





Electricity Industry Restructuring in Australia: experience to date and emerging challenges

Dr Iain MacGill Joint Director, CEEM *IIT Seminar* Madrid, May 2008

www.ceem.unsw.edu.au





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 (grant and consultancy funding)
 - Facilitating wind integration in the NEM
 - Renewable energy policy support options in restructured industries
 - Market design for restructured electricity industries new focus on retail mkts
 - Emissions Trading Schemes + options for Australia
 - Interactions between emissions trading and the Australian NEM
 - Technology assessment for sustainable energy options
 - including energy efficiency, cleaner fossil fuels, renewables, nuclear & CCS
 - Sustainable energy services delivery in developing countries
 - Economic modelling of Distributed Energy demand-side participation & DG
 - Energy efficiency policy regulation, financial mechanisms





Some of the CEEM Team....



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The Australian energy context

- Large, low cost + high quality coal, gas and U reserves
- Major energy exporter World #1 Coal, #2 Uranium, #5 LNG
- An energy intensive economy c.f. other industrialised nations
- Amongst the world's highest per-capita greenhouse emissions

% of Global	Population	GDP	Energy Production	Energy Consumption	Fossil-fuel GHG emissions
Australia	0.3	1.3	2.3	1.0	1.3
China	21	5.4	14	15	18
India	17	1.7	4.2	5.1	4.1
United States	4.6	31	15	21	22
Japan	2.0	14	0.9	4.8	4.6
Korea	0.8	1.8	0.3	1.9	1.7
Germany	1.3	5.6	1.2	3.1	3.2
		(IFA World Energy Statistics 2006)			

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Australia's coal resources





NALLIN MODEL IN

(AER, State of the Energy Market 2007)





Australia's natural gas reserves

Australian gas resources



(AER, State of the Energy Market 2007)

Electricity Industry Restructuring





Australian hydro resources









Electricity demand, Tx and generation







Current NEM generation mix



Note: Excludes power stations not managed through central dispatch.

Data source: NEMMCO



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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	(WWF, Coal-fired electricity and its impact on global
Poland	2000	96	Steady at saturation	warming, 2003)
South Africa	2000	about 92	rising slightly towards s	aturation
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	2
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	





Terminology – its uses and abuses

- Is the Australian El undergoing?
 - A Market reform
 - B Deregulation
 - C Restructuring
 - D Privatisation
 - E Liberalisation





Evolution of El 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 Electricity Industry Restructuring in Australia: Experience to date and emerging challenges





Decision-making framework for a restructured EI

Governance regime	 Formal institutions, legislation & policies Informal social context including politics
Security regime	Responsible for system integrity on local or industry-wide basis, with power to override
Technical regime	 To allow connected industry components to function as industry-wide machine
Commercial regime	To coordinate decentralised decision- making according to commercial criteria
	 Includes formally designed markets & interfaces for regulated participants (NSPs)

Key challenges – gaps & overlaps (no / blurred accountability)

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The Australian NEM

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

NEM regions indicated: *boundaries need not be on state borders*



Management Company Limited

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Governance arrangements

- Council of Australian Governments (COAG):
 - Ministerial Council on Energy (MCE) develops & submits proposals to COAG for approval (www.coag.gov.au; www.mce.gov.au)
- Australian Energy Regulator (<u>www.aer.gov.au</u>):
 - Monitors energy markets & regulates Network Service Providers
- Australian Energy Market Commission (<u>www.aemc.gov.au</u>):
 - Manages rule change for electricity & gas markets
 - Undertakes investigations for MCE
- Australian Energy Market Organisation (AEMO):
 - Enhanced version of National Electricity Market Management Company (www.nemmco.com.au) that will implement national electricity & gas markets & associated security regimes





The (new) overall objective for the NEM

NEL Section 7:

- The national electricity market objective is to promote efficient investment in, and efficient use of, electricity services for the long term interests of consumers of electricity with respect to price, quality, reliability and security of supply of electricity & the reliability, safety and security of the national electricity system
- Possible short-comings of this objective:
 - Emphasises electricity rather than end-use energy services
 - Fails to mention sustainability in 1991, COAG said the NEM should be *efficient AND sustainable*
 - What about technology + participant neutrality?





Features of National Electricity Rules (NER)

- NEM covers all participating states:
 - A multi-region pool with intra-regional loss factors
 - Spot market 5/30 min
 - Ancillary services market (<5 min)</p>
 - No capacity market or equivalent; participants determine unit commitment through energy spot market bidding strategy
 - Centralised projections ahead one day, week, 2 years and 10 years
 - Operated by NEMMCO (owned by states)
- Compulsory participants in NEM:
 - All dispatchable generators & links > 30 MW
 - Network service providers & retailers
- Over-the-counter + exchange derivative markets
 - Outside formal NEM market law, rules & formal arrangements





Spot market offers & bids

- Generators, retailers & consumers:
 - Price-quantity curve (sell/buy) for each half hour:
 - ≤ 10 daily prices, quantities changeable until dispatch
 - Can also bid in ancillary service capabilities into one or more of 8 FCAS markets; regulation raise/lower, contingency raise/lower 6s, 60s, 5 min
 - Demand forecasts 'bid in' at \$10000/MWH (VoLL)
- Bids & offers ranked to give dispatch stack:
 - Considering loss factors & inter-tie constraints
 - co-optimised with ancillary service capabilities dispatch
 - 5 minute prices set by economic dispatch:
 - Half-hourly averages are calculated in 'real time'

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A simplified representation of bids from a 600 MW generating unit that indicates the capacity the generator is willing to offer to the NEM at a range of prices.

(NEMMCO, NEM Briefing 2007)



NEM regions (NEMMCO SOO, 2006)



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Commercial & security/reliability processes







NEM security & commercial regimes





reliability

to meet it

Review, 2006)

(AEMC Reliability

target, spot



 reserve trader settings reliability directions

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Industry structure & decision-making in the NEM



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NEM value chain



(TRUEnergy, Market Briefing 2006)





NEM spot prices (Quarterly volume weighted, www.aer.gov.au)







NEM frequency control ancillary services prices (Quarterly volume weighted, <u>www.aer.gov.au</u>)







NEM exchange traded base derivative prices





Figure A.5

Generation investment and electricity prices by region



New generation investment

Electricity Industry Restructurin





PASA projections

Demand + Reserve

- Primary role is to drive commercial responses
- Have seen a number of market interventions due to forecast reserve shortfalls <6 months out



Electricity Industry





NEM demand vs capacity - past & projected

Figure 1.13

Figure 1.12



NEM peak demand and generation capacity

(AER, State of the Energy Market 2007)

Demand and capacity outlook to 2011–12



Some existing & emerging challenges

- Energy constraints in hydro & thermal plant due to drought
- Dysfunctional retail markets
- Immature emerging gas market(s)
- Structural reaggregation of retailing & generation by private 'gentailers'
- Integration of variable & somewhat unpredictable renewable energy
- Climate change

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Managing potential energy constraints

- Derivative mkts responded to drought however little foresight
- Current PASA projects capacity, not energy constraints
 - eg. Hydro, cooling water for thermal plant
 - NEMMCO to now provide energy adequacy projections







Present retail market design in Australia

- Retail market design for large end-users:
 - Competitive retail market (not yet mature)
 - Regulated network pricing (not yet mature)
- Retail market design for small end-users:
 - Regulated or partially competitive retail market
 - Simplified tariff structure; immature metering; profiling
 - Network charges usually passed through retailer
 - Little support for informed end-user decision making
- Some social policy objectives internalised
- Some environmental objectives internalised
- Limited opportunities for embedded generation



(Dunstan, Developing Demand Response in NSW, October 2005)

- Technical options within Dx system that actively participate in El decision making
 - renewable energy sources including solar thermal, photovoltaics (PV) smaller-scale wind, biomass
 - small-scale fossil fuelled generation, combined heat and power (CHP) plants powered with engines, gas turbines or fuel cells,
 - direct energy storage; chemical 'battery' technologies, superconducting magnetic systems, flywheels
 - electrical end-uses that actively respond to changing conditions;
 eg. 'smart' buildings that control heating & cooling to exploit their inherent thermal energy storage
 - End-use energy efficiency





Typical measures of competition not very useful

- **Retail transfers?** Data limitations, relevance
- Price spreads? Can mean competition, or market failure
- an important reason there is effective competition ... is "Because the provision of energy is viewed as a homogenous, low engagement service... "AEMC, Effectiveness of Competition in Vic., 2008

0%

Figure 6.8

Cumulative monthly switches as percentage of small customers—New South Wales, Victoria and South Australia



Figure 6.9



Customers not with their host retailer at 31 December

Sources for table 6.5 and figures 6.8-9:

NSW

Customer switches: NEMMCO; Customer numbers: IPART, NSW electricity information paper no. 4—Retail businesses' performance against customer service indicators, 1 July 2001 to 30 June 2006; ESCOSA, 2005-06 Annual performance report: performance of South Australian energy retail market, 2006, p. 72. ESC, Energy retail businesses comparative performance report for the 2005–06 financial year, 2006, p. 2.

Vic

SA





Meanwhile, decision making in the real world (Washusen, 2005)







and network investment



500

400

300 200

> 100 0

United Energy

CitiPower

2004-05

2005-06

— Country Energy

EnergyAustralia — Ergon Energy

2006-07

2007-08

2008-09

- ENERGEX - Integral Energy

ActewAGL — Australian Inland

2009-10

200

300

100

ETSA Utilities

2003-04 2004-05 2005-06 2006-07 2007-08 2008-09 2009-10 2010-11

SPAusNet

Aurora Energy

Powercor

Alinta





Current developments

- Advanced Metering Infrastructure (AMI) rollout
 - Including 2-way communications, direct load control options, quality of supply measurement, DG connection support
- Network investment
 - Arrangements to test augmentation options against possible DE options
- Forthcoming removal of retail price regulation
 - Subject to jurisdictions and likely sequentially





Immature gas markets

- **Questions of long-term reserves** for NEM however major CSM coming on line
- Little transparency in gas prices most traded via confidential long-term contracts
- New gas gen raising challenges
 - Scale & peakiness with OCGT

(AER, State of the Energy Market 2007)2,000









- Structural & potential market power challenges
- Emerging trio of major gentailers
- Possible privatisation of NSW Govt. retailers & generators







Figure 2.11 Number of price intervals above \$5000 a MWh

(AER, State of the Energy Market 2007)



Data source: NEMMCO





The Australian wind resource

(Simple estimates of background wind – Australian Greenhouse Office)







Current status of Australian wind generation

Estimated state average load, total installed generation capacity and wind installed or under construction (ausWEA, ESAA)







Wind penetrations set to rise significantly

- Current Australian wind gen ~ 1GW & 1% energy penetration
- New Renewable Target of 20% by 2020 might see 5-10GW installed
- Most current projects in SA and Victoria rather than NSW & Qld







A challenging context for climate policy

- Energy-related emissions climbing 70% of total
 - Estimated +35% over 1990–2004, projected +56% in 2010
 - 'On track' to meet Kyoto 108% target due to 'land clearing' hot air



Electricity generates 35% of total emissions + fastest growing sector. Electricity Industry Restructuring in Australia: Experience to date and emerging challenges





New Federal Government commitments

- Ratify Kyoto Protocol
- Introduce Emission Trading System by 2010. Detailed design finalised by end 2008.
- Adopt greenhouse gas reduction target of 60% on 1990 levels by 2050. Interim targets finalised wrt Garnaut review September 2008.
- Adopt Mandatory Renewables Target of 20% by 2020, 45,000GWh. Target to be phased out 2020-2030
- \$500M Renewable Energy Fund intended to develop, commercialise and deploy renewable energy.
- Invest \$500M under National Clean Coal Fund to finance deployment of clean coal technologies. (Energetics, Dec. 2007)
- Range of Energy Efficiency policies





Estimated effect of a carbon price on merit order



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Forthcoming governance arrangements

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 - Manages rule change for electricity & gas markets
 - Undertakes investigations for MCE
- Australian Energy Market Organisation (AEMO) bringing together
 - NEMMCO
 - A Gas Market Operator
 - A National Transmission Planner

