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Renewable Energy: Policy options & integration issues

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BPPT, Jakarta, 28/11/06

www.ceem.unsw.edu.au

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Outline

- Sustainability context
- Renewable energy technologies & characteristics
- Key issues with high levels of renewable energy penetration

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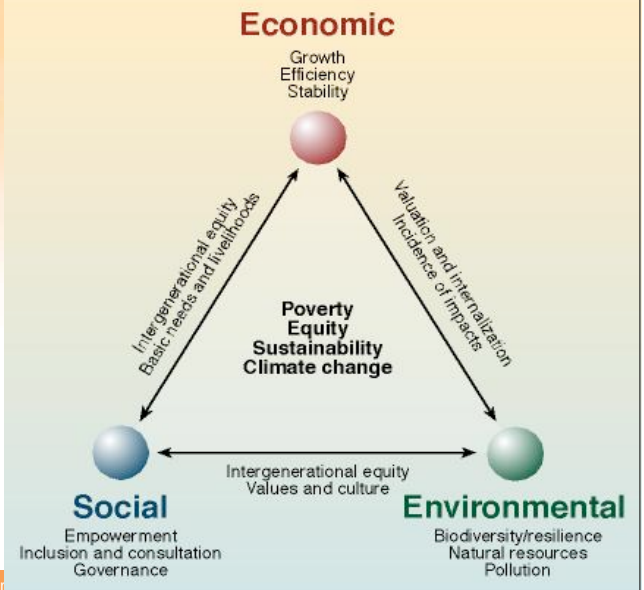
Sustainability context for the electricity industry
(IPCC COP7)

Must also achieve resource adequacy:
Short & long-term system security (availability & quality of supply)

Key elements of sustainable development and interconnections



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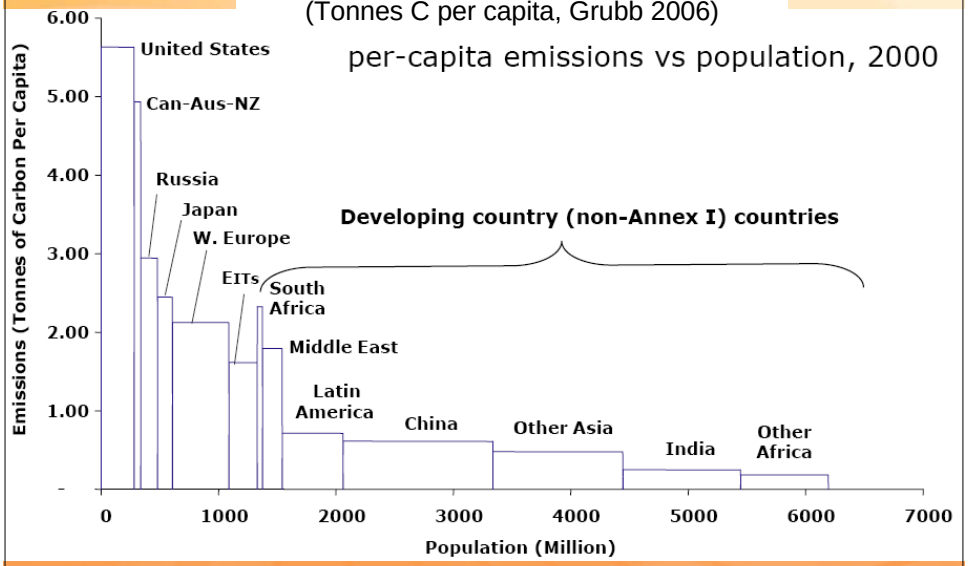
Climate change emissions
(Tonnes C per capita, Grubb 2006)



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Renewable energy barriers, challenges & opportunities, IEA, 2006

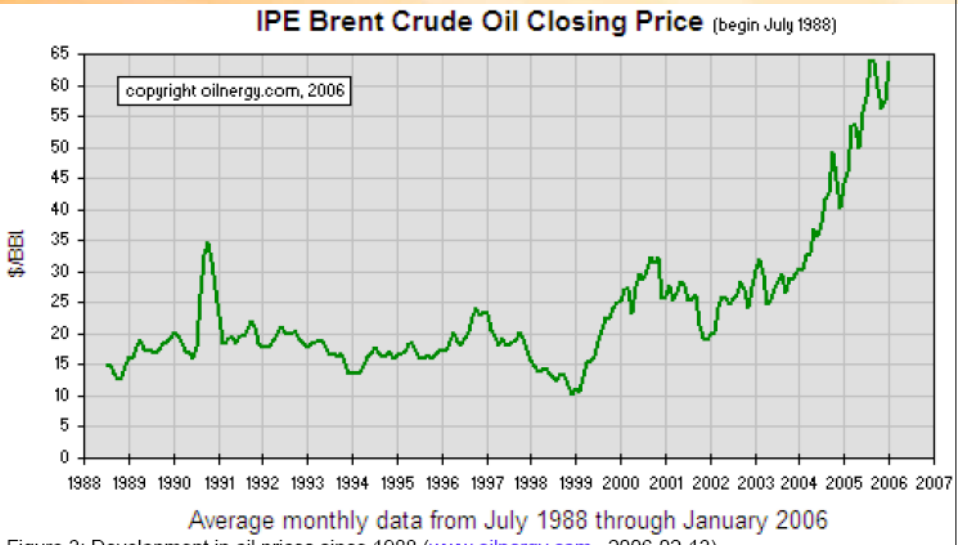

Figure 3: Development in oil prices since 1988 (www.oilnergy.com , 2006-02-13)

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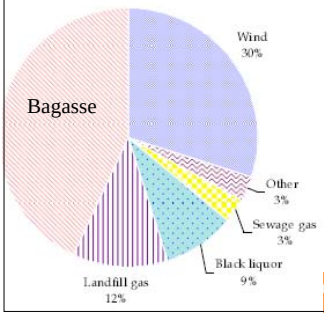
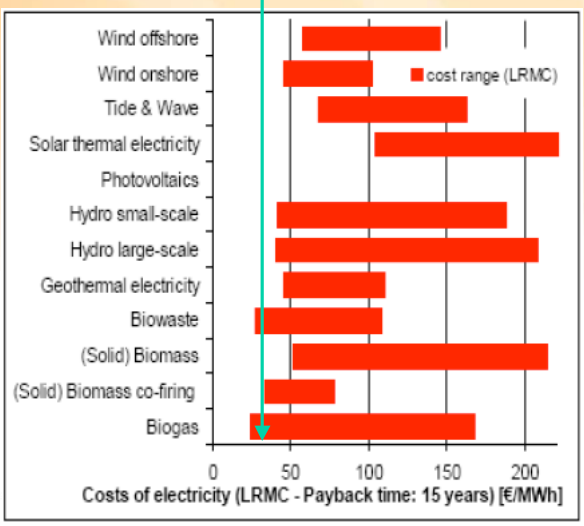
Coal-fired power station approx 35€/MWh

Renewable energy & coal comparison (IEA, 2006)

Aust. non-hydro RE market shares (%)





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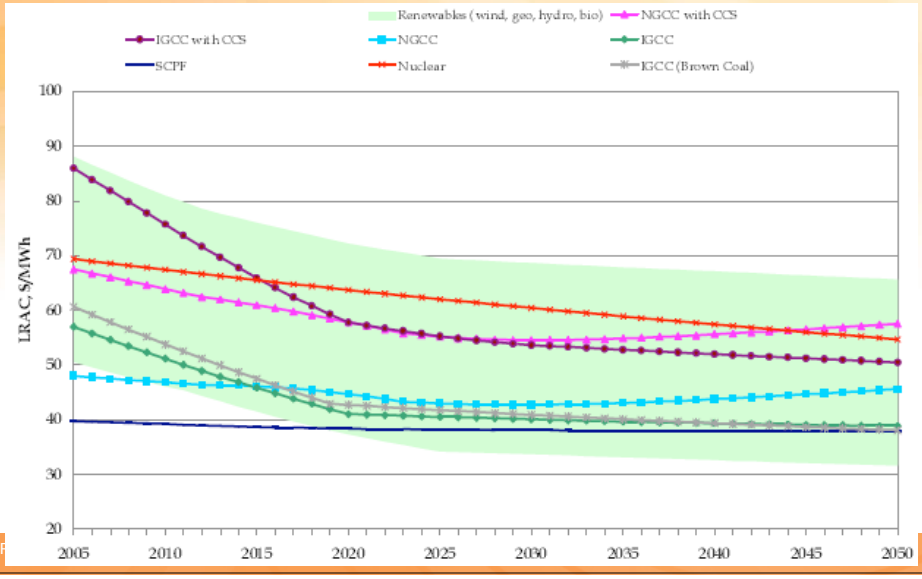
Low-emission generation cost trends (MMA, 2006)



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Status of RE technologies: *hardware perspective* (IEA, 2006)

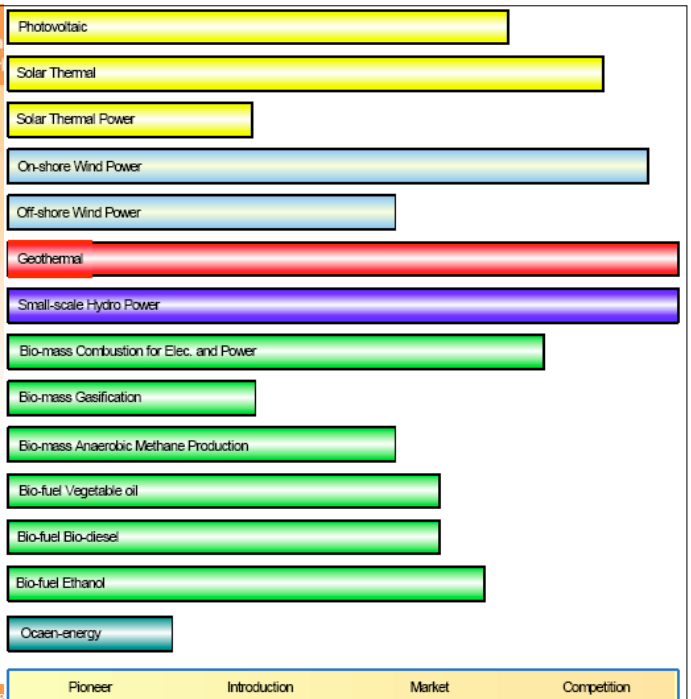

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Figure 4: Development of renewable energy technologies – rough indication! [16]

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The most effective policy options depend on the context (Grubb, 2006)

	Voluntary, regulatory and systemic instruments	Economic instruments	Innovation instruments
Behaviour			
Substitution			
Technical innovation			

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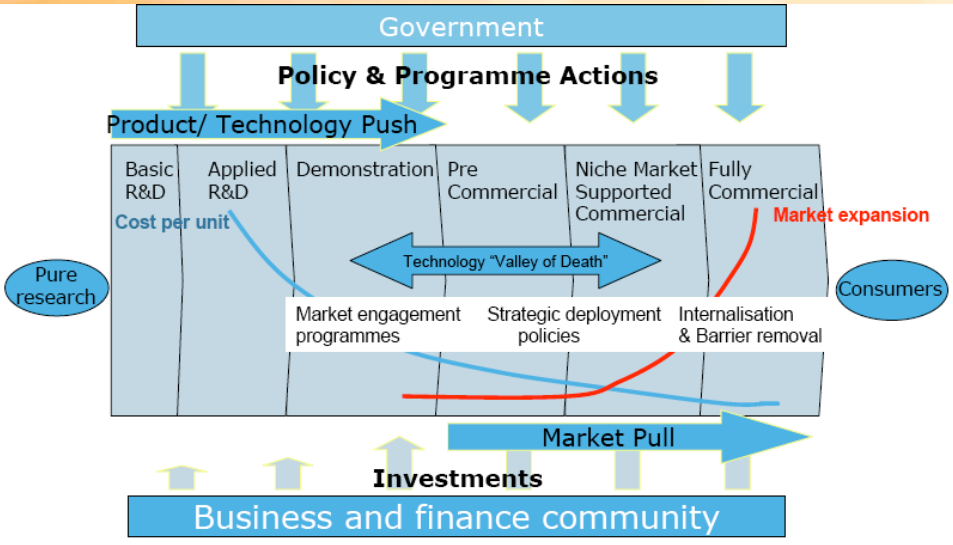
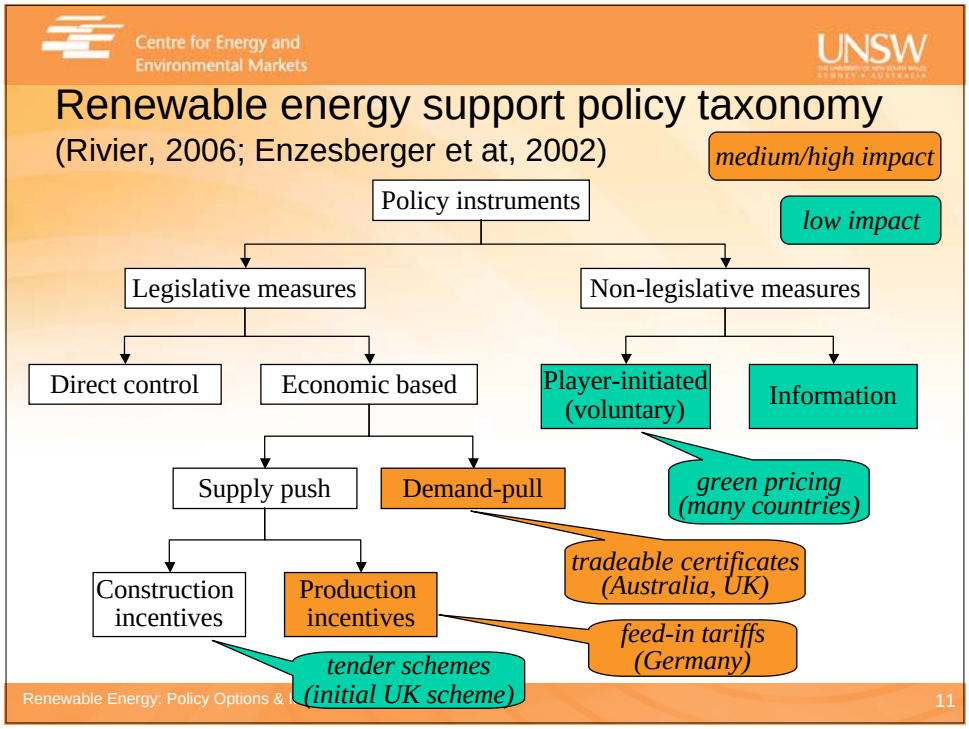
Successful innovation requires both technology push & market pull (Grubb, 2006)

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Renewable energy support policy taxonomy
(Rivier, 2006; Enzesberger et at, 2002)
medium/high impact
low impact
Policy instruments
Legislative measures
Non-legislative measures
Direct control
Economic based
Player-initiated (voluntary)
Information
Supply push
Demand-pull
green pricing (many countries)
tradeable certificates (Australia, UK)
Construction incentives
Production incentives
feed-in tariffs (Germany)
tender schemes (initial UK scheme)
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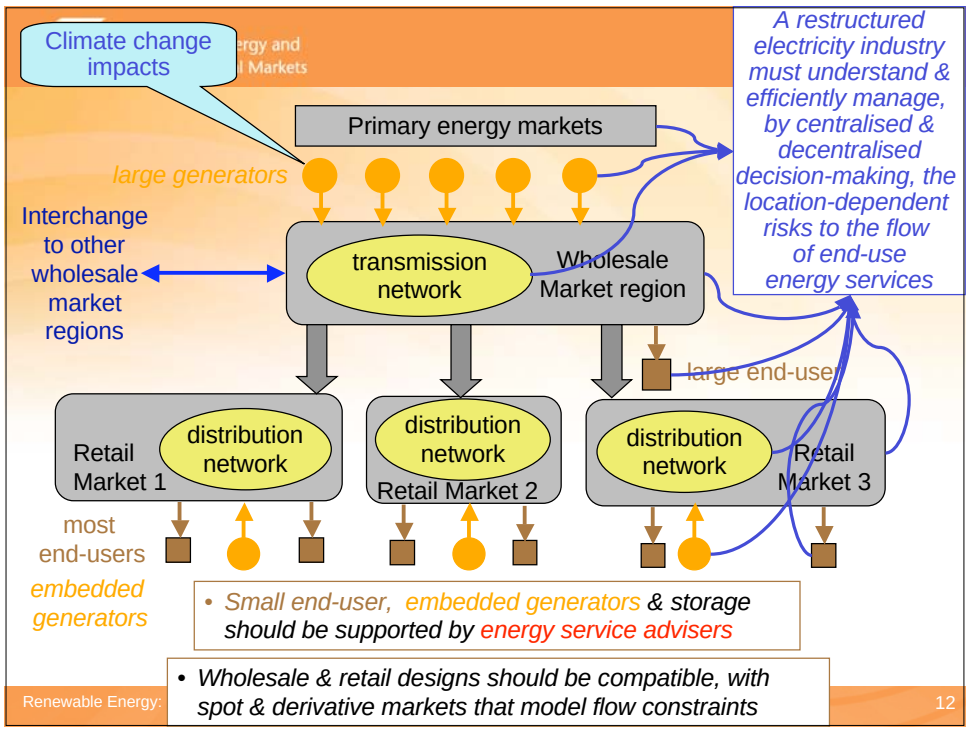
Climate change impacts
Primary energy markets
large generators
A restructured electricity industry must understand & efficiently manage, by centralised & decentralised decision-making, the location-dependent risks to the flow of end-use energy services
Interchange to other wholesale market regions
transmission network
Wholesale Market region
large end-users
Retail Market 1
distribution network
distribution network
Retail Market 2
distribution network
Retail Market 3
most end-users
embedded generators
• Small end-user, embedded generators & storage should be supported by energy service advisers
• Wholesale & retail designs should be compatible, with spot & derivative markets that model flow constraints
Renewable Energy:
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Contributors to unavailability of electricity supply for small end-users (USA data, AEMC, 2006)

Contributor	Average unavailability per customer year	
	(minutes)	(%)
Generation/transmission	0.5	0.5
132 kV	2.3	2.4
66kV and 33kV	8.0	8.3
11kV and 6.6kV	58.8	60.7
Low voltage	11.5	11.9
Arranged shutdowns	15.7	16.2
Total	**96.8 minutes**	**100.0**

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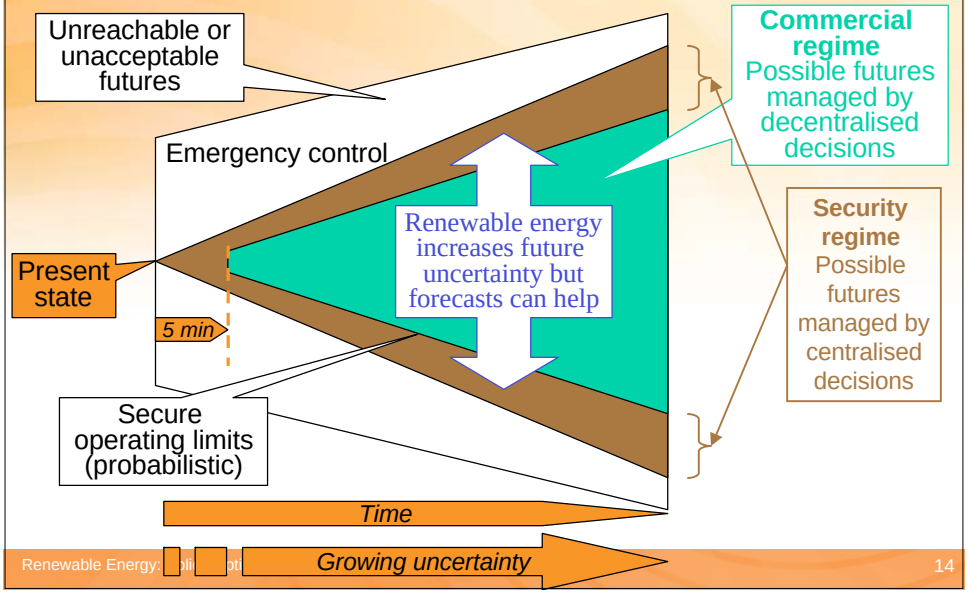
Security & commercial regimes (global & local)



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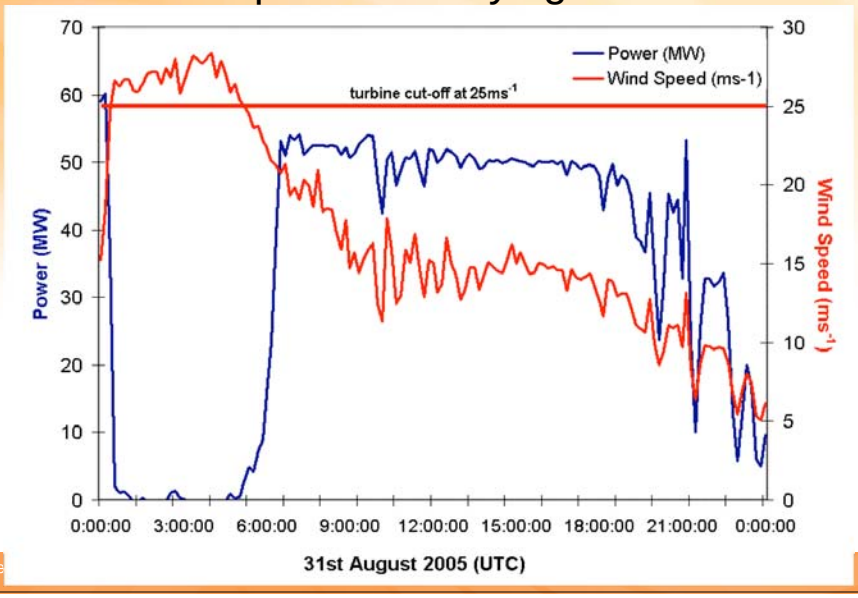
Wind farm response to varying wind conditions



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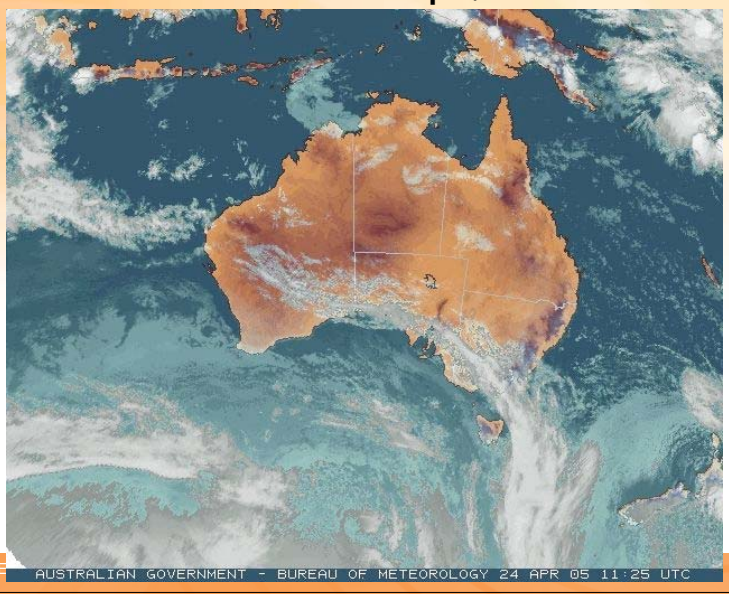
S1: Infra-red satellite map (BoM Aust,1125 UTC 24/4/05)



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Low-pressure cell over southern Australia

(BoM, 2006)

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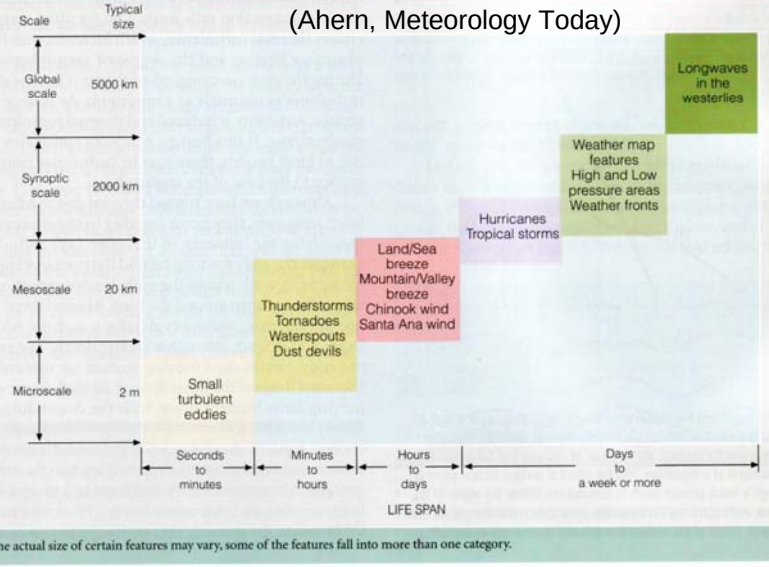
•TABLE 9.1

The Scales of Atmospheric Motion with the Phenomena's Average Size and Life Span*

(Ahern, Meteorology Today)



*Because the actual size of certain features may vary, some of the features fall into more than one category.

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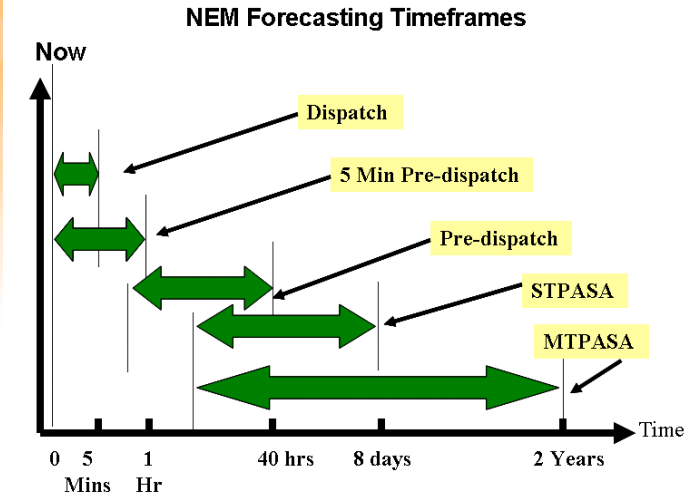
NEMMCO Forecasting Timeframes



(AWEFS functional requirements, www.nemmco.com.au)

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Key technical issues for high-penetration renewable energy

- Design & demonstration of distributed resource systems (generation, storage, end-use response)
- Advanced metering, communication & control for distributed resources
- Improved power electronic devices
- Compact, high-capacity & cost-effective reversible energy storage
- Mathematic modelling & forecasting for renewable energy generation & distributed resources

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Key regulatory & policy issues for high-penetration renewable energy

- Institutional issues:
  - Robust security regime with security-constrained dispatch
  - Efficient commercial regime (operation & investment)
  - Effective regulatory framework (network services)
  - Compatible arrangements for gas industry
- Policy issues:
  - Appropriate innovation in renewable energy technologies
  - Correct location & timing for investment in renewables
  - Forecasting for security & commercial regimes
  - Active end-user participation (value, timing, efficiency)
  - Skill development in all relevant areas

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Key commercial issues for high RE

- Advanced auction-style electricity markets:
  - Spot & derivative energy; ancillary services
    - Within continually updated security constraints
    - With active end-users supported by ESCOs
    - With attention to equity issues
- Efficient network access regimes:
  - Availability & quality; active end-user participation
- Renewable energy forecasting tools for:
  - Renewable energy generators
  - Other generators and end-users
  - System operators & policy-makers
- Efficient financial mechanisms to counter un-costed fossil fuel externalities

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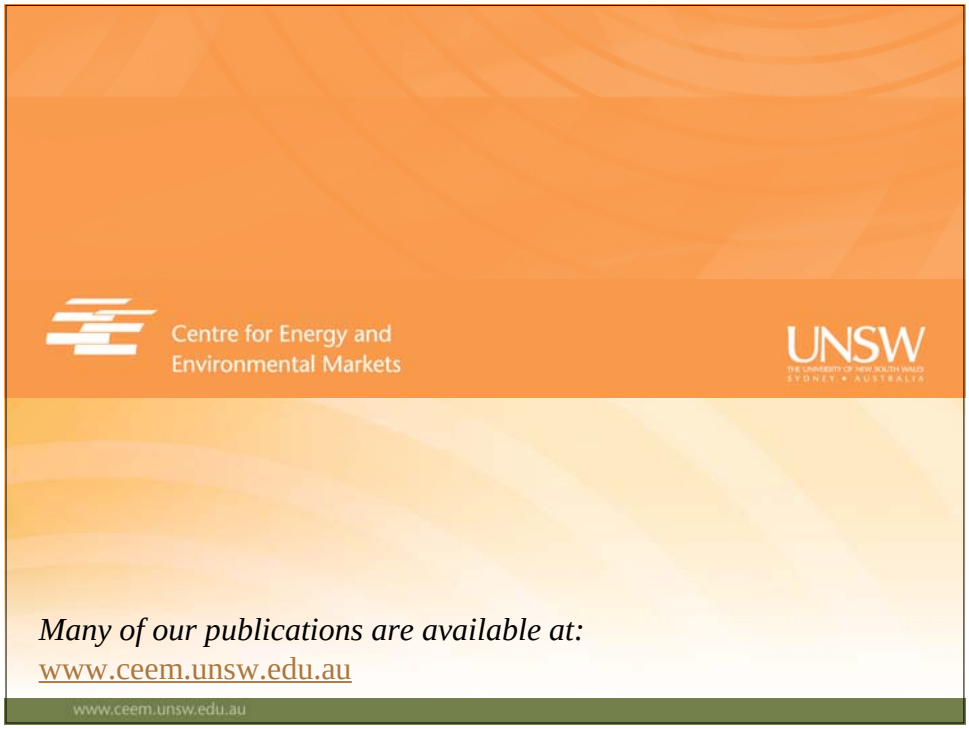
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