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Renewable Energy & Energy Efficiency Certificate Trading: the Australian Experience

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APEC Workshop on Recent Advances in Utility-Based Financial Mechanisms that Support Renewable Energy & Energy Efficiency
Honolulu, Hawaii, 30 March – 1 April 2009*

www.ceem.unsw.edu.au

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The Art of Knowing and Doing

The study of **technology** concerns *what* things are made and *how* things are made. Technology, from the Greek *science of (practical) arts*, has both a *material* and an *immaterial* aspect.

What is technology?

(www.iiasa.ac.at)

Software & orgware are critical in complex technological systems such as electricity industries

Technology = Hardware + Software + "Orgware"



Hardware: Manufactured objects (artifacts)
Software: Knowledge required to design, manufacture, and use technology hardware
"Orgware": Institutional settings and rules for the generation of technological knowledge and for the use of technologies

Technology's most important characteristic: **Continuous change >>**

Decision-making framework for an e



Making decisions about technology

- Decision-making (DM) is a characteristic behavior of humans
- Technology is a specific result of human DM:
 - Accumulated, path-dependent decision-making
- A technological system is a complex collection of technological components
 - An electricity industry is a large technological system
- A Decision-making framework for an electricity industry is a systematic tool for analysis or design:
 - For example, the issues involved in integrating renewable energy or improving end-use efficiency



Decision-making framework for an electricity industry

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

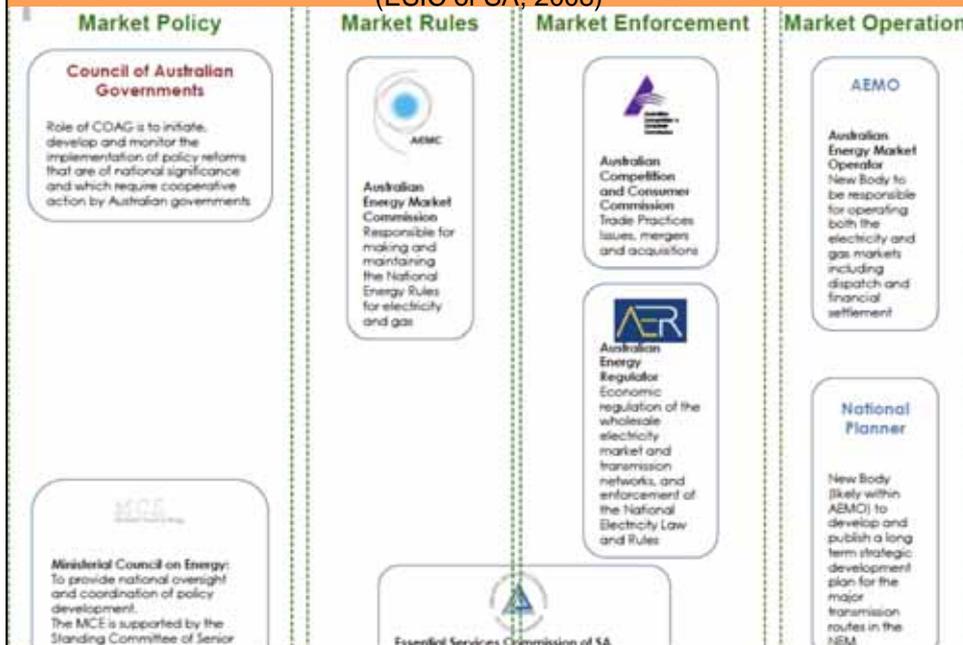


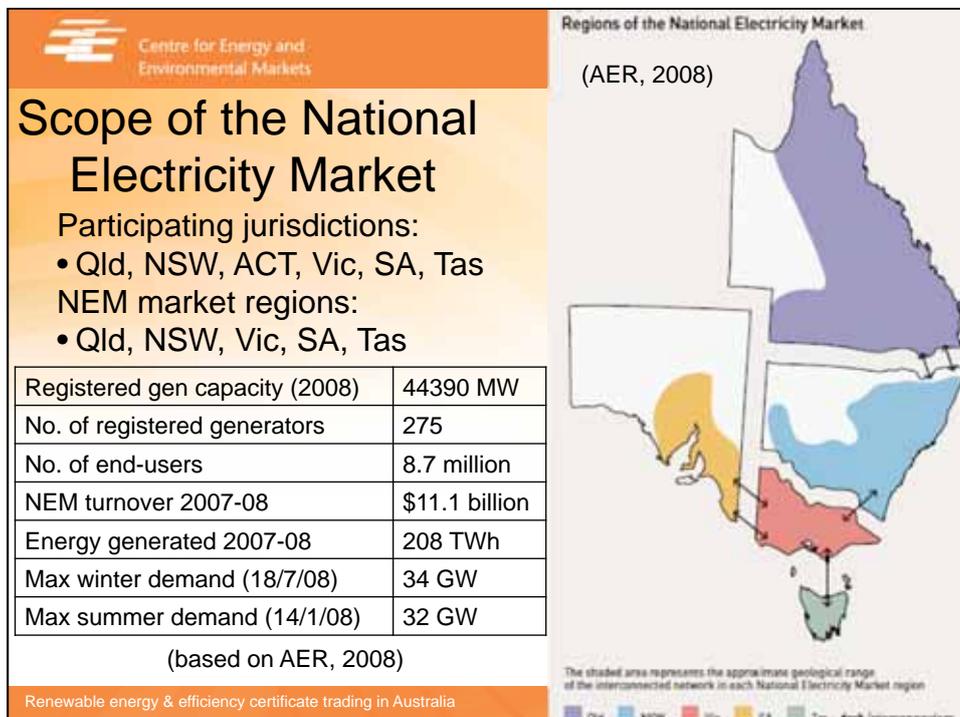
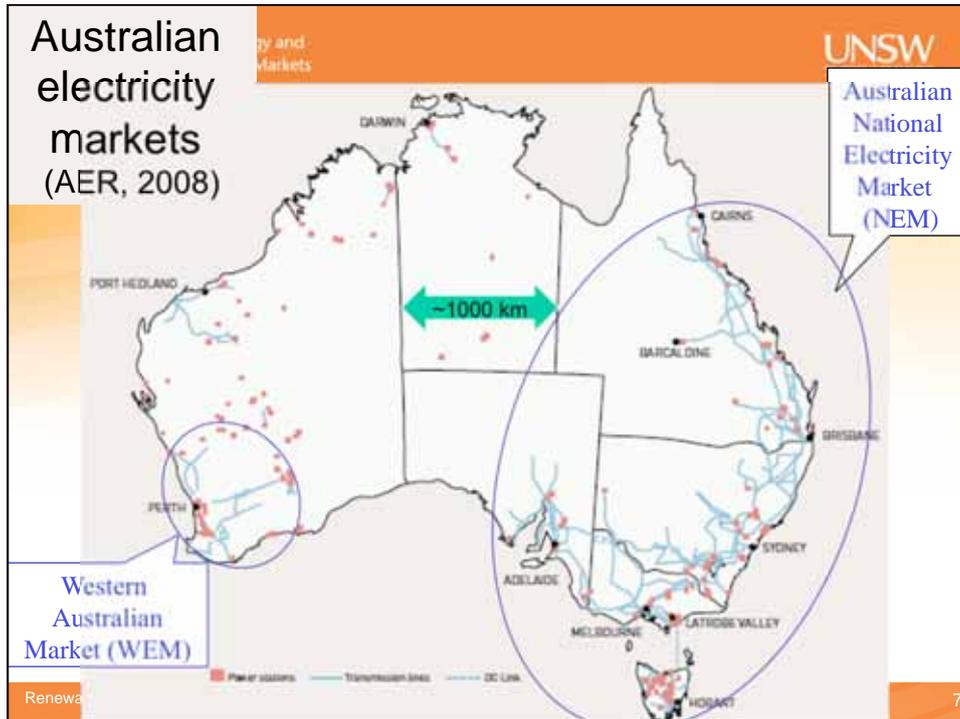


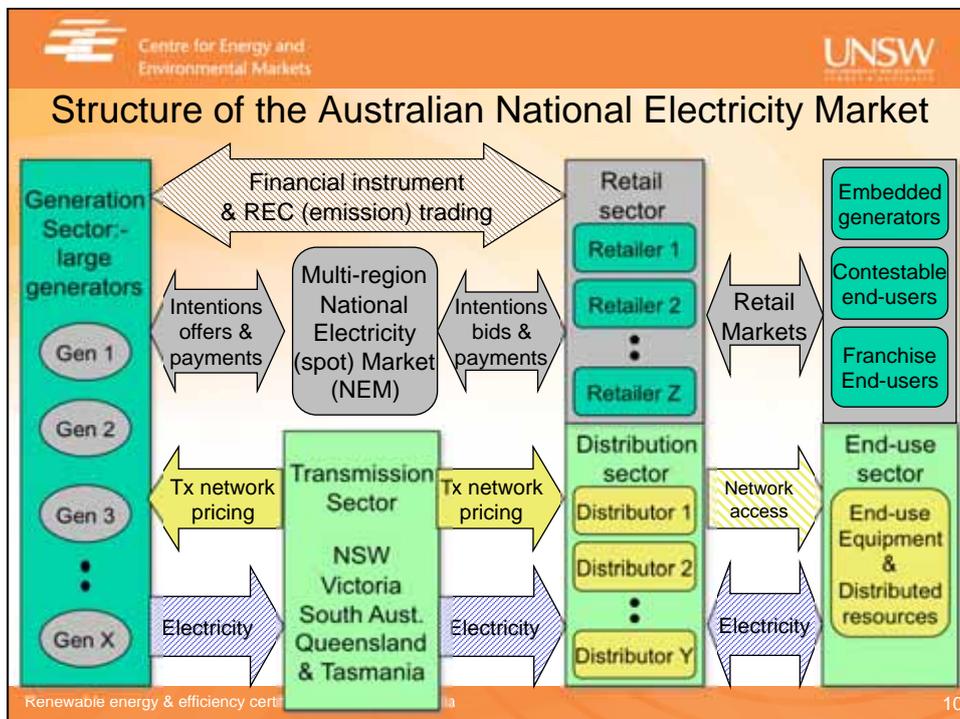
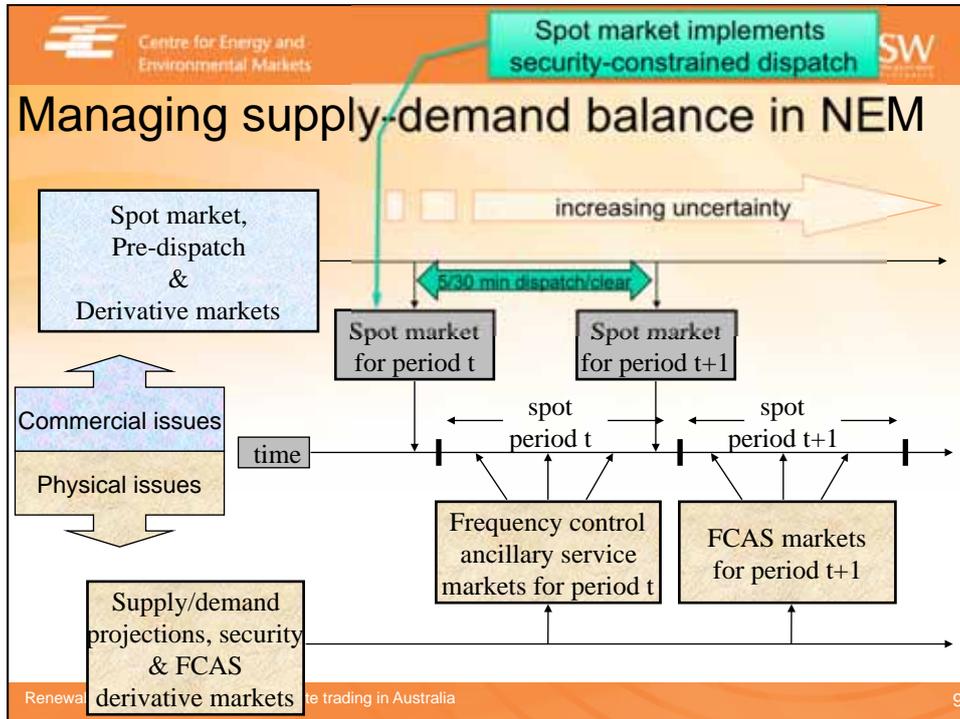
Broad governance issues for an electricity industry

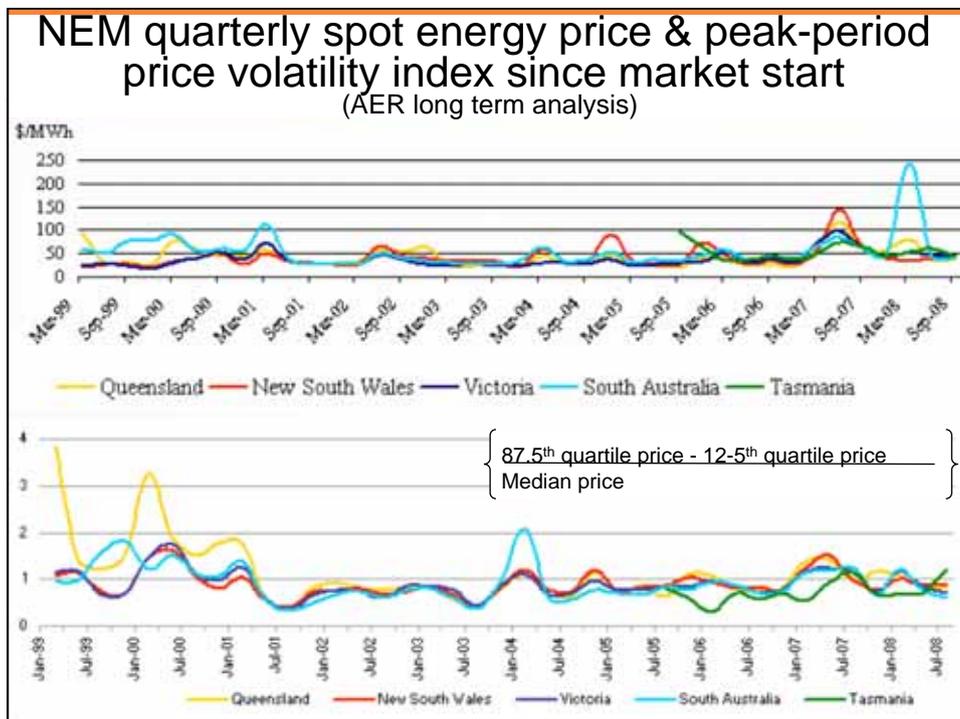
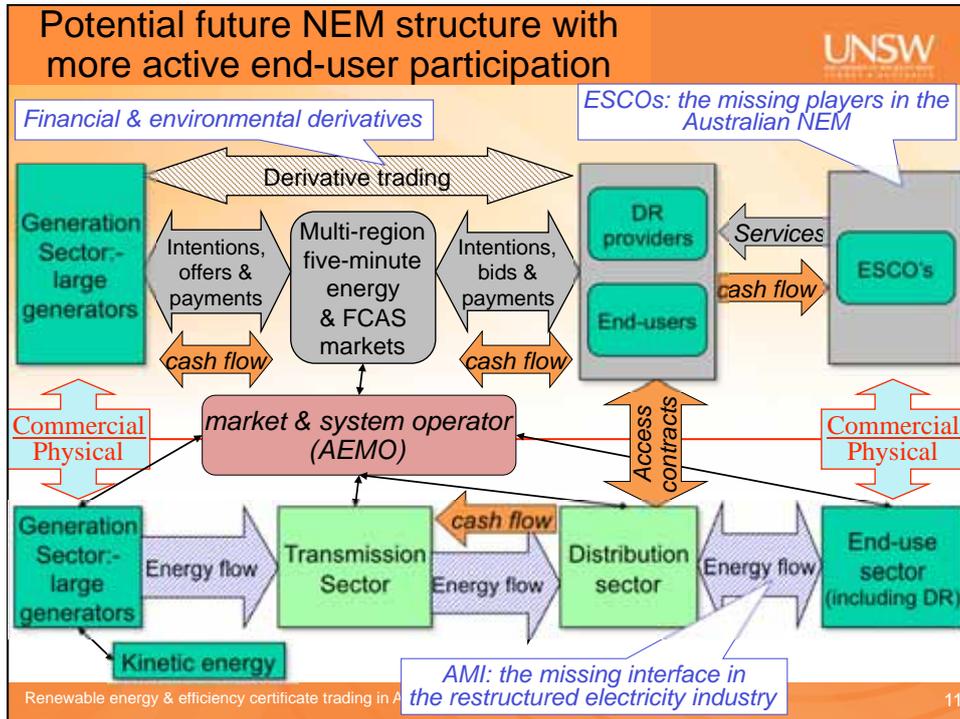
- Social issues - electricity as an *essential good*:
 - How can we secure access to primary energy resources?
 - How can we make essential residential energy services affordable?
 - Commercial & industrial energy services:
 - What is the appropriate role of subsidised electrical energy in regional, industry and corporate development?
- Environmental issues - local, regional & global:
 - What environmental impacts are acceptable?
 - How can adverse impacts be minimised?
 - What do we mean by “essential” - should we be more frugal in energy use?

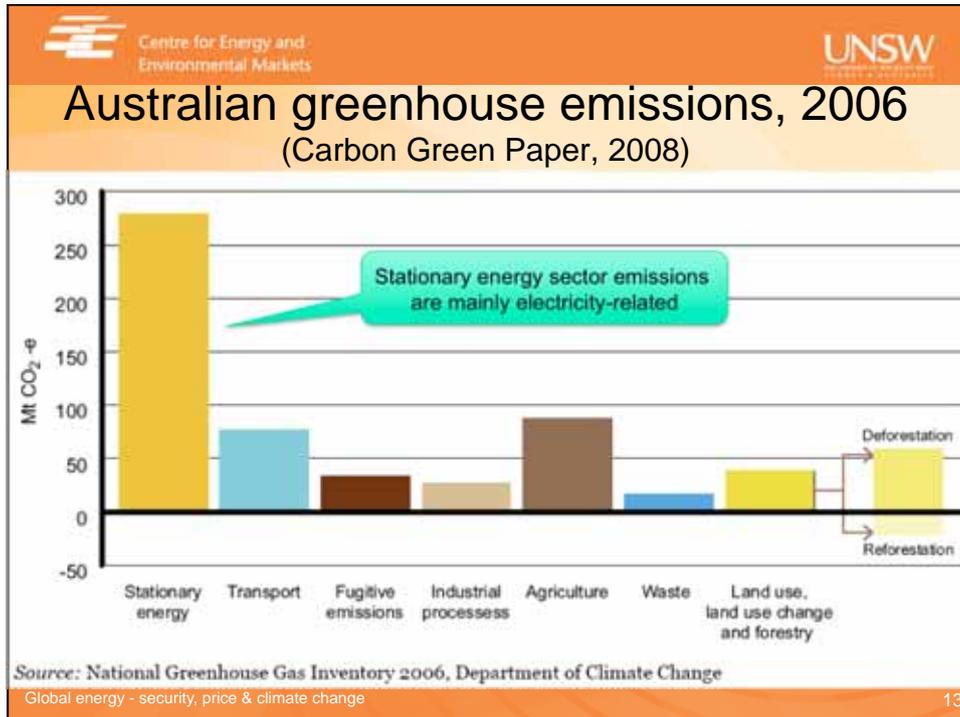
Stationary energy sector governance in Australia (ESIC of SA, 2008)











Global energy - security, price & climate change

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AEMC Review of energy market frameworks in light of climate change policies (2008-2009) #1

The Review is to:

- examine the potential impacts of the CPRS and expanded RET on both the electricity and gas markets across all jurisdictions;
- determine what adjustments may be necessary within the existing energy market frameworks, having regard to the National Electricity and Gas Law objectives - to deliver efficient, safe, secure and reliable energy supplies in the long term interests of consumers; and
- provide detailed advice to the MCE on implementation of any amendments required.

The AEMC is to have regard to:

- the MCE's requirement that amendments will only be supported if they contribute to the energy market objectives;
- the need for amendments to be proportionate;
- the value of stability and predictability in the energy markets regulatory regime; and
- any other AEMC Reviews, Rule changes or MCE reforms that may relate to this Review.

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AEMC Review of energy market frameworks in light of climate change policies (2008-2009) #2: *The energy market decision-making context*

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graph LR; A["Influences on behaviour"] --> B["Behaviour"]; B --> C["Desired outcomes"]
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Influences on behaviour

- Market rules
- Other aspects of regulation
- Financial incentives
- New policy
- Other policies e.g. economic & market

Behaviour

- Pipeline operators
- Producers
- Generators
- Networks
- Retailers
- Customers
- System operators
- Energy consumers

Desired outcomes

- Market objectives
 - efficiency
 - security
 - reliability
- Delivered through competition

The AEMC does not see climate change as a problem specific to energy markets

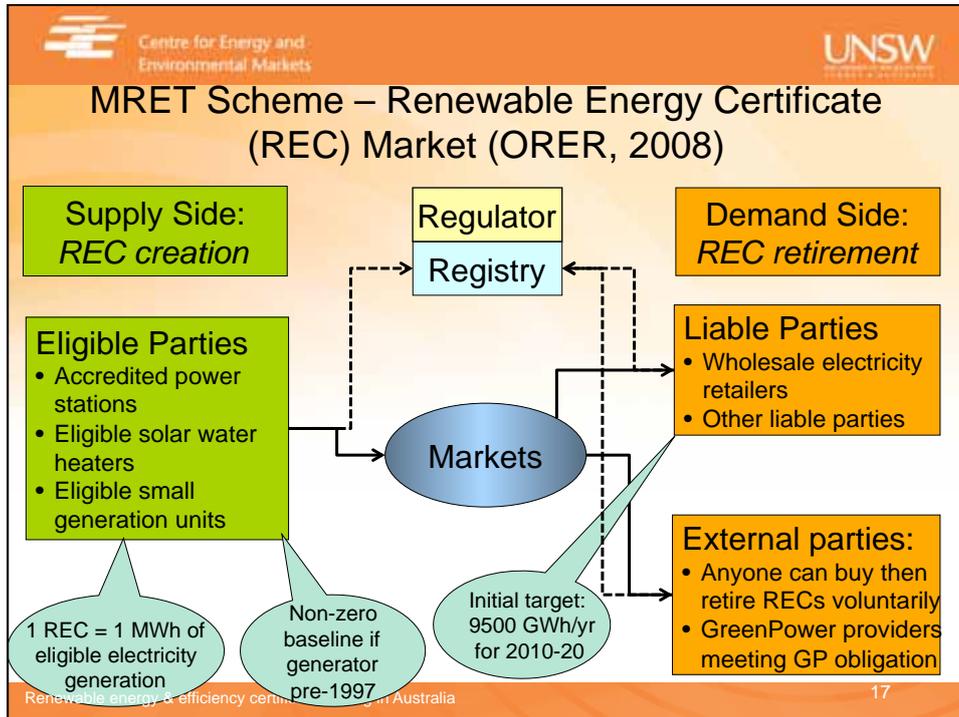
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Renewable energy, efficiency & emission trading in Australia

- Australia-wide (tradable instruments):
 - Mandatory renewable energy target - MRET (since 2001)
 - Carbon pollution reduction scheme (proposed for 2010)
- New South Wales (tradable instruments):
 - Greenhouse gas reduction scheme – GGAS (since 2003)
 - NSW energy savings scheme - NEET (from 2009)
- Victoria (tradable instruments):
 - Victorian energy efficiency target – VEET (from 2009)
- South Australia (NOT tradable instruments):
 - Residential energy efficiency scheme – REES (from 2009)

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MRET performance to date

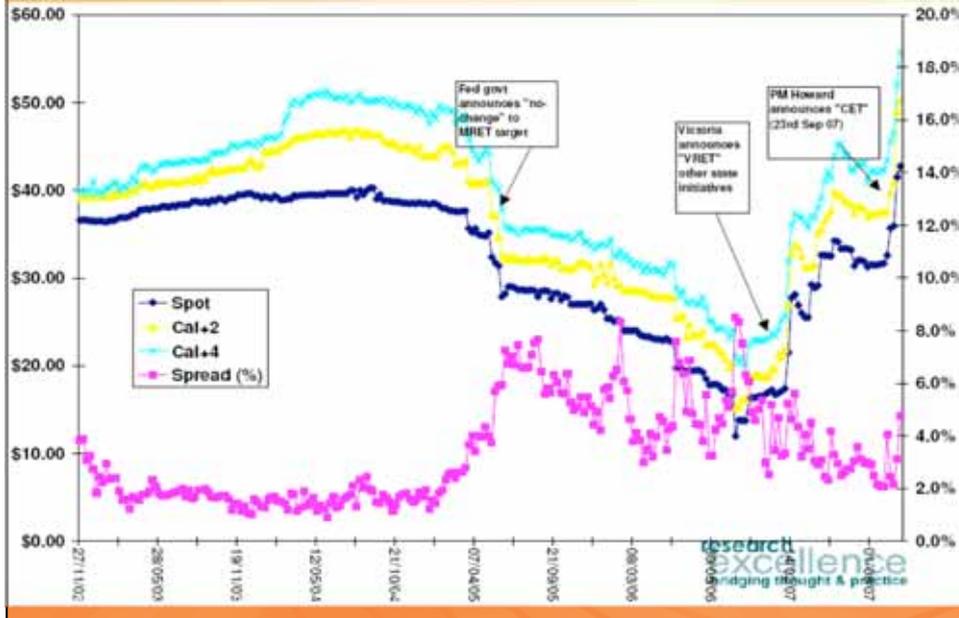
- **Strengths:**
 - Investment in new renewable energy generation:
 - About half income from energy and half from RECs
 - REC target easily met
 - Reasonable efficiency – low cost by international standards
 - Technology flexibility valuable:
 - Biomass less than expected but wind + others more
- **Weaknesses:**
 - Windfall gains for 'old hydro'
 - Boom-bust cycle due to policy uncertainty & early scheme end-date (2020)

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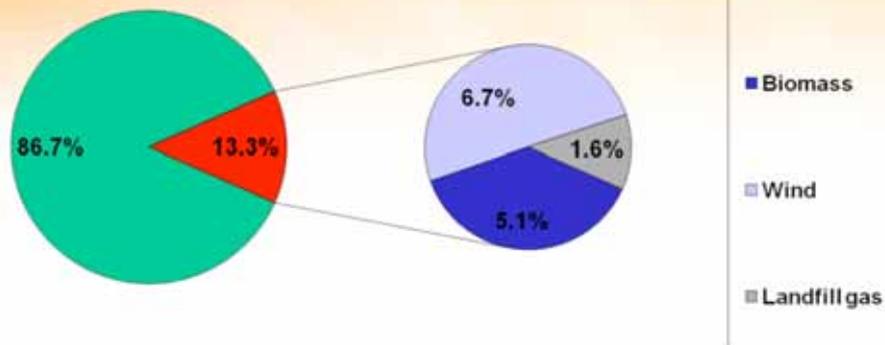


REC spot & derivative market prices

(Nolles, Garnaut Review Presentation, 2007)



Renewable energy generation in Australia, 2004-05 (18.7 TWh or ~ 9%) (NGF, 2007)



Non-storable renewable energy in a competitive electricity industry

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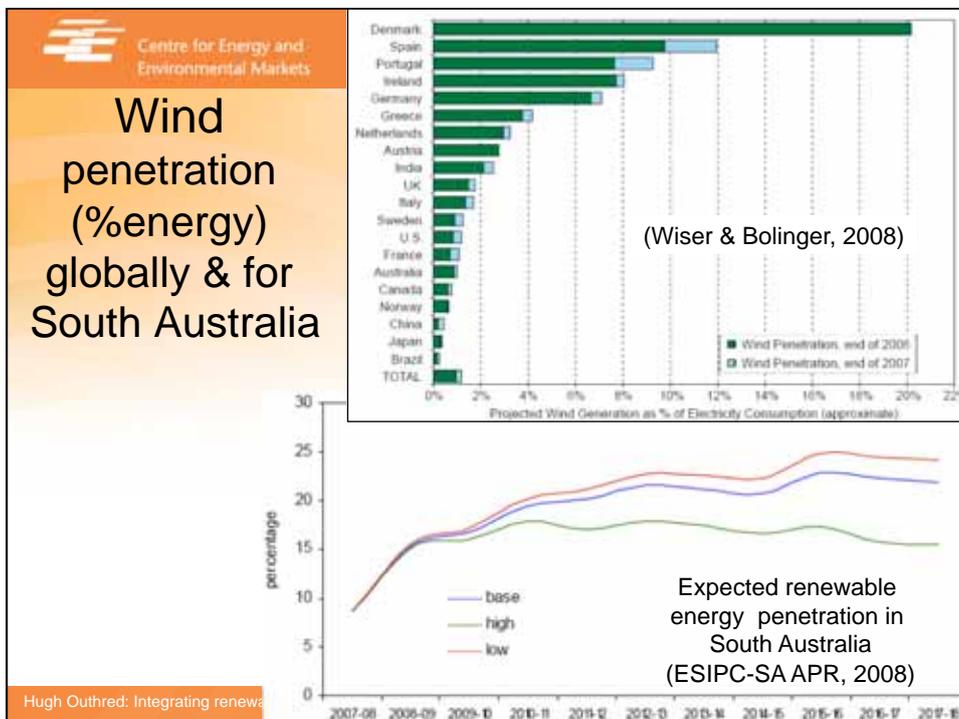


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Investment to November 2008 (ORER, 2008)

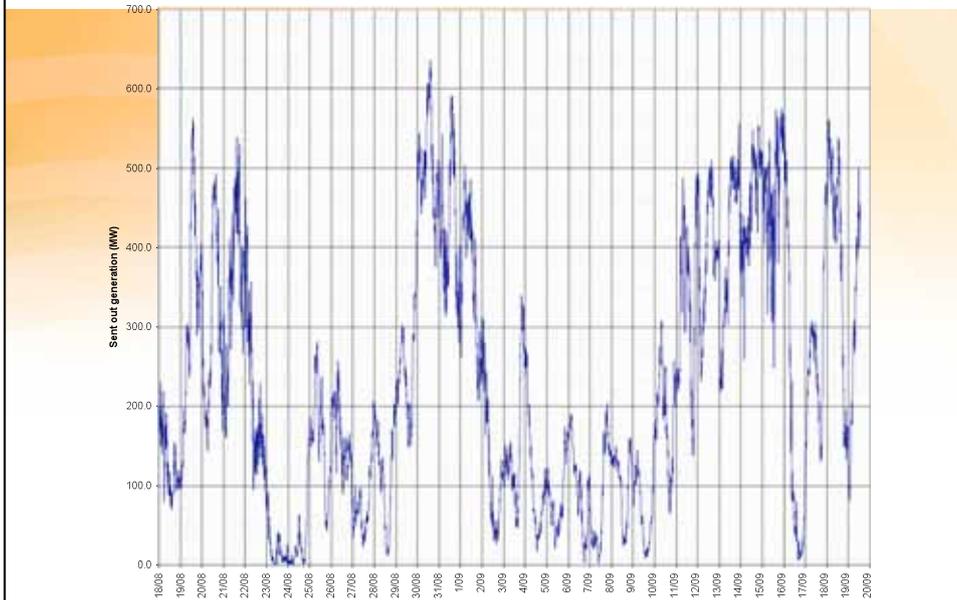
Eligible Renewable Energy Source	Investment \$M	Estimated RECs GWh/year
Wind	2530	3500
Hydro	300	1600
Solar Water Heaters	710	1210
Wood Waste	50	450
Landfill Gas	160	510
Bagasse	600	600
Other	450	300
TOTAL	4800	8650

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Wind generation in South Australia, Aug 08



Hugh Outhred: Integrating renewable energy into electricity industries

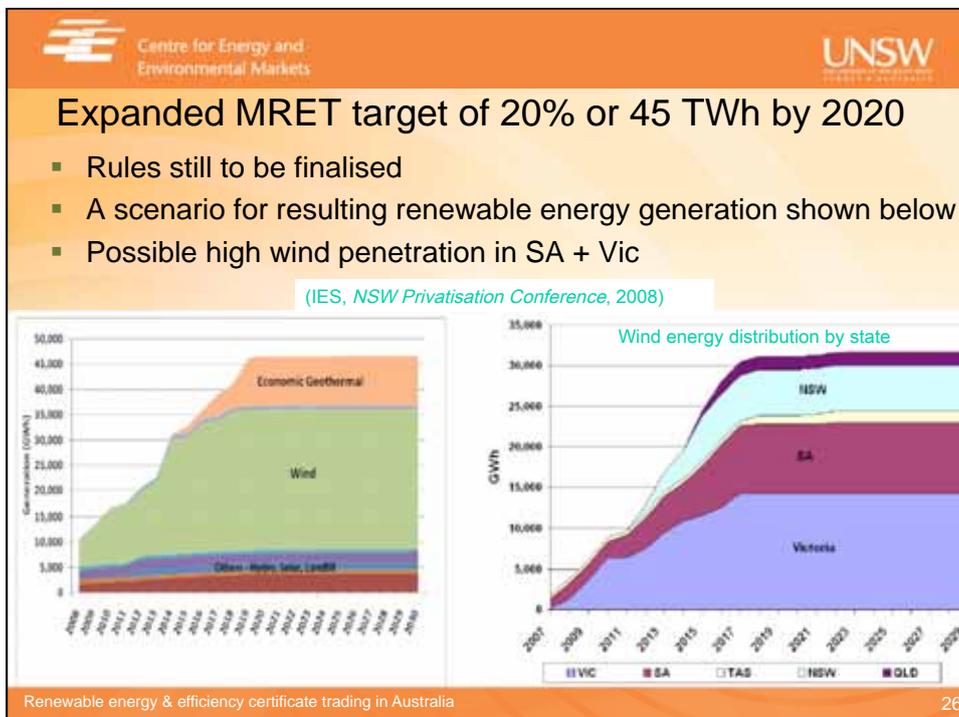
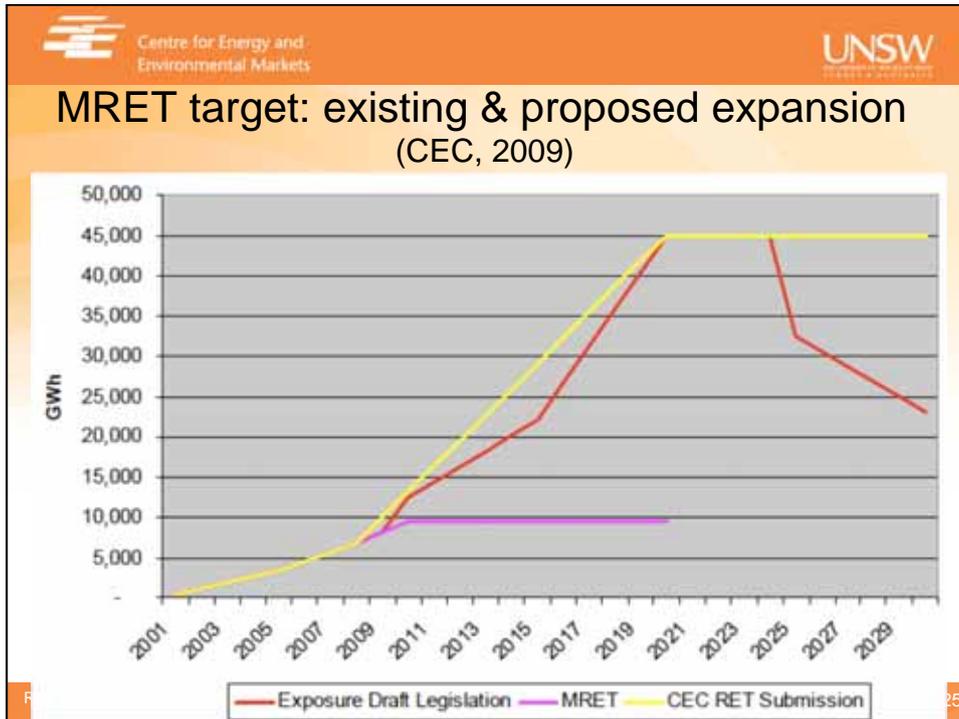
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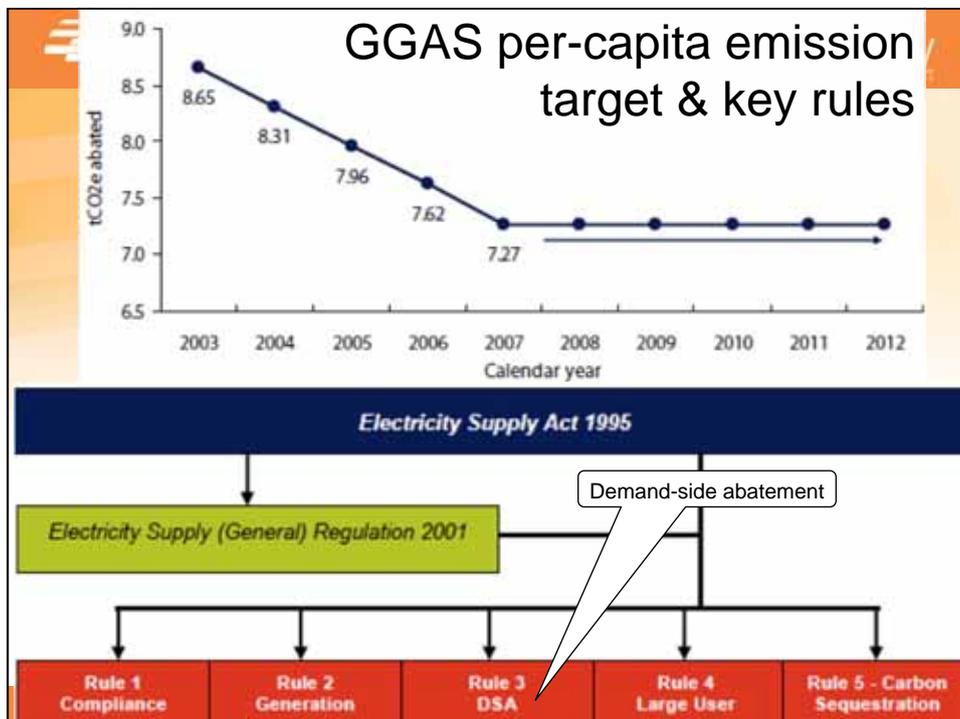
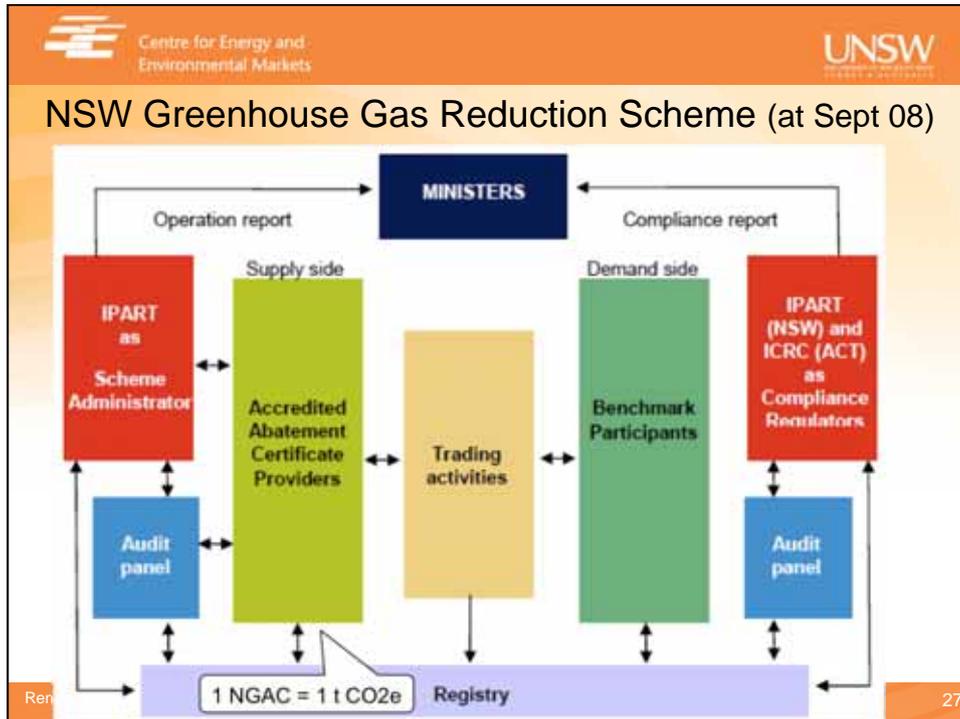
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NEM income for SA wind & other generators (ESIPC-SA APR 2008)

Year	Volume Weighted Price for Wind Generators		Volume Weighted Price for Other SA Generators	
	Full Year (\$/MWh)	Summer (\$/MWh)	Full Year (\$/MWh)	Summer (\$/MWh)
2004-05	NA	NA	39.25	32.62
2005-06	32.57	39.59	43.91	67.50
2006-07	49.69	51.55	58.71	67.21
YTD 2007-08	66.99	63.94	108.25	149.92





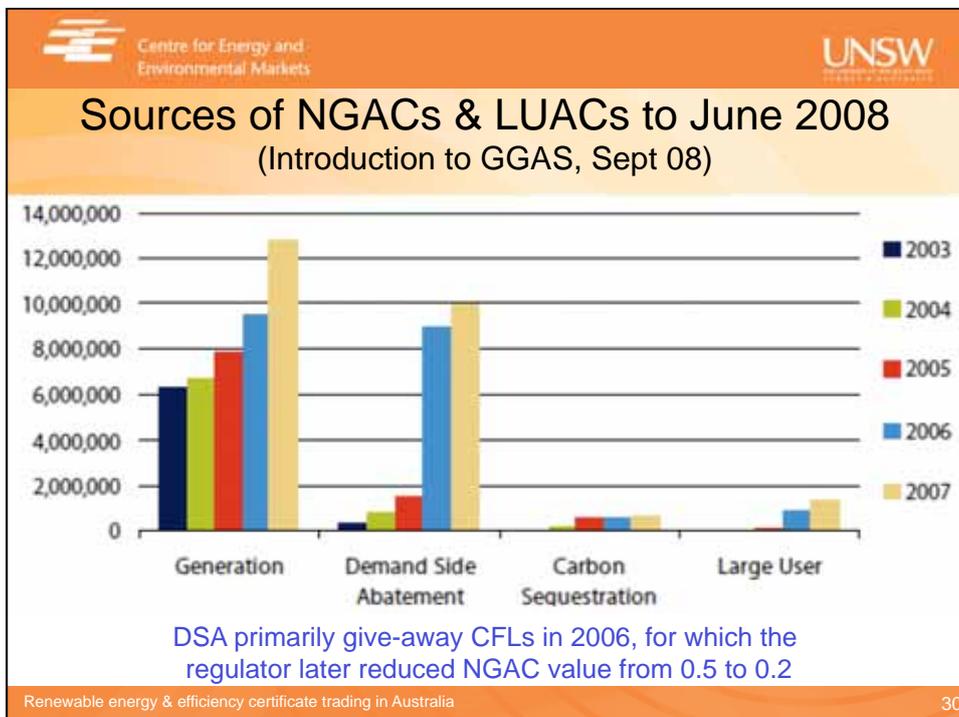




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Default DSA NGACs (Crossley,08)

Gas hot water system replacing an electric one	20
Compact fluorescent lamp rated at 8000+ hours	0.5
Compact fluorescent lamp rated at 5000+ hours	0.3
AAA showerhead connected to an electric hot water system	4.0
AAA showerhead connected to a hot water system with an unknown energy source	3.1
Refrigerator 3.5 to 6 star rating	0.1 to 2.5
Clothes washer 2.5 to 6 star rating	1.3 to 3.5
Clothes dryer 3 to 6 star rating	0.3 to 1.2
Dishwasher 4 to 6 star rating	0.1 to 0.5





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Challenges of GGAS design

- Degree of abstraction:
 - Large gaps between policy objectives, commercial arrangements + physical outcomes
- Broad scope
 - Adds complexity, dilutes accountability for policy makers & participants
 - Risks creating a ‘market for lemons’
 - eg. give-away CFLs & showerheads

```
graph LR; A[Green-house policy intent] -- Imputed linkage --> B[NGAS Legislated objectives]; B -- Imputed linkage --> C[Liability party requirements]; C -- Imputed linkage --> D[Baseline and Credit rules]; D -- Imputed linkage --> E[Actual abatement activities];
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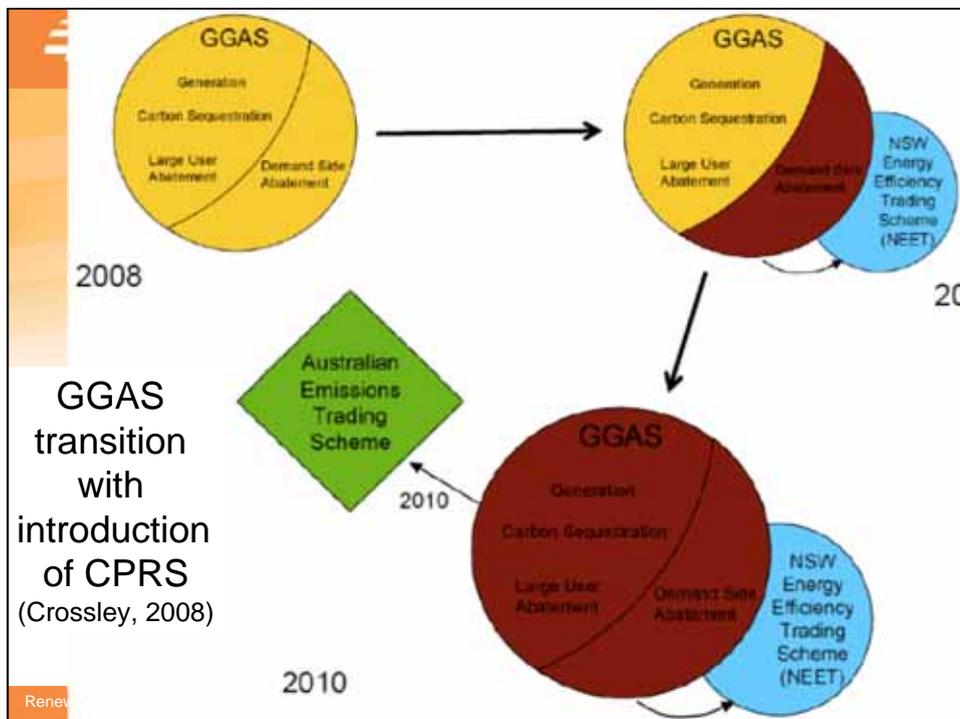


Emerging global carbon markets (ANZ, 2008)

Carbon Credit	Schemes	2006		2007	
		Volume (MtCO ₂ e)	Value (US\$M)	Volume (MtCO ₂ e)	Value (US\$M)
EUA	EU ETS	1101	\$24,357	2061	\$50,097
NSW	NGAC	20	\$225	25	\$224
CER and ERU	CDM and JI under the Kyoto Protocol	508	\$5,477	832	\$13,376
CFI	Chicago Climate Exchange	10	\$38	23	\$72
VER/VCU's	Voluntary	33	\$146	42	\$265
Total		1,745	31,235	2,983	64,035

▶ Turnover doubled from 2006 to 2007

Source: State and Trends of the Carbon Market 2008 - World Bank





NSW Energy Savings Scheme from July 2009

- To replace DSA feature of existing NGAC scheme
- To operate alongside national ETS (CPRS)
- An entity that improves efficiency of electricity use in NSW can create equivalent NEET certificates
- Liable parties: elec retailers & non-trade-exposed direct end-users (annual certificate obligation)
- Target: ramp from 0.4% to 4% of elec sales by 2014
- Terminate in 2020 or before if national NEET starts
- IPART to be NEET scheme regulator



Victorian efficiency (VEET) scheme

(www.dpi.vic.gov.au/energy)

- Modelled on UK energy efficiency trading scheme
- Liable parties will be energy retailers (elec & gas)
- To commence in 2009 & operate in 3-year phases, may run for 20 years, will use tradeable certificates:
 - 1 VEEC = 1 tonne CO₂-e;
 - Initial target = 2.7 Mt CO₂e reduction per year
- Eligible activities prescribed in regulations:
 - 25 in initial list all in household sector
 - List to be reviewed every 6 months

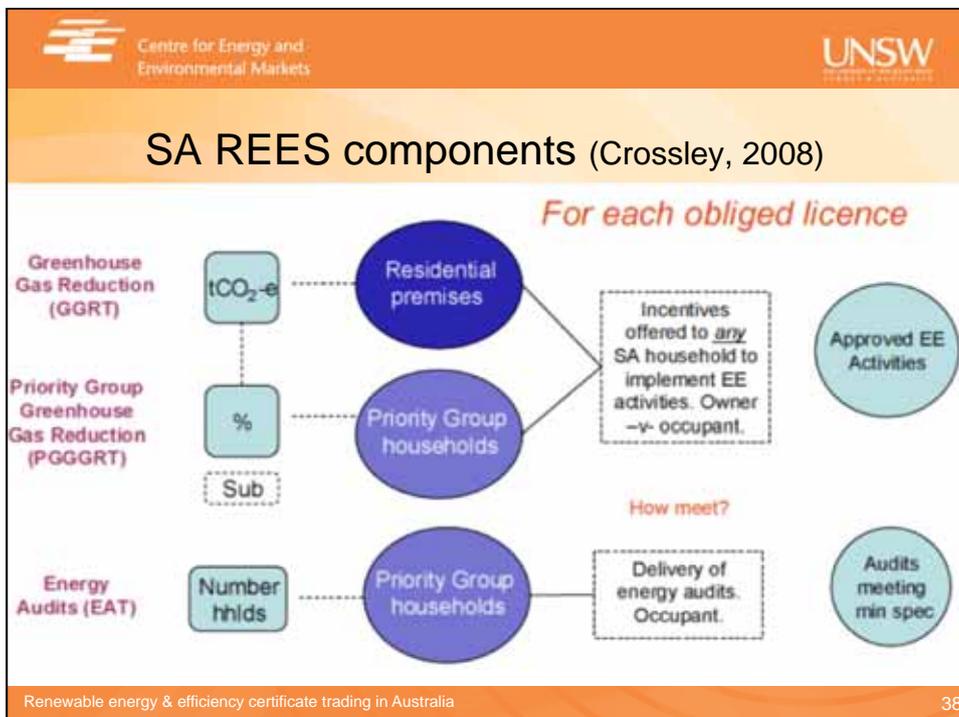




Initial list of VEET eligible activities (Crossley, 2008)	
Gas/LPG storage water heater replaces an electric resistance water heater	Installation of gas/LPG space heater
Gas/LPG instantaneous water heater replaces an electric resistance water heater	Install high efficiency space air-to-air heat pump (non gas reticulated areas only)
Electric boosted solar or heat pump hot water heater replaces an electric resistance water heater	Installation of ceiling insulation in existing home with uninsulated ceilings
Solar retrofit kit fitted to an existing electric resistance water heater	Installation of under floor insulation in existing home with uninsulated floors
Gas/LPG boosted solar hot water heater replaces electric resistance water heater	Installation of a thermally efficient window
Gas/LPG boosted solar hot water heater replaces gas/LPG water heater	Retrofit of existing single glazed window with a fixed attachment which raises thermal efficiency of existing window
Solar pre-heater for an existing gas/LPG water heater	Air sealing
Installation of high efficiency ducted gas heater to replace existing gas ducted heater	Installation of low energy GLS lamp
Installation of high efficiency ducted gas heater to replace existing central electric resistance heater	Installation of low energy small decorative lamp
Installation of ducted air-to-air heat pump to replace existing ducted air-to-air heat pump (non gas reticulated areas only)	Installation of low energy reflector lamp
Installation of ducted air-to-air heat pump to replace existing central electric resistance heater	Installation of low energy downlight
	Installation of low flow shower rose replacing conventional shower rose
	Destruction of refrigerator purchased before 1996
	Purchase of high efficiency refrigerator
	Purchase of high efficiency freezer

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Carbon Pollution Reduction Scheme (CPRS)

- Australia-wide emission-trading cap & trade scheme
 - All Kyoto gases – CO₂, CH₄, N₂O, SF₆, HFCs & PFCs
 - Entities with facilities that emit ≥ 25,000 CO₂-e pa (~1000)
 - Entities that supply certain fuels & synthetic GHGs
- Target: 5-15% reduction from 2000 level by 2020
- Permits & allocations:
 - 1 Australian Emission Unit (AEU) = 1 tonne CO₂-e
 - Up to 131 million AEU's allocated to coal-fired generators
 - Assistance to Energy Intensive Trade-Exposed Industries
 - Price cap of AUD 40 with 5% pa increase

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Timeline for key CPRS decisions (Hatfield-Dodds, 2008)

December 2008: White Paper announcements
2020 National Target range
Indicative National Emissions Trajectory 2010-11 to 2012-13

December 2009: Copenhagen Conference
Inform scheme cap and national emissions targets

October 2009: National Greenhouse & Energy Reporting System data
Inform scheme cap and national emissions targets

July 2010: Scheme commencement

Early 2010: Scheme announcements
Scheme caps for 2010-11 to 2014-15

Early 2011: Extension announcements
scheme caps to 2015-16
Indicative National Emissions Trajectory to 2015-16

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Conclusions from the Australian experience

- In the Australian context (may not be transferrable):
 - The National Electricity Market works well
 - The Tradeable Renewable Energy Certificate Scheme has worked well for low-cost RE: wind, hydro & biomass
 - Grid-connected PV still uncompetitive:
 - FiTs used instead but are a form of middle-class welfare
 - Tradeable Energy Efficiency Certificate Schemes are not yet working well
 - Emissions-Trading Scheme yet to be implemented:
 - Unlikely to act fast enough for Australia to make an equitable contribution to avoiding dangerous climate change



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