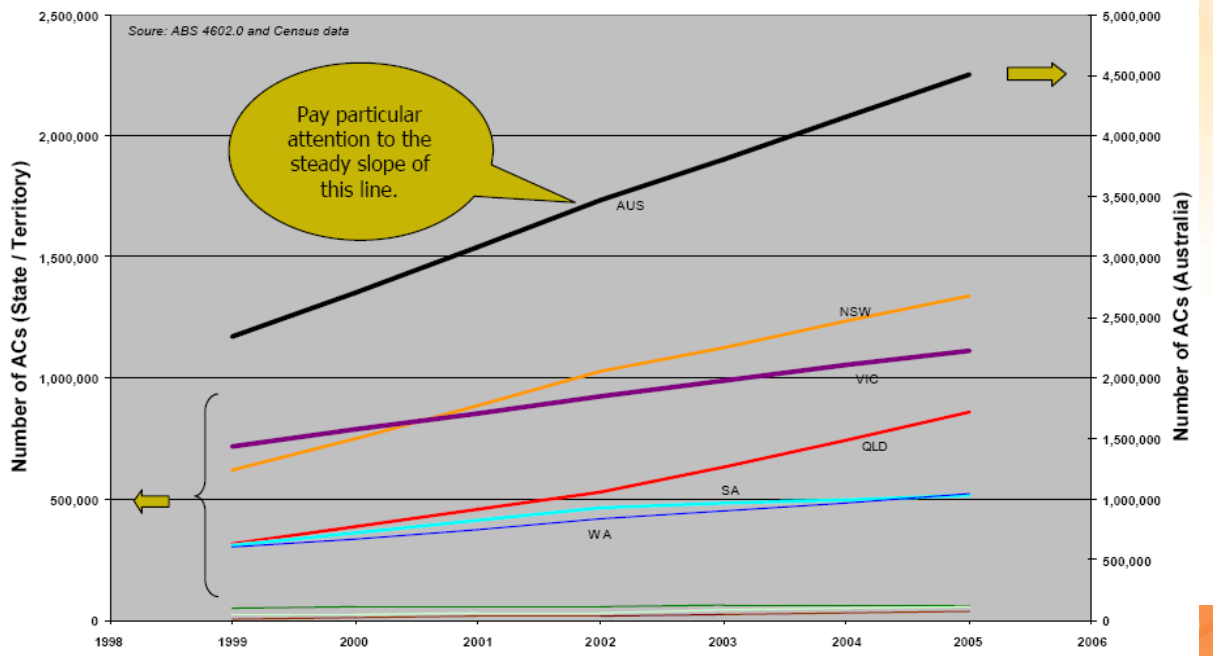
- Stationary energy sector responsible for half of Australian greenhouse emission
- CoAG national energy policy objectives include need for action on climate change but EI restructuring has no specific env. objectives
- However, original expectation by some that would help *"14 MtCO2 reduction from BAU in 2010":*
  (Commonwealth Govt, *Climate Change: 2nd Communication to IPCC,* 1997)
  - Efficient competition in supply by gas + renewables
  - More sensible patterns of energy use
- Instead, likely outcome is increased emissions wrt BAU (CoAG, 2002)
  - Low cost of coal fired generation, immature gas market
  - Reduced emphasis on EE from lower prices
  - Current failure to price greenhouse emissions
  - Market design and regulation that favours incumbents Supply-side orientation of reforms to date

Growing pressures on restructuring

- Continuing growth in peak demand
  - Energy an essential good but also growing discretionary + 'conspicuous consumption' energy services; eg. Air Conditioning, industry development
  - Estimated to require $24b investment in Tx + Dx infrastructure over next 5 years; this is regulated expenditure
  - This growth will also require major investment in new peaking plant
  - Current market arrangements smear these costs, potentially perverse outcomes
- Growing climate change concerns
  - Protecting the climate seems likely to require major (60-80% by 2050), rapid (peaking within decades) global emissions reductions
  - Australian per-capita emissions 2 X > developed world average, 5-10 X > developing world
  - Emission reductions will impose direct costs on EI
- Facilitating integration of intermittent renewables

=> Underlying cost structure of industry likely to grow

Air conditioning trends (Washusen, 2005)



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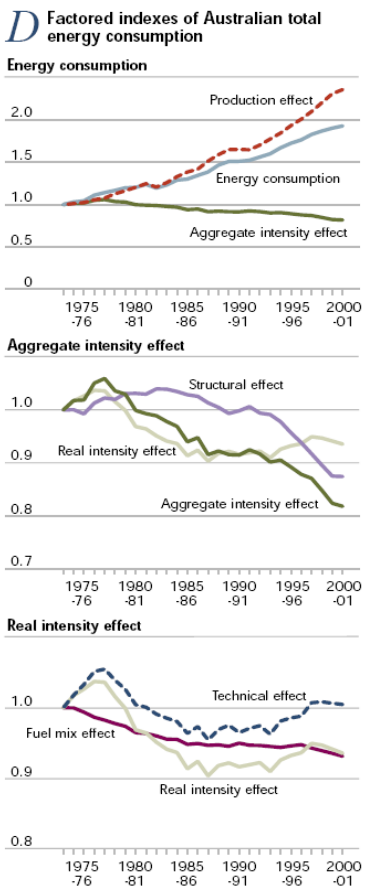
Energy intensity outcomes

- Moderate structural impacts
- Mainly adverse fuel mix impacts over last 20 years
- Technical effect (incl. efficiency) has been worsening over last 20 years



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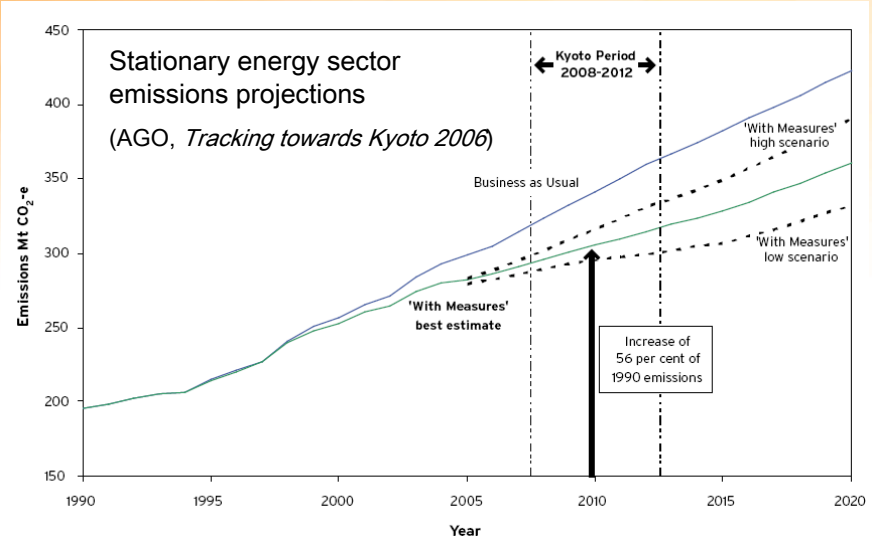
A challenging context for climate policy

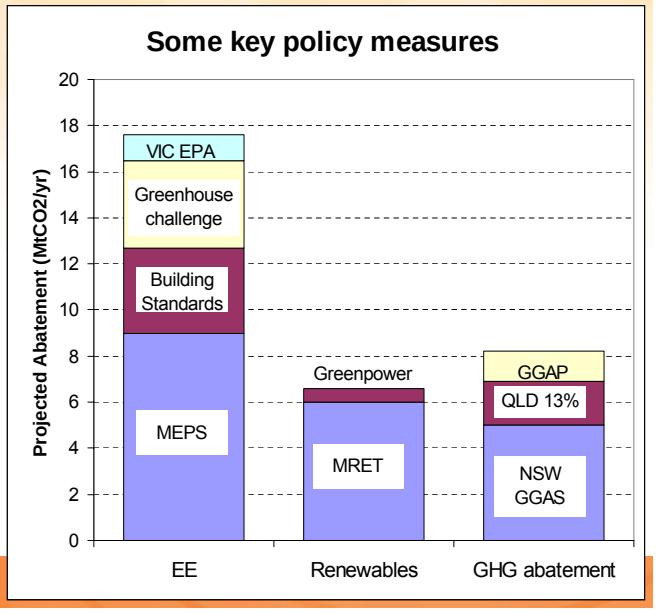
- Energy-related emissions climbing – 70% of total
  - Estimated +35% over 1990–2004, projected +56% in 2010



- Growing volume + value of energy exports

Current Australian Climate Change Policy

- Significant proportion of expected policy driven abatement from Energy Efficiency & renewables
- State Govts now mandating additional renewable energy targets in absence of Federal action



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