Centre for Energy and Environmental Markets

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The outlook for electricity industry restructuring in Australia

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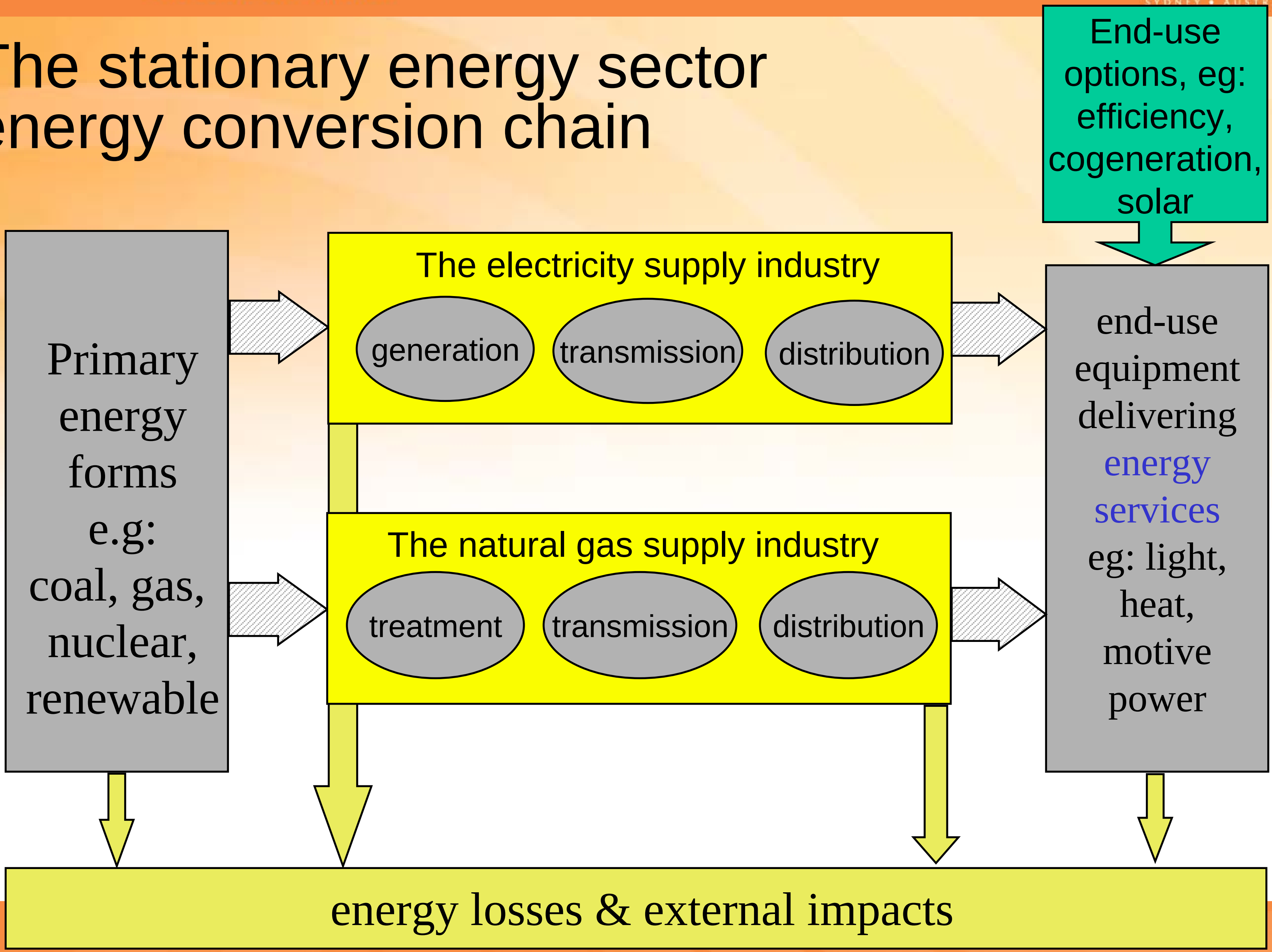
Hugh Outhred
Presiding Director
CEEM

Outline

- Key properties of the electricity industry
- Objectives of electricity industry restructuring
- Challenges in electricity industry restructuring
- Key features of the Australian implementation
- Strengths of the Australian implementation
- Weaknesses of the Australian implementation
- Current developments
- Future prospects
- Conclusions

The stationary energy sector energy conversion chain



Key features of the electricity industry

- Part of the stationary energy sector:
  - In competition with, and dependent on, other energy vectors to deliver end-use energy services
- Significant externalities:
  - Environmental (eg climate change)
  - Social (eg “essential good”)
- Characteristics of AC electrical energy:
  - Alternating current (AC) electrical energy is:
    - A high quality, secondary energy form:
    - Expensive to make but flexible to transport & use
  - Influenced by many stochastic processes
  - Has specific physical properties

- Specific properties of AC electrical energy:
  - No cost-effective storage of AC electrical energy
  - Instantaneous transmission & distribution
  - Energy flows according to network laws:
    - From all generators to all end-use equipment
    - Quality & availability shared by all equipment at the same location
- The ultimate “just in time” industry:
  - Supply & demand must balance at all times
    - Generator output determined by end-use equipment
    - Supply & demand side options are equally valid
  - Cannot assign energy from a particular power station to a particular consumer:
    - ‘pool’ rather than ‘bilateral’ trade
  - Wholesale & retail activities not clearly separable:
    - Retailers don’t have a clear role in an electricity industry

Objectives of electricity industry restructuring

- Improve economic efficiency by facilitating competition & new entry, which assumes:
  - Effective markets & clear accountabilities via sound legal & policy frameworks
- Enhance accountability to end-users & society through ‘customer choice’, which assumes:
  - End-users become active participants in the industry
  - End-users are independent agents who make “informed” decisions & efficiently manage the associated risks:
- Implement a market-based approach to social & environmental externalities:
  - Assumes political will to regulate non-monetary impacts
- In some cases, release government funds by asset sales:
  - Creates a moral hazard for politicians

The electricity industry restructuring process

Issue	Transition	Key challenges
Industry structure	*From* monopoly *To* competing firms *Plus* system operator(s)	Cultural change; Adequate competition; *Accountability*
Commercial framework	*From* cost recovery *To* market prices	Market power; Market design fidelity; *Accountability*
Industry regulation	*From* rate of return *To* Incentive Reg'n	Multiple objectives; Measuring outcomes; *Accountability*
Sustainability	*From* direct cost *To* full costs	Variable RE energy flows End-user participation; *Accountability*

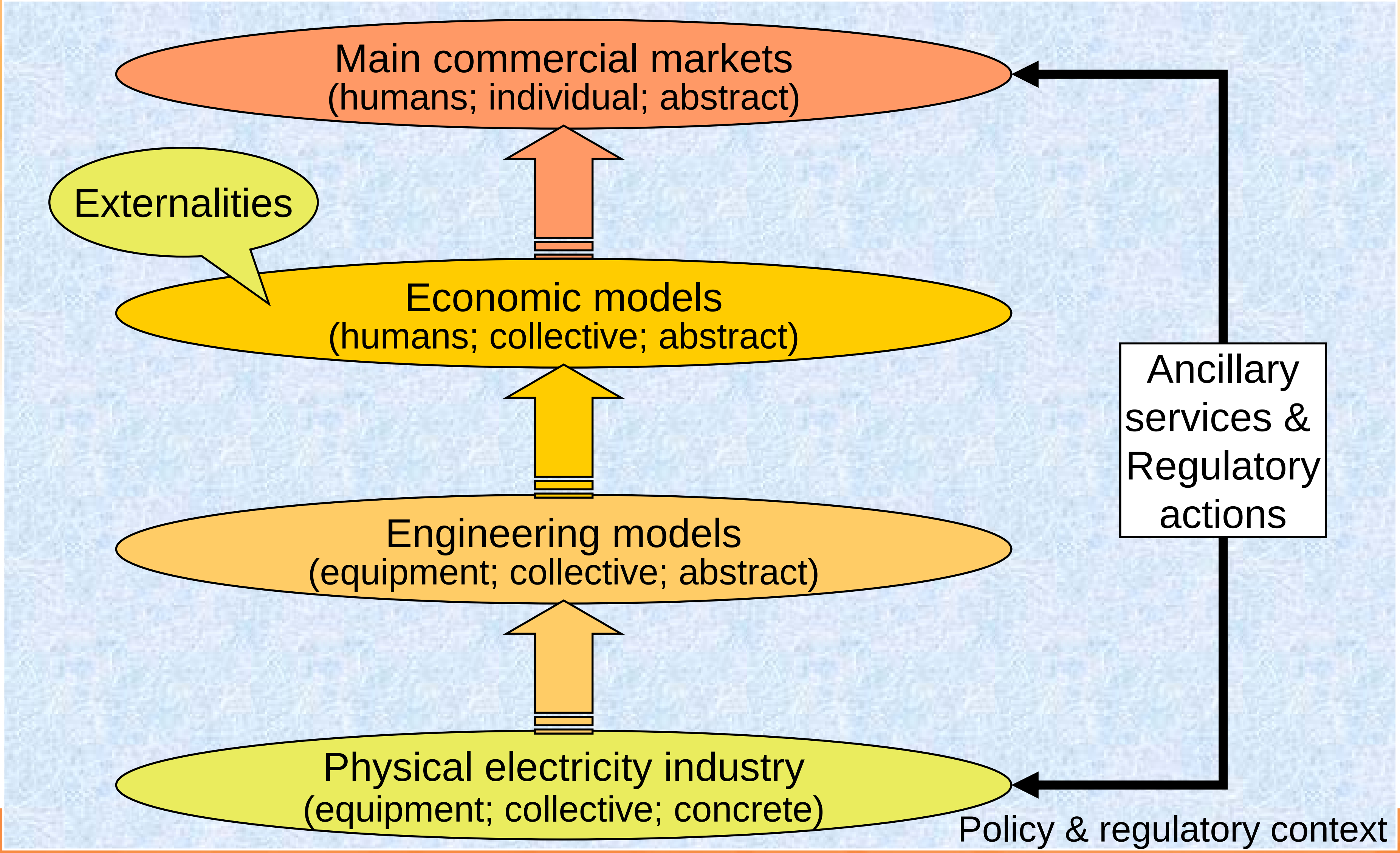
Challenges in electricity industry restructuring

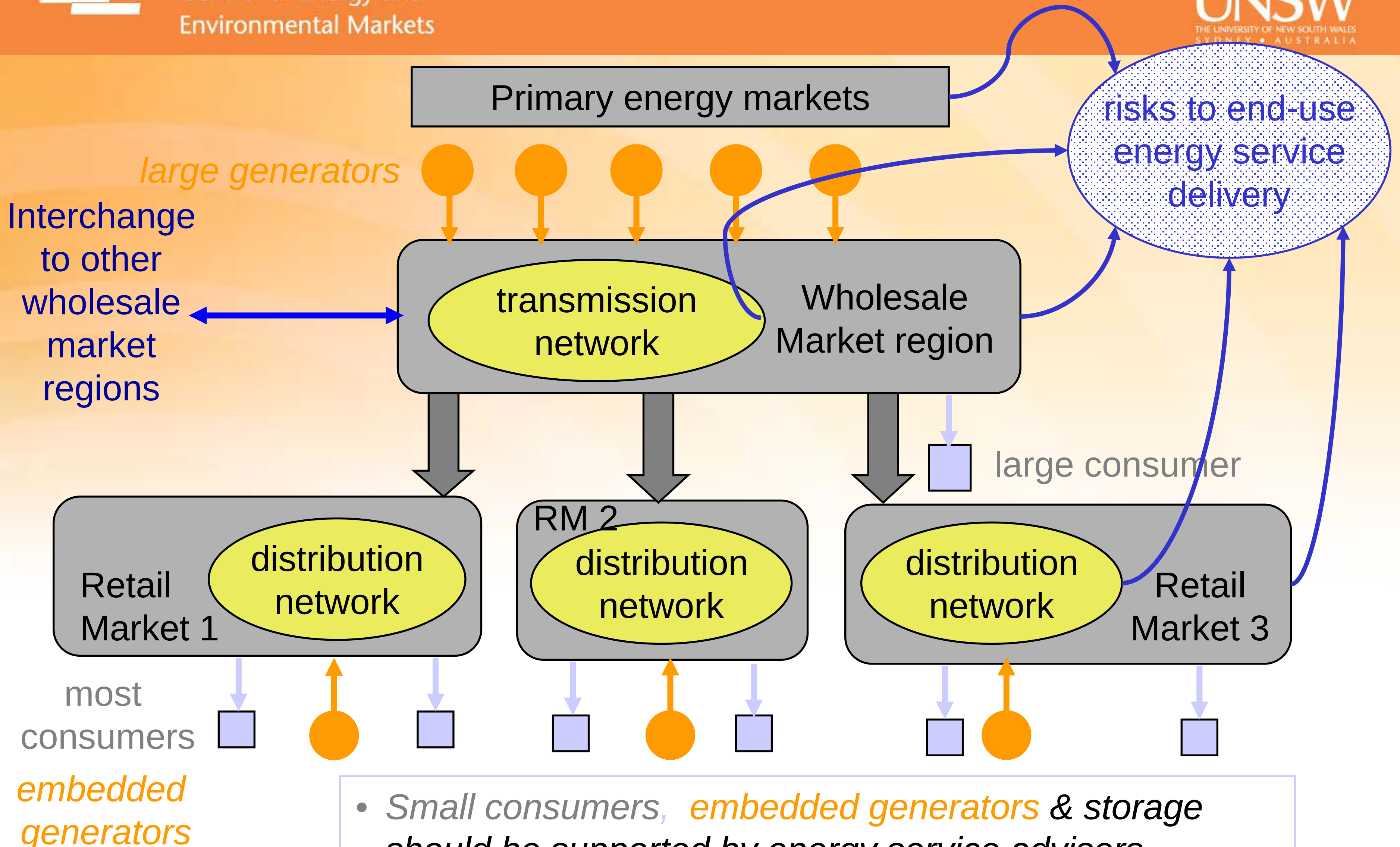
- The industry is infused with short & long term risk:
  - A *flow* industry with short-term uncertainty in, & shared responsibility for, location-specific availability & quality
- Electricity markets are incomplete & thus inefficient:
  - Economic value derives from end-use energy services not electricity
  - Temporal & locational averaging; important externalities
  - Imbalance between large & small participants; gaming
  - Long-term risks due to asset longevity & capital intensity
- *Centralised decision making* remains, by:
  - System operators, Network Service Providers, Regulators
- There is an unavoidable interaction between:
  - Cooperative (*centralised*) short & long-term decision making and
  - Competitive (*decentralised*) short & long-term decision making
- Which results in:
  - *Ambiguity in the accountability of industry decision makers*

Useful models of an AC electricity industry

- Physical reality, e.g. for AC electricity:
  - Instantaneous voltages, currents & power flows
- Engineering models (a typical example):
  - Balanced 3 phase sinusoidal voltages & currents
- Main commercial models (typical examples):
  - Spot & forward markets; network access regime:
    - *Designed to elicit economically efficient behaviour*
- Ancillary services to manage mismatches:
  - Between main commercial models & physical reality
- Policy & regulatory framework for the industry:
  - Societal objectives & behavioural norms

Trading in electricity:- an abstraction from reality





- *Small consumers, embedded generators & storage should be supported by energy service advisers*

- *Wholesale & retail market designs should be compatible*
  - *Both should include network models*

Challenges for a restructured industry

- Consistency between centralised & decentralised processes:
  - Centralised power system security: *most ancillary services; industry operation; industry design & regulation*
  - Decentralised market processes: *some ancillary services; spot & forward markets*
- Sound interface between centralised & decentralised processes:
  - Clear accountabilities & “hand-overs”
- Active involvement of informed end-users:
  - Industry economic value derives from end-use energy services NOT electrical energy

Timescales & mechanisms for risk management

(*centralised* power system security & *decentralised* markets)

Time scale	Issues	Mechanisms *centralised* & decentralised
< 30 minutes	• Demand fluctuations • Contingencies	• *Ancillary services*
30 minutes to several days	• Demand uncertainty • Inter-temporal links, eg • Unit commitment	• Ex-ante spot market • Short term forward market

Weeks to years Š (operation)	• Inter-temporal links, eg
	  • Retail tariff setting
	  • Hydro scheduling
		• Long term forward market

Weeks to years Š (investment)	• Optimal investment decisions	• Long term forward market • *Policy framework*

Power system security

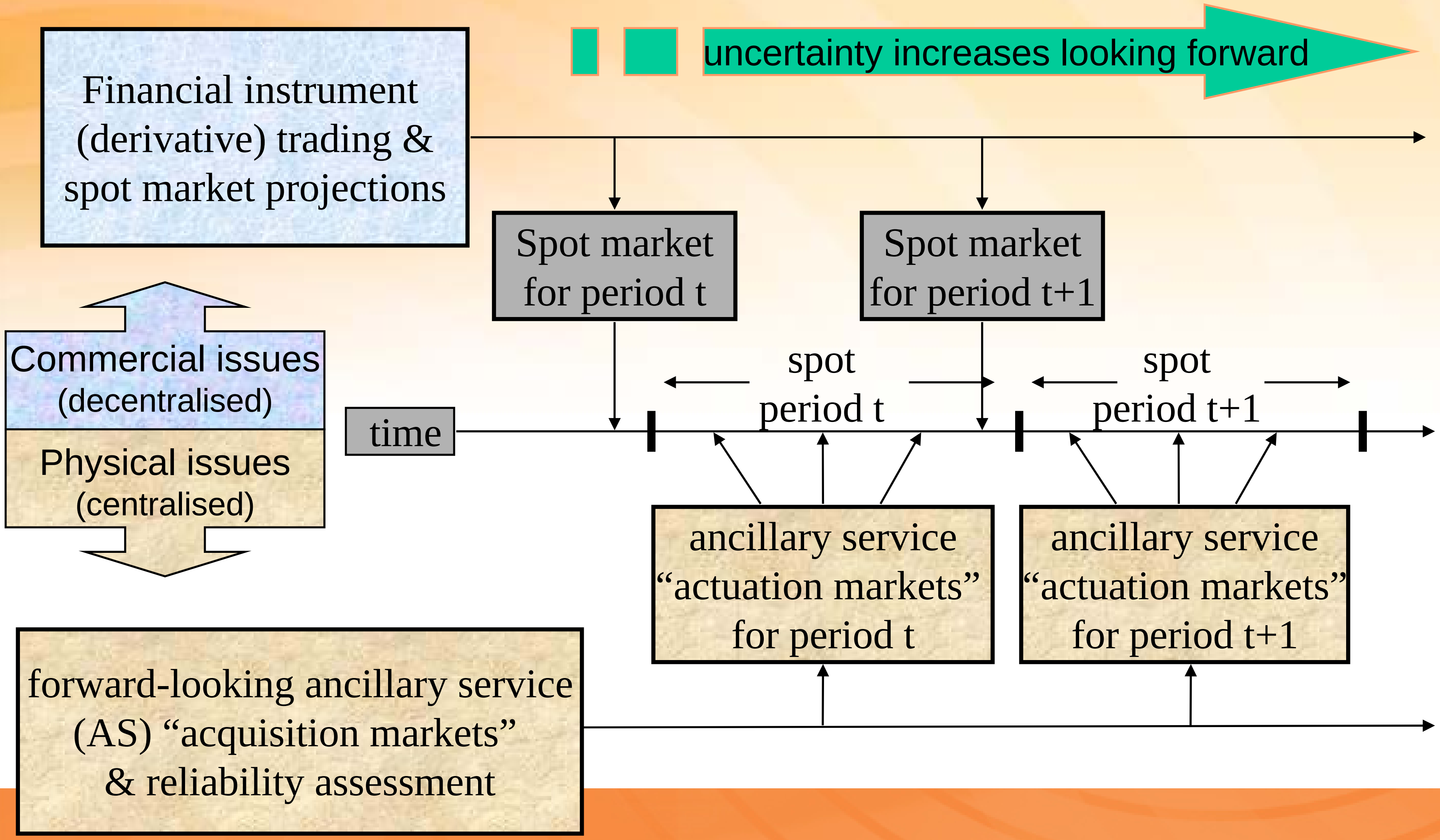
(Australian National Electricity Code (NEC) Chapter 4)

- Satisfactory operating state:
  - Frequency “normal” (49.9-50.1Hz), except for brief excursions within 49.75-50.25Hz
  - Voltage magnitudes within specified limits
  - All equipment operating within equipment rating
- Contingencies (equipment outages):
  - Credible, eg single generator or network element (N-1)
  - Non-credible, eg multiple outages except abnormal condns
- Secure operating state:
  - Currently in a satisfactory operating state
  - Would return to a satisfactory operating state following any single credible contingency (consider loss of largest gen / interconnector)

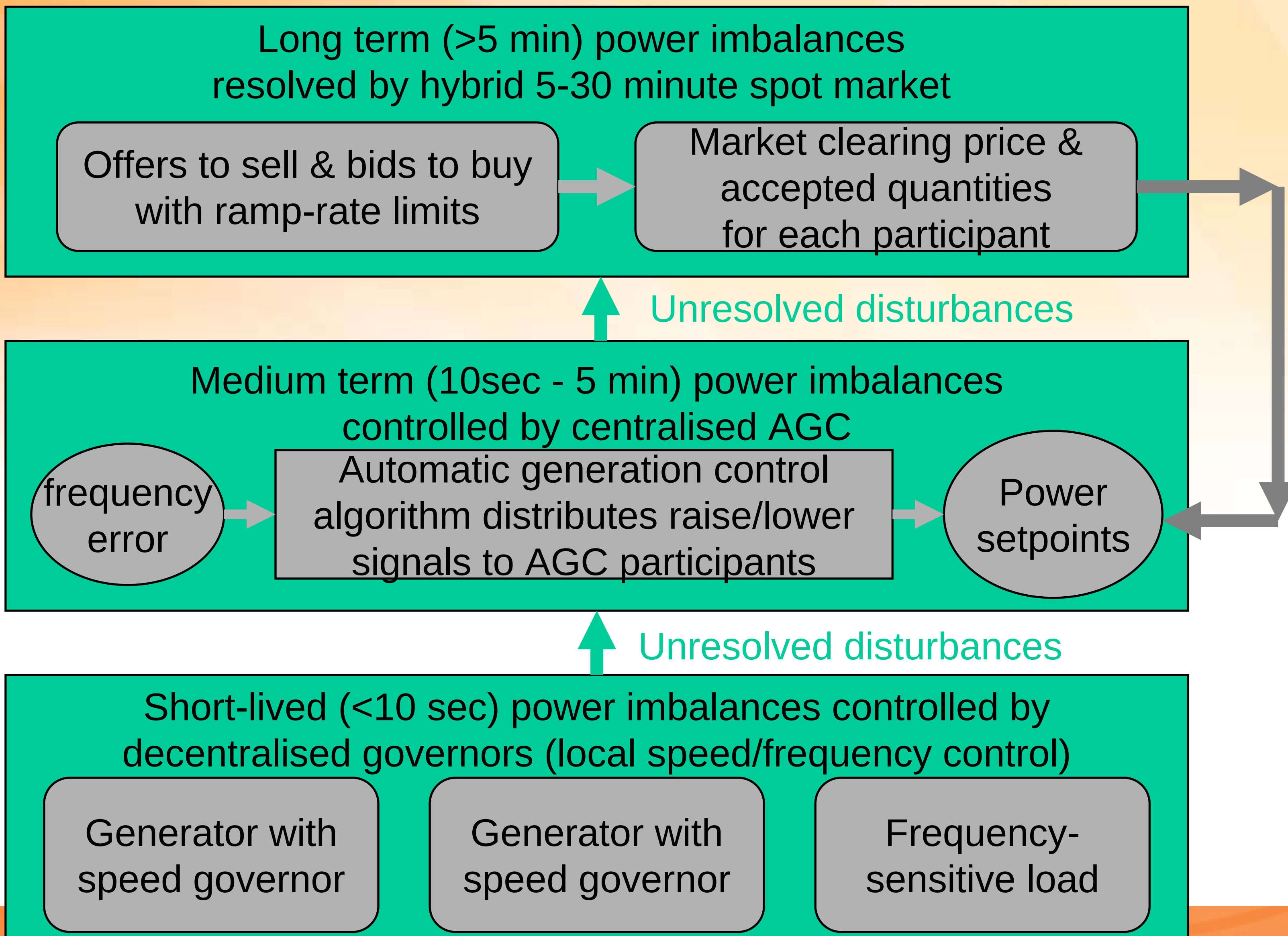
=> Require sufficient FCAS available to cover sudden loss of largest generation unit / interconnector within each NEM region

Centralised & decentralised risk management

(requires adequate location detail & active demand-side involvement)



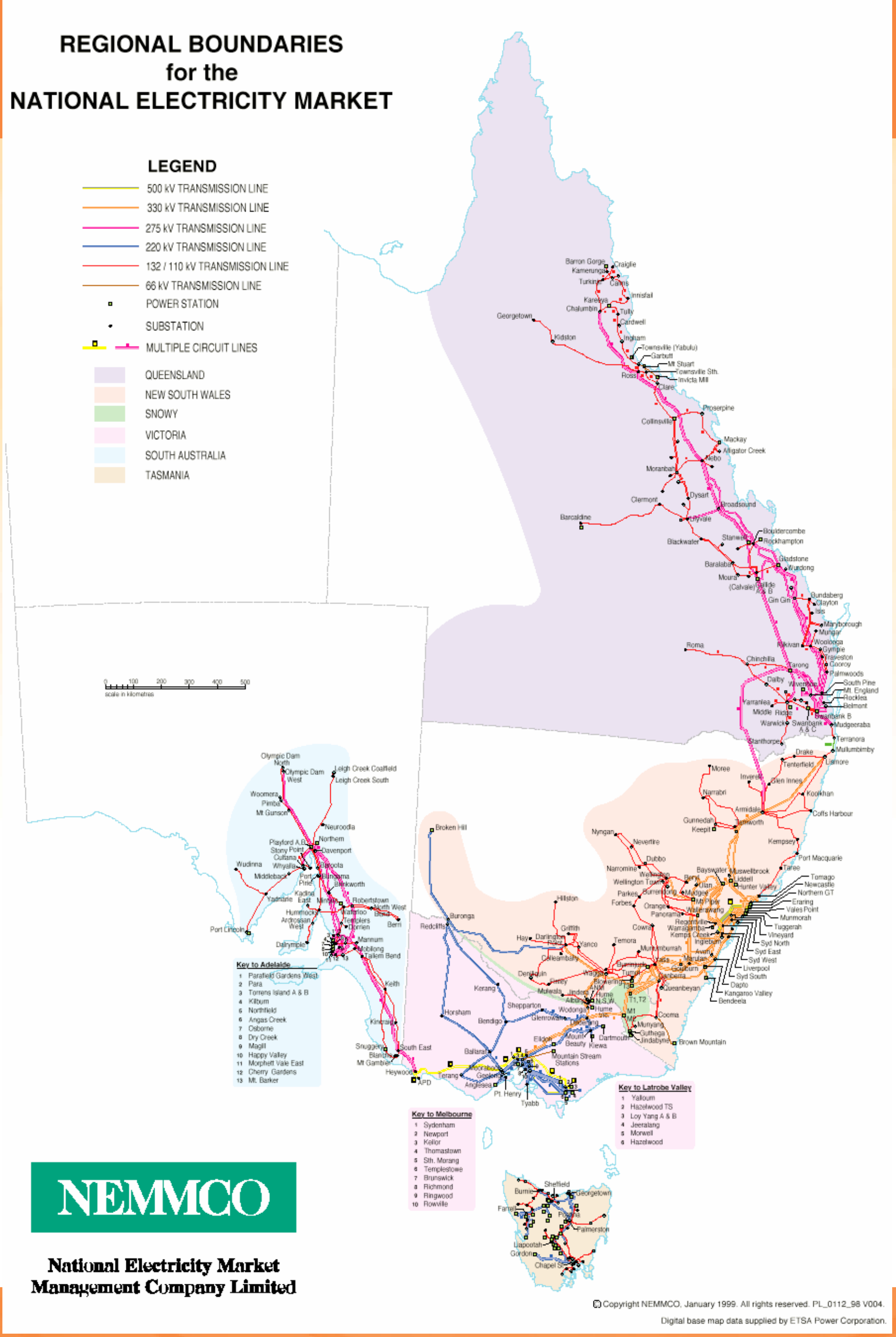
Frequency control & NEM 5-30 minute spot market



Scope of the NEM

- Queensland
- New South Wales & ACT
- Victoria
- South Australia
- Tasmania (on connection to the mainland)

NEM regions are indicated, and their boundaries need not be on state borders (e.g. two regions in NSW)



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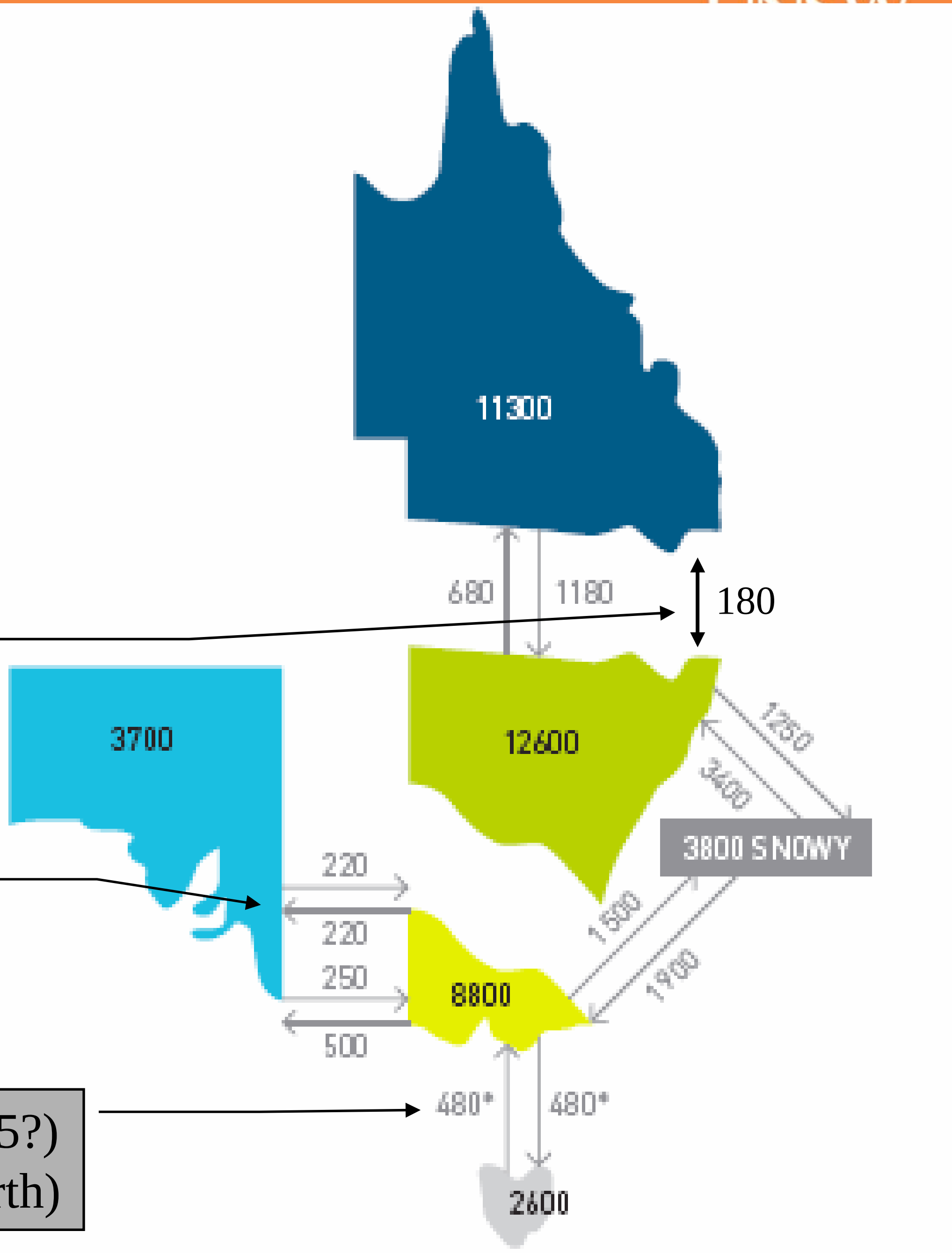
NEM market regions

(Securing Australia's Energy Future, 2004)



Directlink DC link, currently MNSP

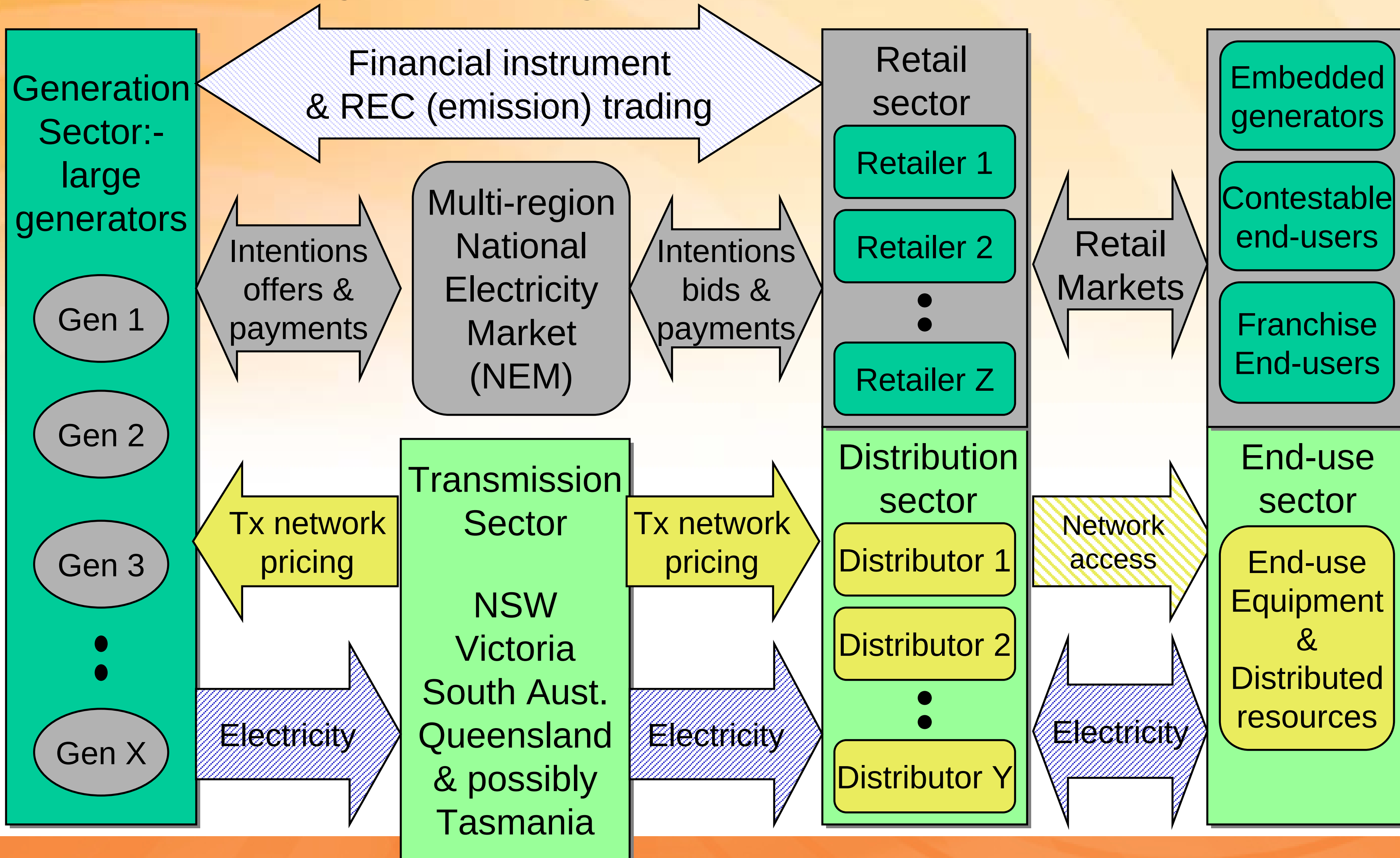
Murraylink DC link, now regulated, formerly MNSP

Basslink DC link MNSP (2005?) 600MW short term rating (north)

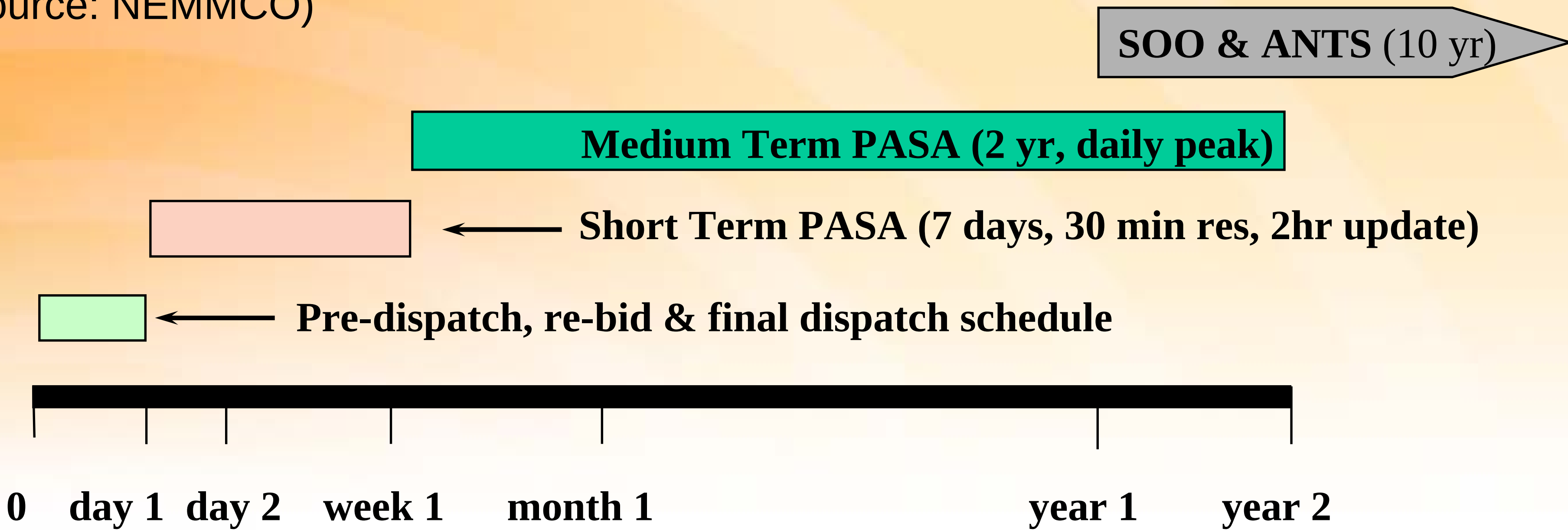
Key NEM features

- 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

Electricity industry structure in SE Australia

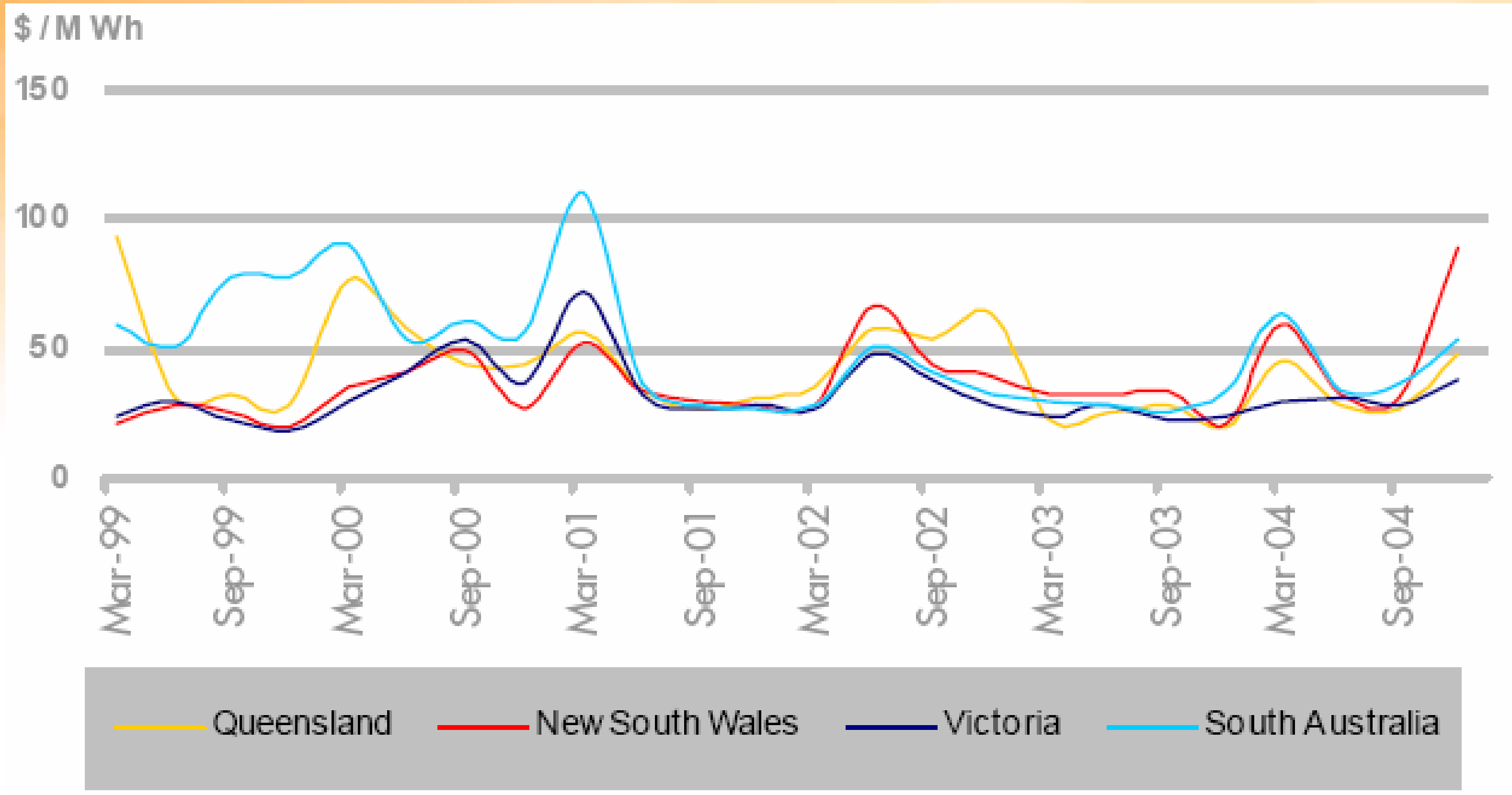


Dispatch, Pre-dispatch, PASA, SOO & ANTS
(source: NEMMCO)

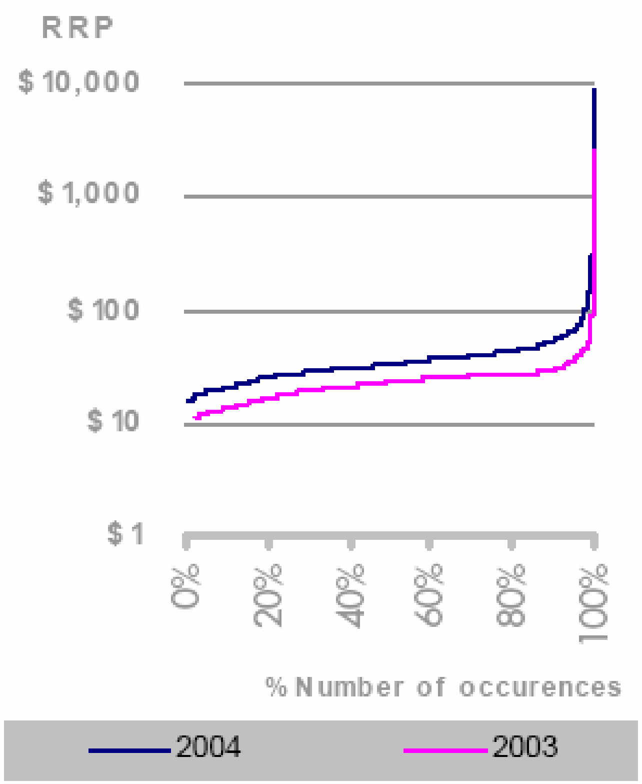


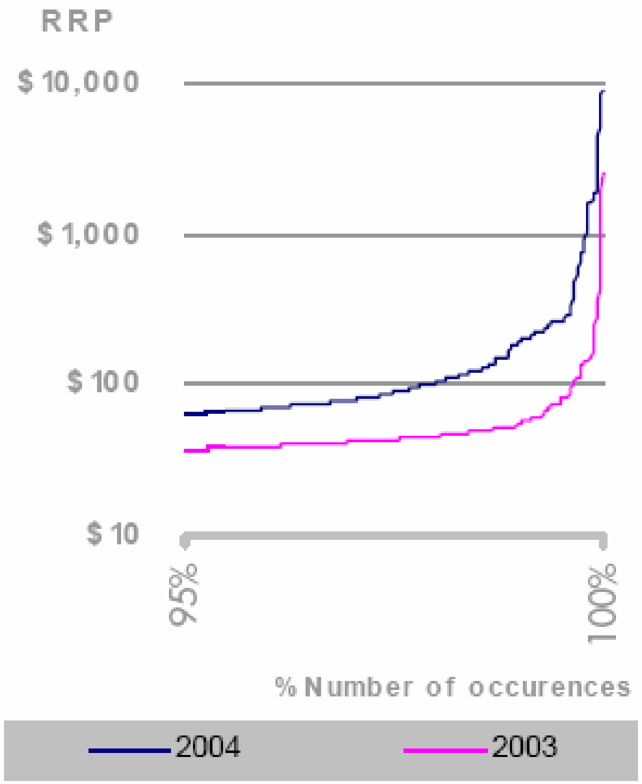
- ST & MT Projected Assessment of System Adequacy support reserve assessment & participant operating decisions. ST PASA projects region demand & reserve for 7 days @ 30 min resolution, updated every 2 hours. MT PASA projects region daily peak demand & reserve for 2 yrs, updated weekly.
- Statement of Opportunities (SOO) & Annual National Transmission Statement (ANTS) are intended to inform generation, demand & network investment decisions (10 year horizon, issued annually)

Weekly avg. NEM spot prices since market inception (NECA, 04Q4 Stats, 2005)

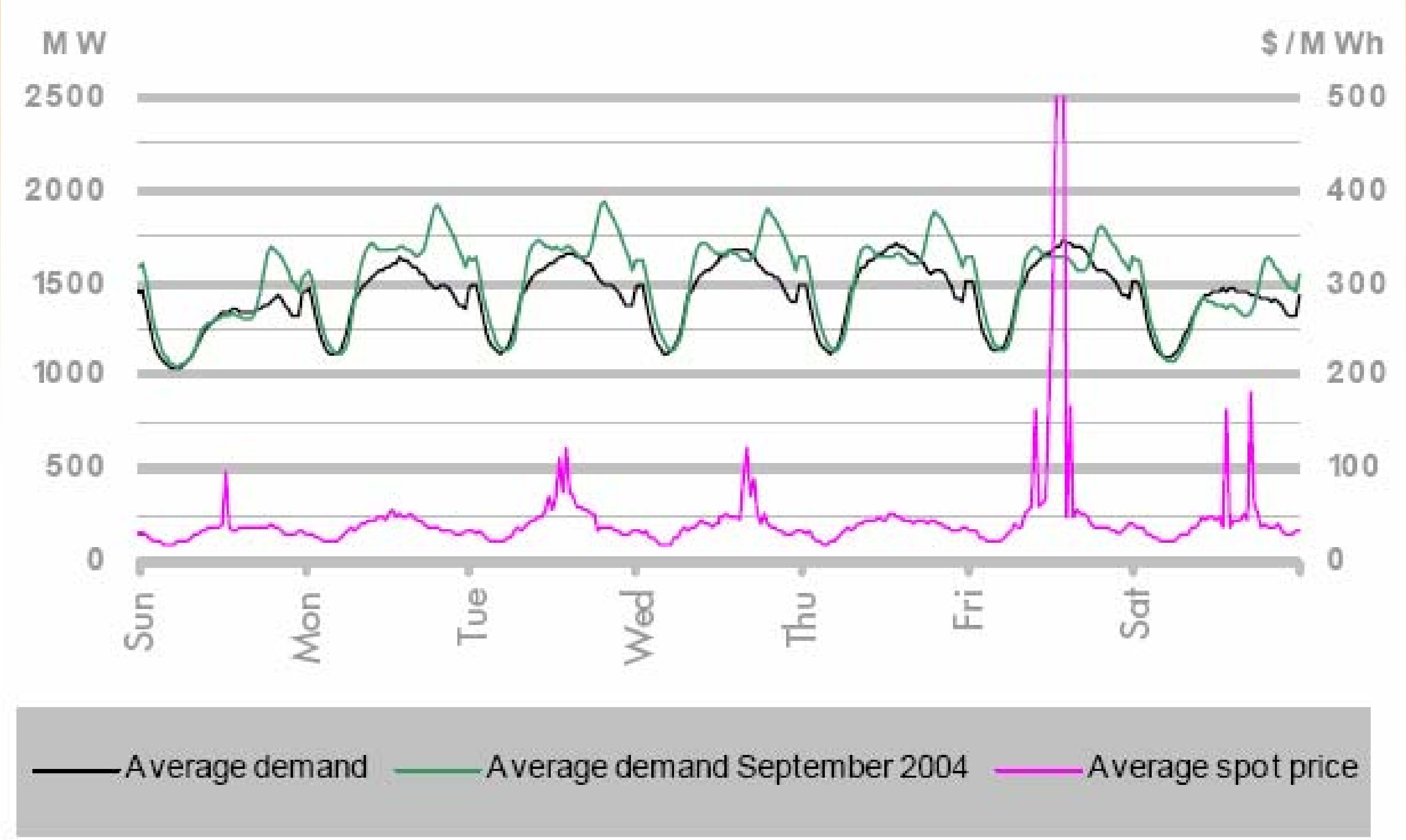


Spot price duration curve, SA, Sept-Dec 2004 (NECA, 04Q4 Stats, 2005; half-hour spot prices)



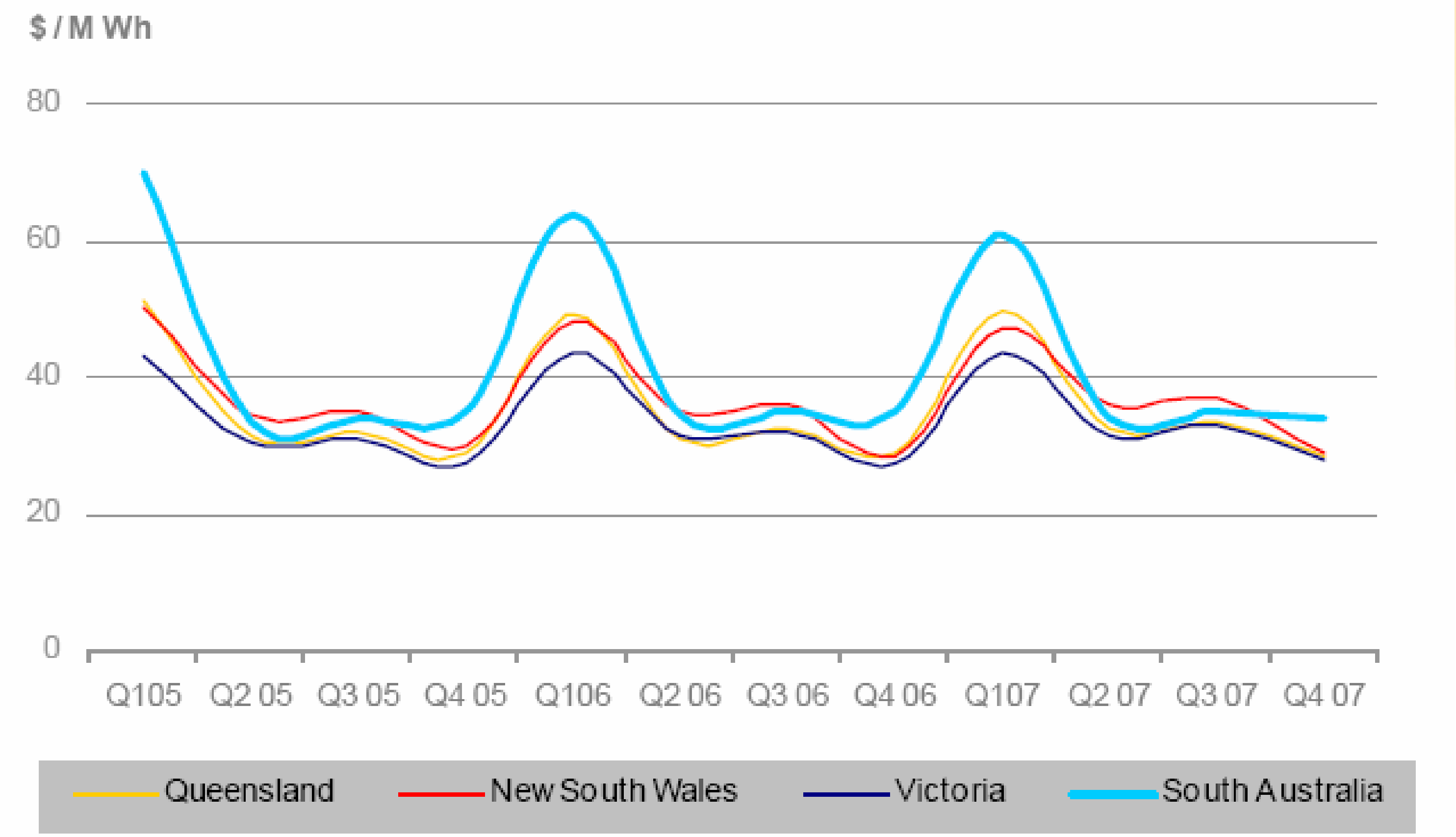


Average weekly price & demand, SA, Q4 2004
(NECA, 04Q4 Stats, 2005)

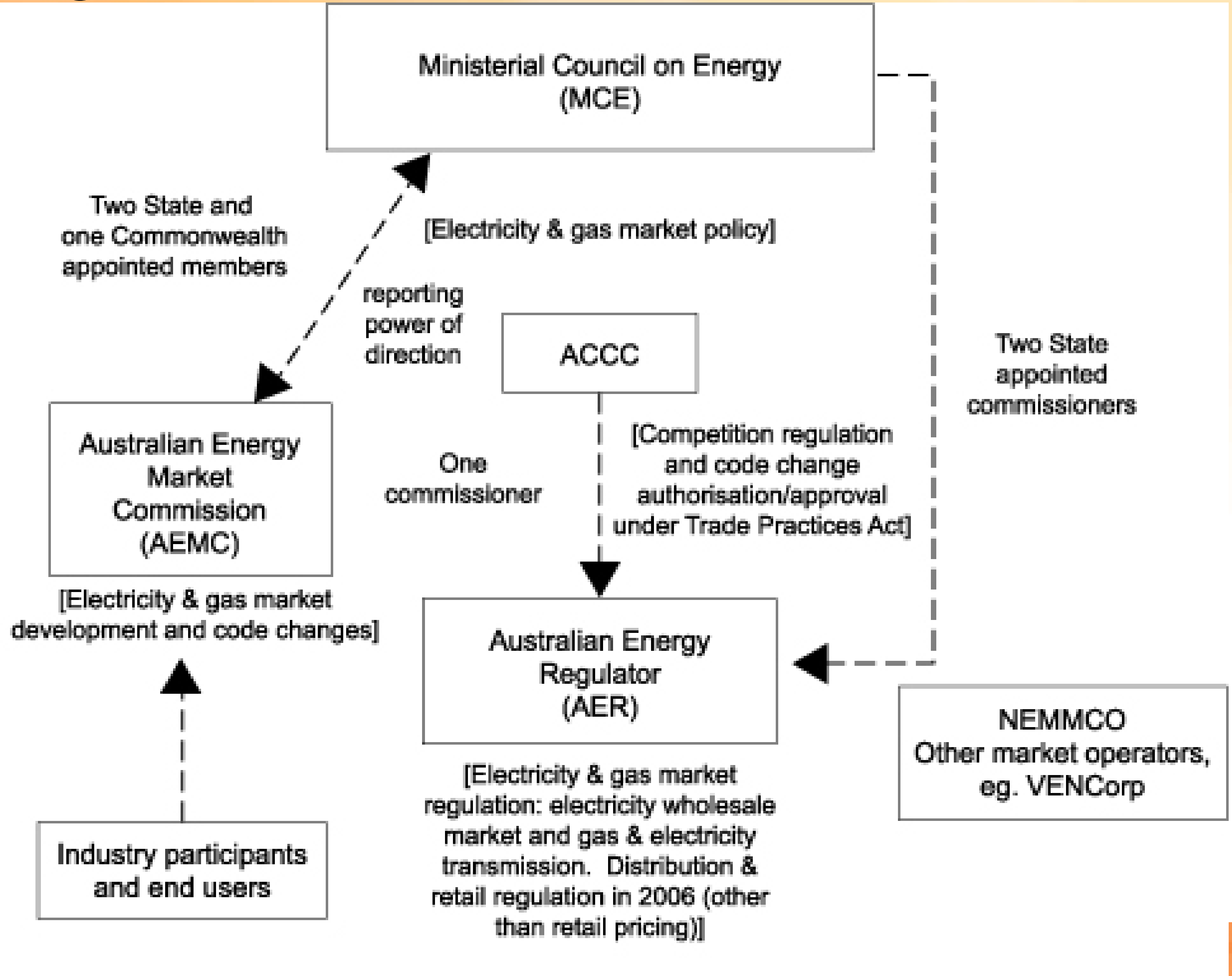


Flat contract prices, Q4 2004

(NECA, 04Q4 Statistics, 2005)



NEM governance (Allens Arthur Robinson, 2003)

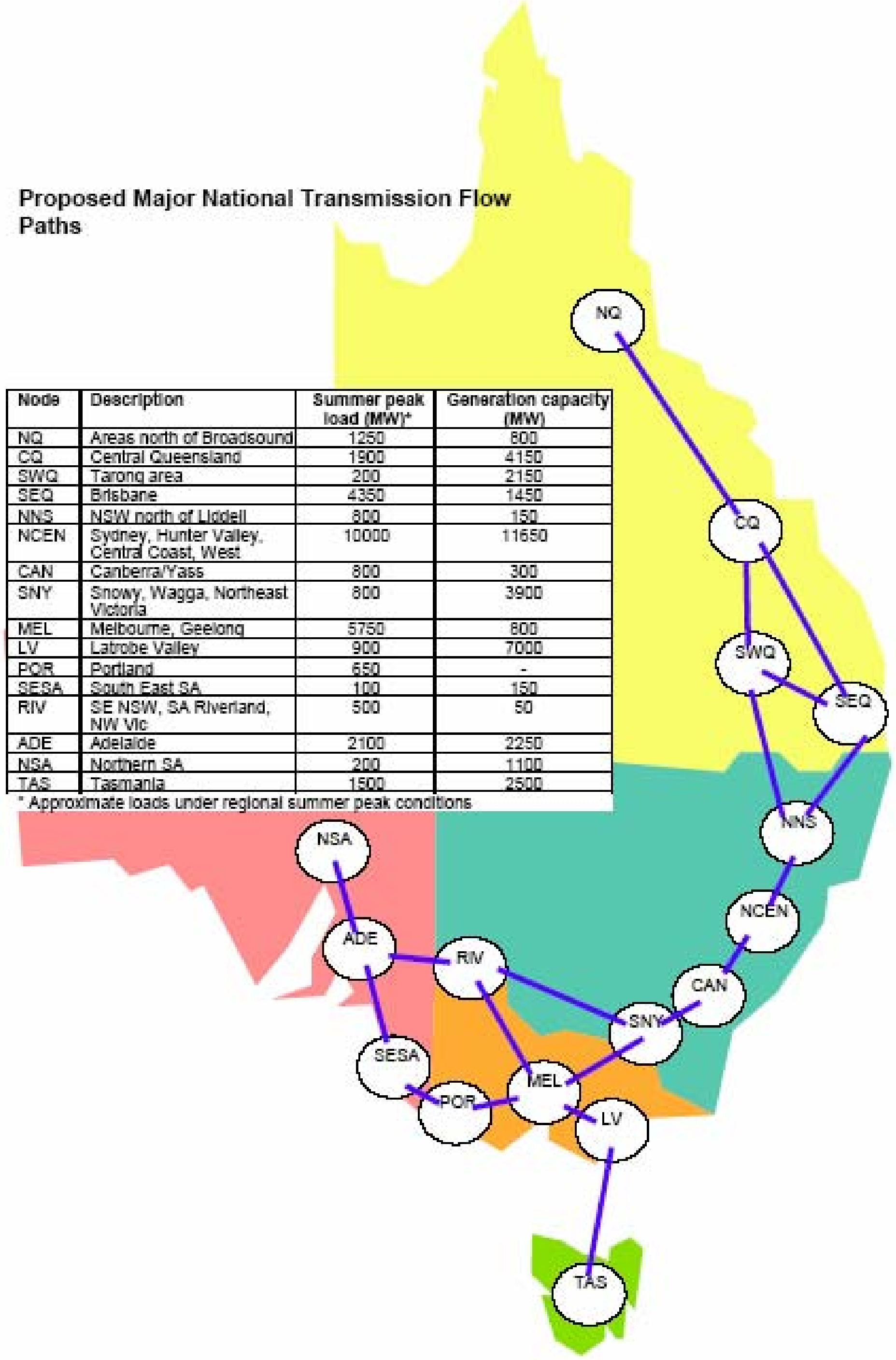


Electricity transmission: ANTS

- An integrated overview:
  - Future constraints on major transmission paths
  - Information on augmentation options
  - Incorporated into SOO & complimentary to projection of supply-demand balance

    (www.mce.gov.au)

Proposed Major National Transmission Flow Paths



Node	Description	Summer peak load (MW)*	Generation capacity (MW)
NQ	Areas north of Broadsound	1250	800
CQ	Central Queensland	1900	4150
SWQ	Tarong area	200	2150
SEQ	Brisbane	4350	1450
NNS	NSW north of Liddell	800	150
NCEN	Sydney, Hunter Valley, Central Coast, West	10000	11650
CAN	Canberra/Yass	800	300
SNY	Snowy, Wagga, Northeast Victoria	800	3900
MEL	Melbourne, Geelong	5750	800
LV	Latrobe Valley	900	7000
POR	Portland	650	-
SESA	South East SA	100	150
RIV	SE NSW, SA Riverland, NW Vic	500	50
ADE	Adelaide	2100	2250
NSA	Northern SA	200	1100
TAS	Tasmania	1500	2500

* Approximate loads under regional summer peak conditions

Conclusions on electricity restructuring in Australia

- Experience to date:
  - A thoughtful & balanced process over a decade produced mostly good results
  - However, there are important weaknesses:
    - Difficulties with network representation and pricing
    - Lack of active demand side participation
- Future prospects:
  - It is not clear that further progress will be made:
    - Complexity; climate change challenges; loss of expertise; political resistance to effective demand-side engagement

A number of our publications on this topic are available at:
www.ceem.unsw.edu.au

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