Centre for Energy and Environmental Markets

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Distributed Generation: Regulatory & Institutional Barriers

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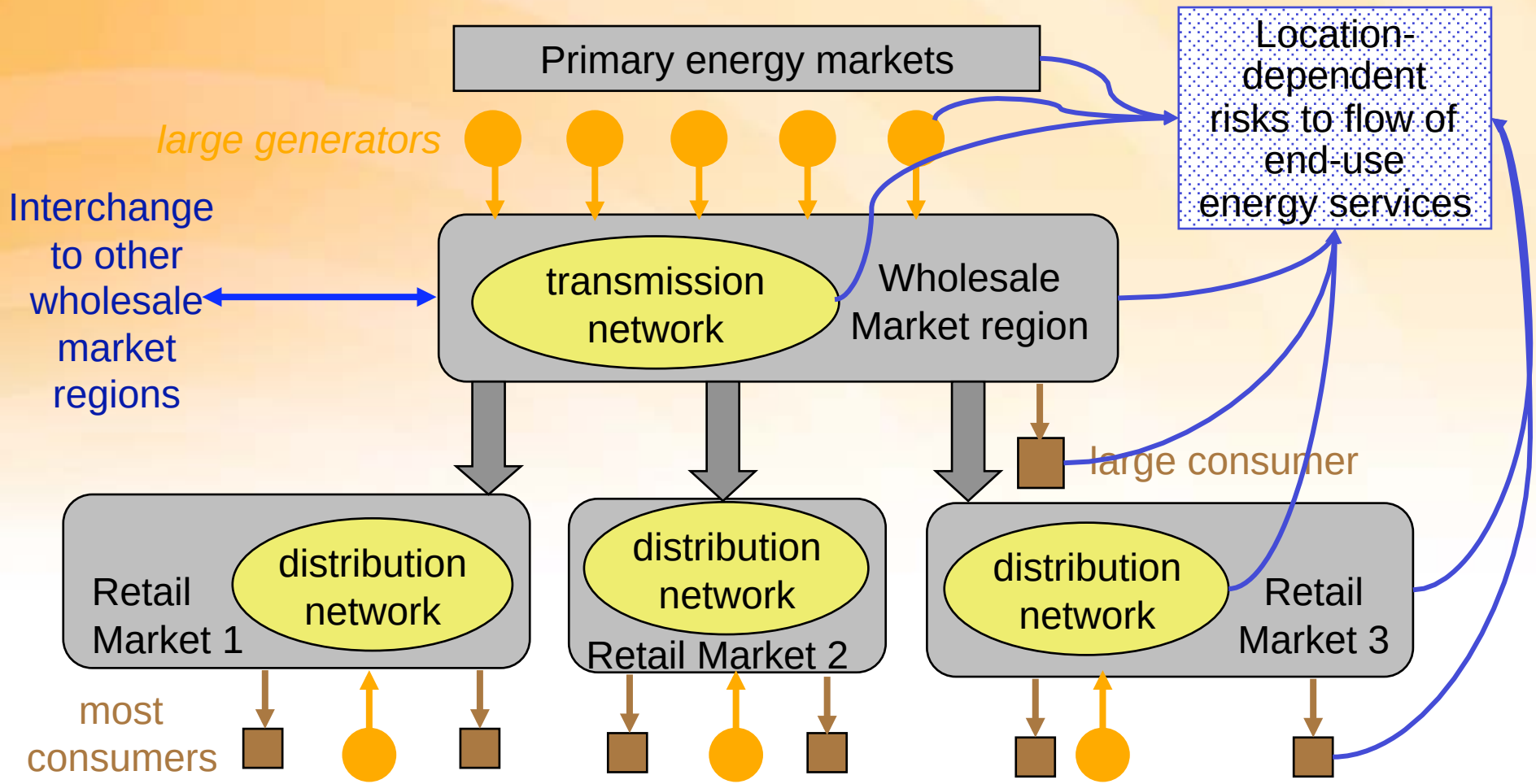
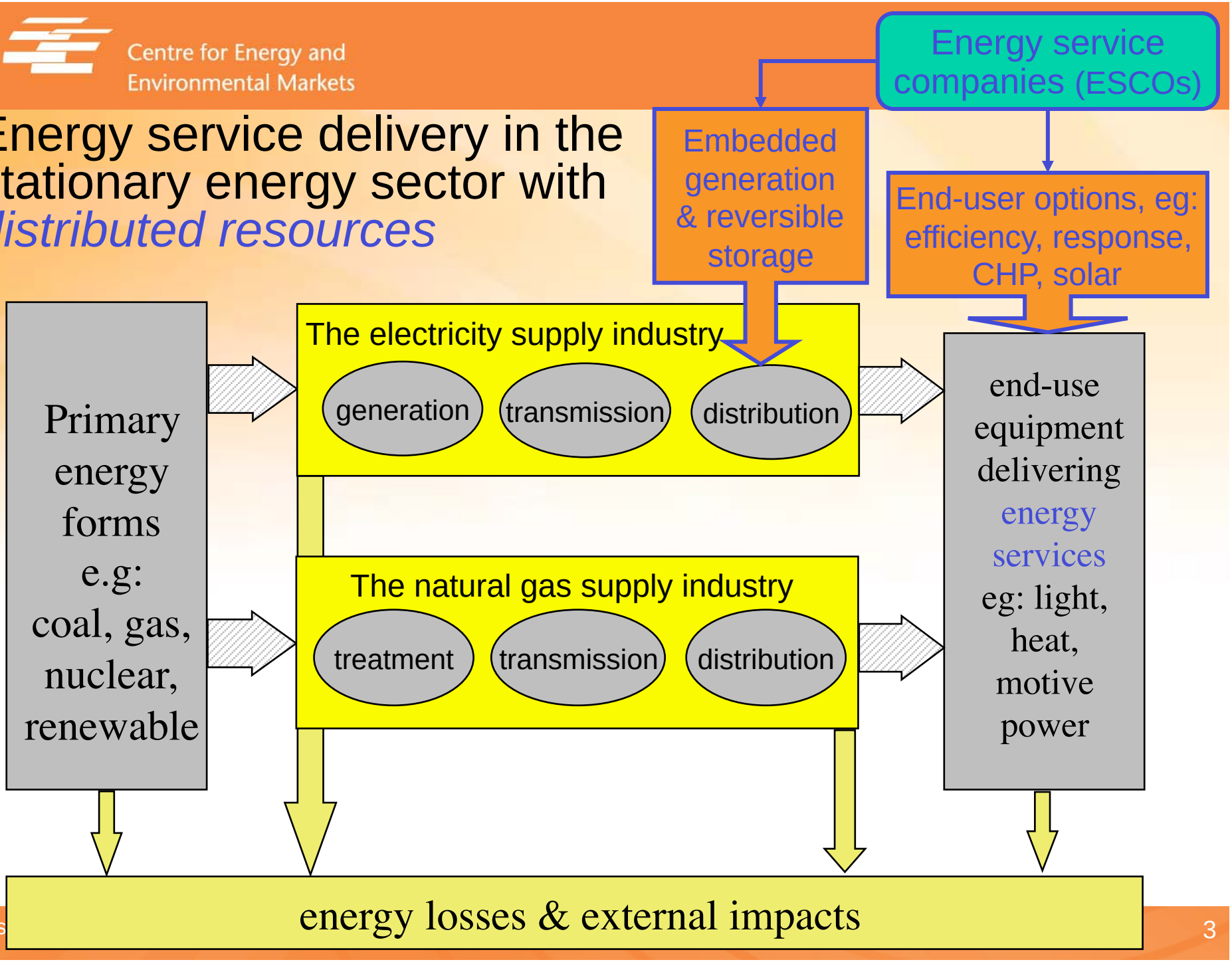
Distributed generation in a restructured electricity industry



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

- *Wholesale & retail designs should be compatible, with spot & derivative markets that model flow constraints*

Energy service delivery in the stationary energy sector with *distributed resources*



Energy service companies (ESCOs)

- Promote distributed resource (DR) options, such as embedded generation, flexible (price-responsive) demand, increased end-use efficiency
- More used to working with commercial & industrial than residential end-users (eg energy contracting)
- Should assess life-cycle cost-benefits, including availability, quality & external impacts
- Need efficient *retail spot & derivative markets* for energy & ancillary services including externalities:
  - Without efficient & consistent retail contracts, rebound effects will negate energy efficiency enhancements

Some distributed resource options

- Gas-based embedded generation options:
  - Reciprocating engines, small gas turbines, fuel cells
  - Waste heat recovery (heating, cooling, electricity)
- Renewable energy embedded generation options
  - PV, wind, solar thermal (heat & electricity)
- Intermediate & end-use energy storage
- End-uses options:
  - Flexibility (price or direct load control)
  - Enhanced end-use efficiency & frugality
- Metering, communications & control

Availability & quality of supply

- Quality of supply attributes (QOS):
  - Voltage, frequency, waveform purity
  - Supply availability
- Perfect availability & quality not achievable:
  - Supply availability & quality can vary widely in distribution networks
  - Customer equipment can also affect quality
- Risks to availability & quality of supply threaten the flow of end-use energy services:
  - Directly or indirectly through equipment malfunction
  - Hard to define legal obligations (mainly on distributors) for availability & quality at end-user connection points

Contributions to unavailability of 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**

Outages of overhead radial distribution feeders are the main cause of unavailable supply

NEM DNSP reliability targets

SAIDI = system ave. outage duration in min/ yr

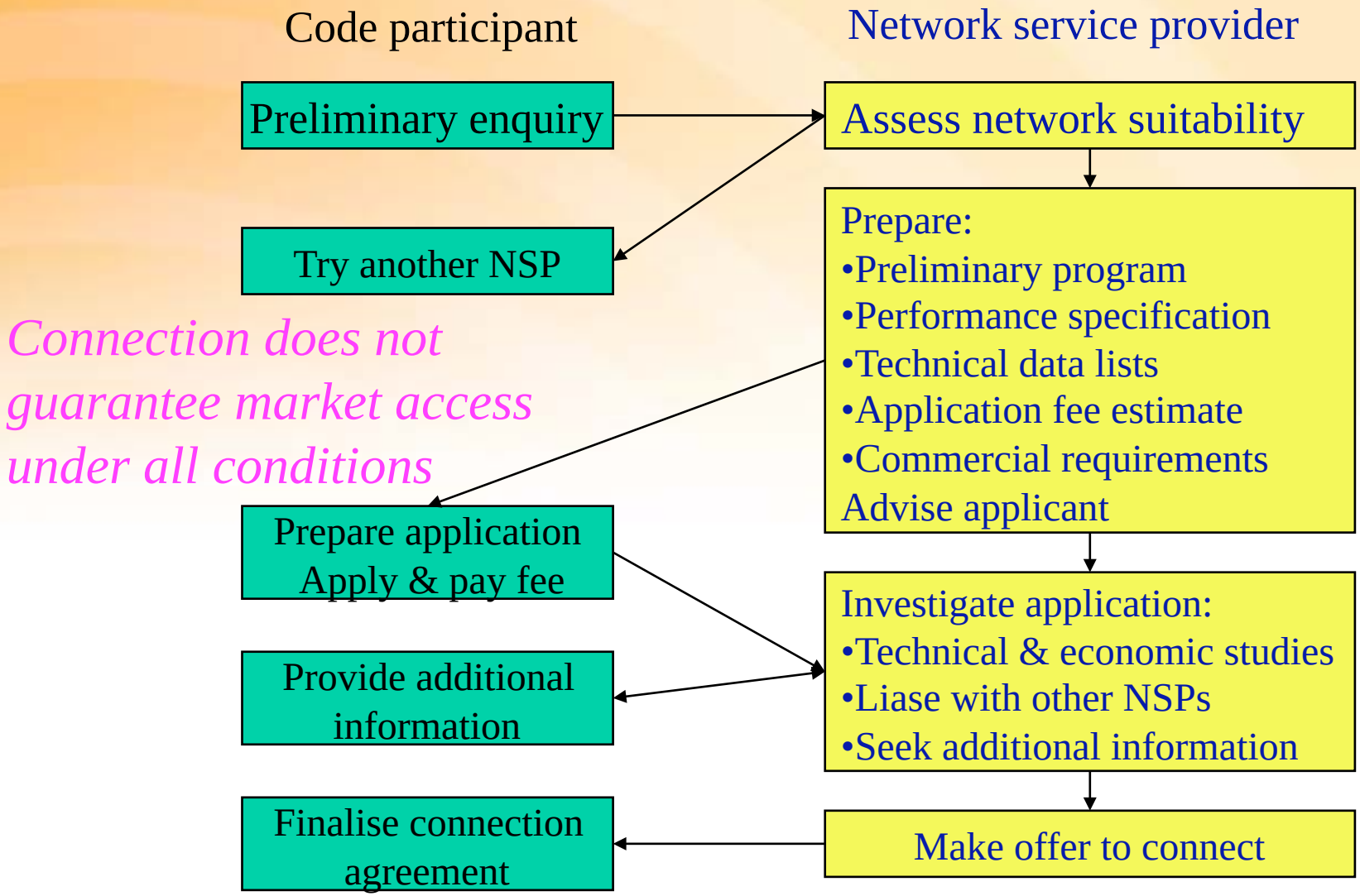
SAIFI = system ave. no. of outages per year

CAIDI = SAIDI/ SAIFI = customer ave. outage duration in min/yr

(AEMC, 2006)

Region	DNSP	Feeder	SAIDI	SAIFI	CAIDI
Queensland	Energex	CBD	20	0.33	
		Urban	162	1.78	
		Short Rural	272	2.84	
	Ergon Energy	Urban	220	2.75	
		Short Rural	610	5.70	
		Long Rural	1,180	9.00	
New South Wales	Integral Energy	Total	374	2.91	128
	Energy Australia	Total	102	1.20	
	Country Energy	Total	403	3.56	113
	Australian Inland	Total	303	1.70	182
South Australia	ETSA	Urban	90	1.10	
		Rural	290	2.65	
		Remote	200	1.20	
Victoria	Citipower	CBD	21.4	0.25	63
		Urban	44.9	0.80	44
	TXU	Urban	116.0	1.78	60
		Short Rural	216.0	2.75	68
	Powercor	Total	212.0	2.28	76
	AGL	Urban	79.0	1.27	58
		Short Rural	127.0	2.25	50
	United Energy	Urban	79.0	1.17	57
		Short Rural	128.0	2.24	48
ACT	ActewAGL	All	91	1.2	74.6[1]

Network connection: NSP gatekeeper (NER Ch5)



Connection requirements for generators in National Electricity Rules

- Reactive power & voltage control capability
- Quality of electricity injected into network
- Protection requirements
- Remote control arrangements
- Excitation system requirements
- Loading rates
- Ride-through to avoid cascading outages:
  - Loss of largest generator; 175ms network fault
- *Issues concerning availability obligations*

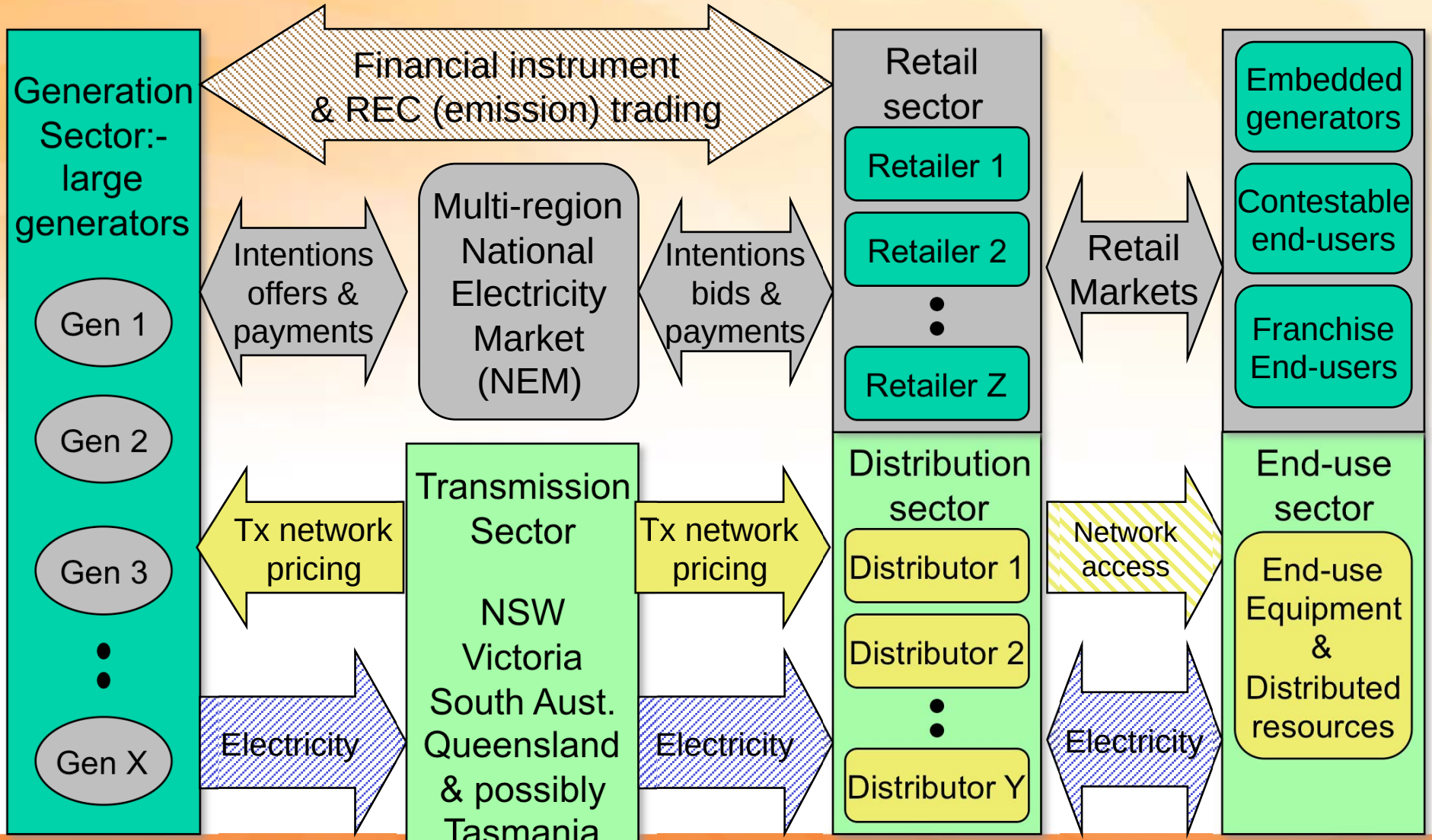
Australian electricity restructuring to date

- Has focussed on wholesale market design, network services & ancillary services
- Has not focussed on retail market design or end-user concerns about quality of supply:
  - This has hindered the development of distributed gen'n
- However a number of policies now favour DG:
  - Distribution regulation & pricing review
  - Roll-out of interval metering in NSW & Victoria
  - Policies on end-use efficiency (NFEE & jurisdictions)
  - Renewable energy targets & gas industry restructuring
  - Evolving climate change policies

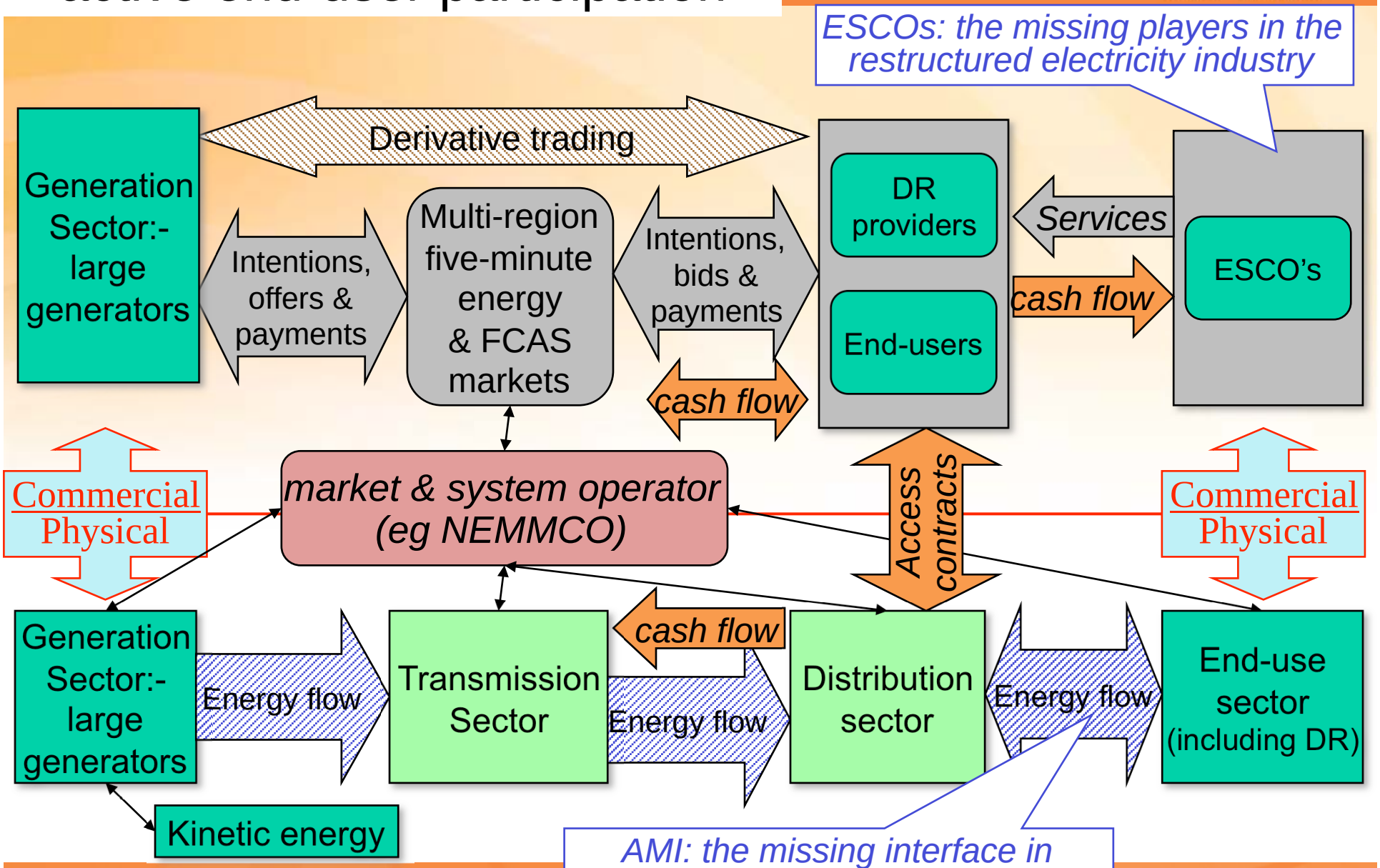
Emission reduction targets in Australia (Owen Rpt, 2007)

Jurisdiction	Long-term (2050) economy-wide targets	Intermediate economy-wide targets	Renewable or low emission targets
Commonwealth Government	No policy. (To be announced in 2008.)	Annual caps for period up to 2020 for an emission trading scheme to be announced in 2010.	2% extra renewable energy target by 2010 (legislated)
New South Wales	60% reduction on 2000 levels	Return to 2000 levels by 2025	10% renewable energy target by 2010 and 15% by 2020
Victoria	60% reduction on 2000 levels		10% renewable energy target by 2016 (legislated)
Queensland	60% reduction on 2000 levels		18% gas generation by 2020 and 10% low emission target by 2020
South Australia	60% reduction on 1990 levels (legislated)		20% renewable energy target by 2014 (legislated)
Western Australia	60% reduction on 2000 levels		15% renewable energy target by 2020 and 20% by 2025
Tasmania	60% reduction on 2000 levels		
Australian Capital Territory	60% reduction on 2000 levels	Return to 2000 levels by 2025	Implement a renewable energy target in line with NSW.

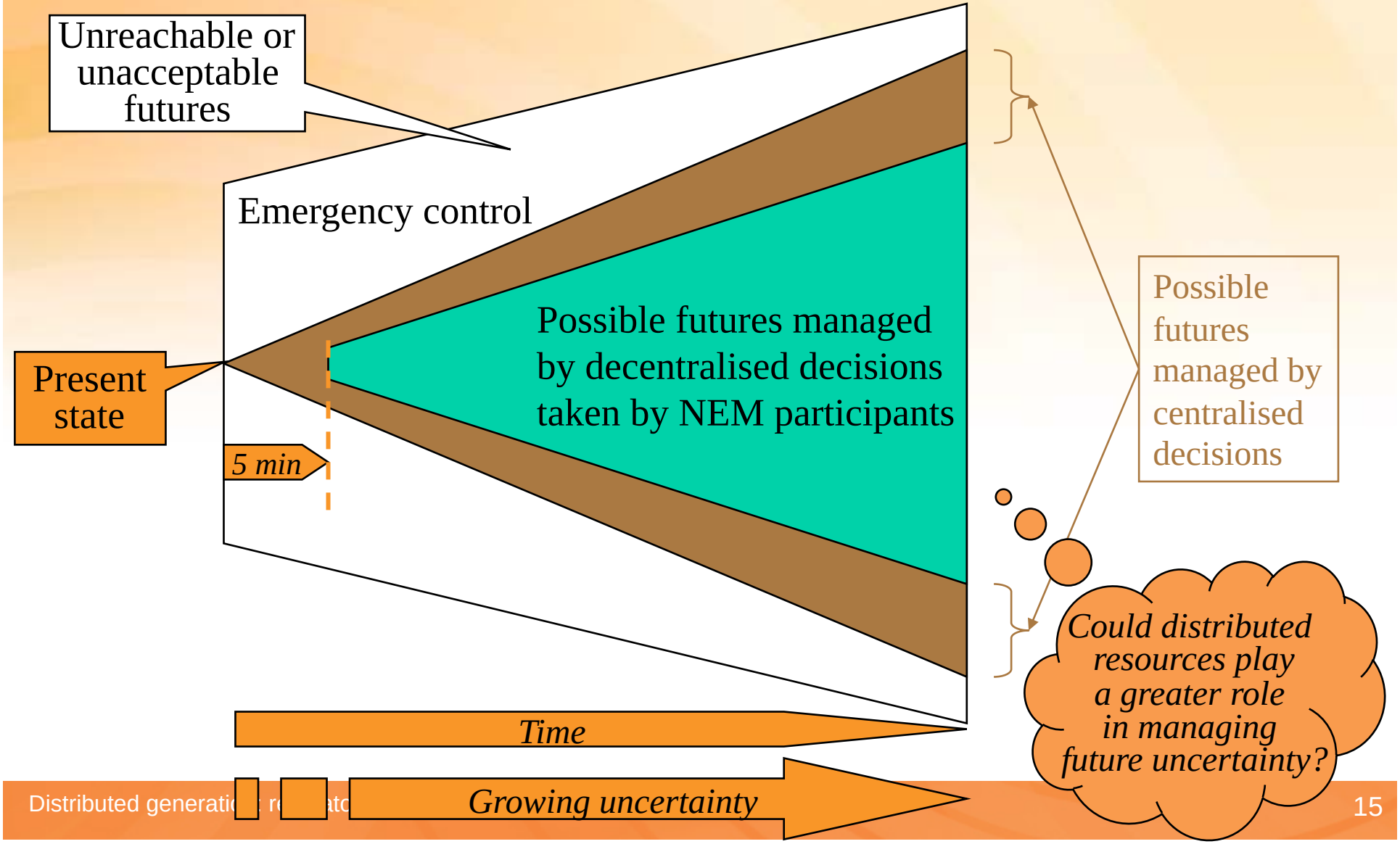
Present electricity industry structure in SE Australia



Enhanced NEM structure with active end-user participation

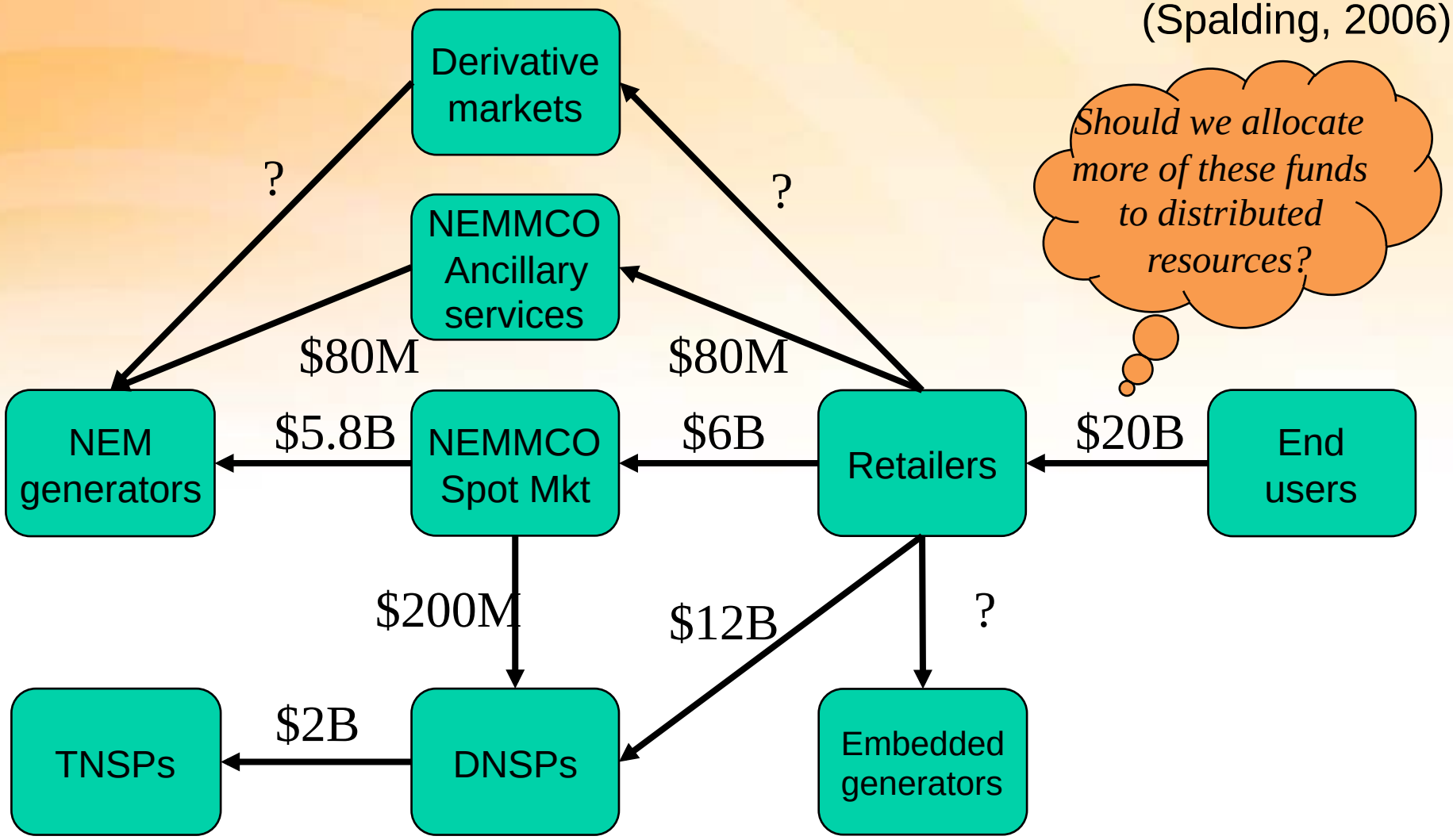


Managing future uncertainty in the NEM

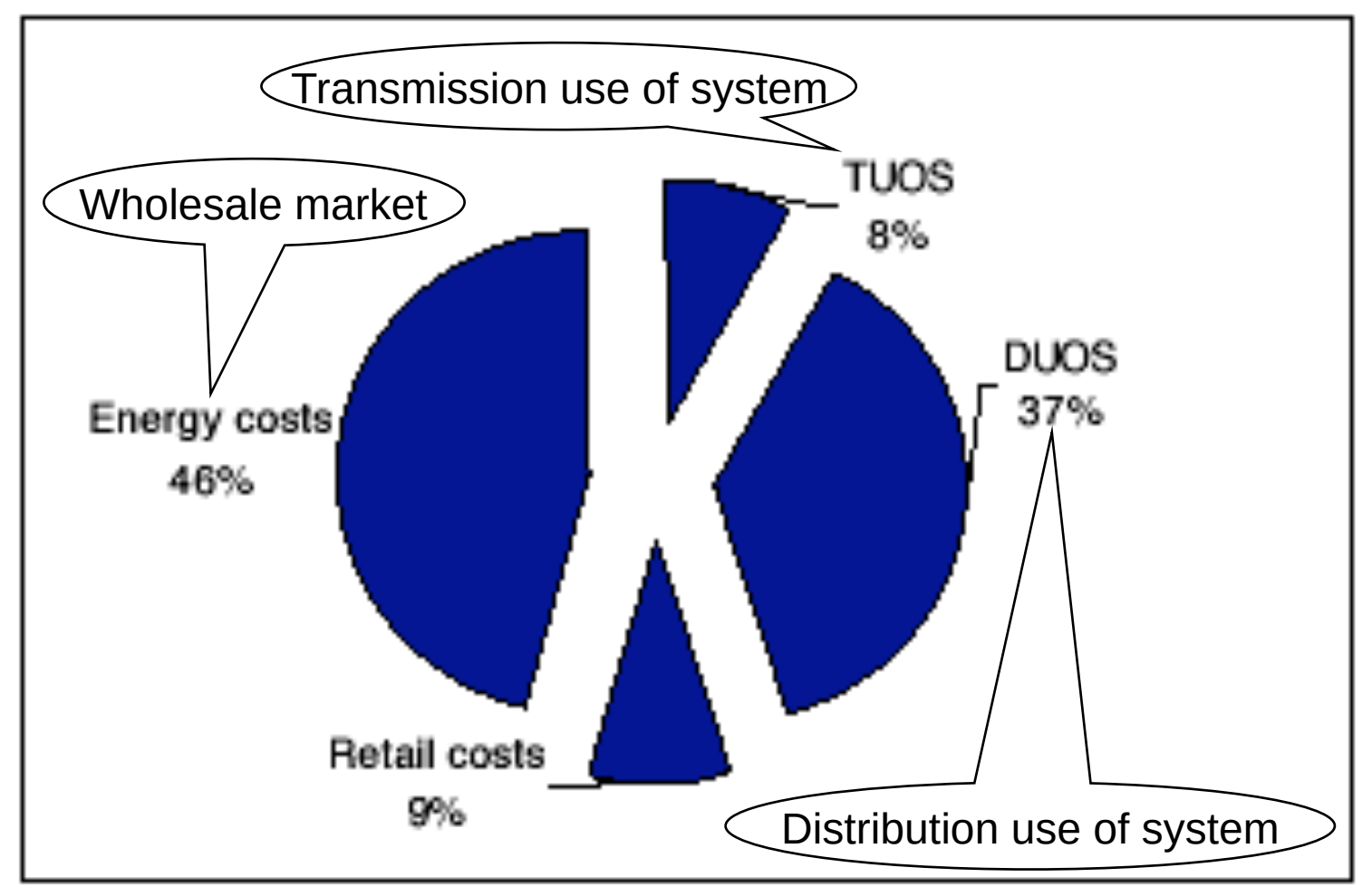


Cash flow in SE Australia electricity industry

(Spalding, 2006)

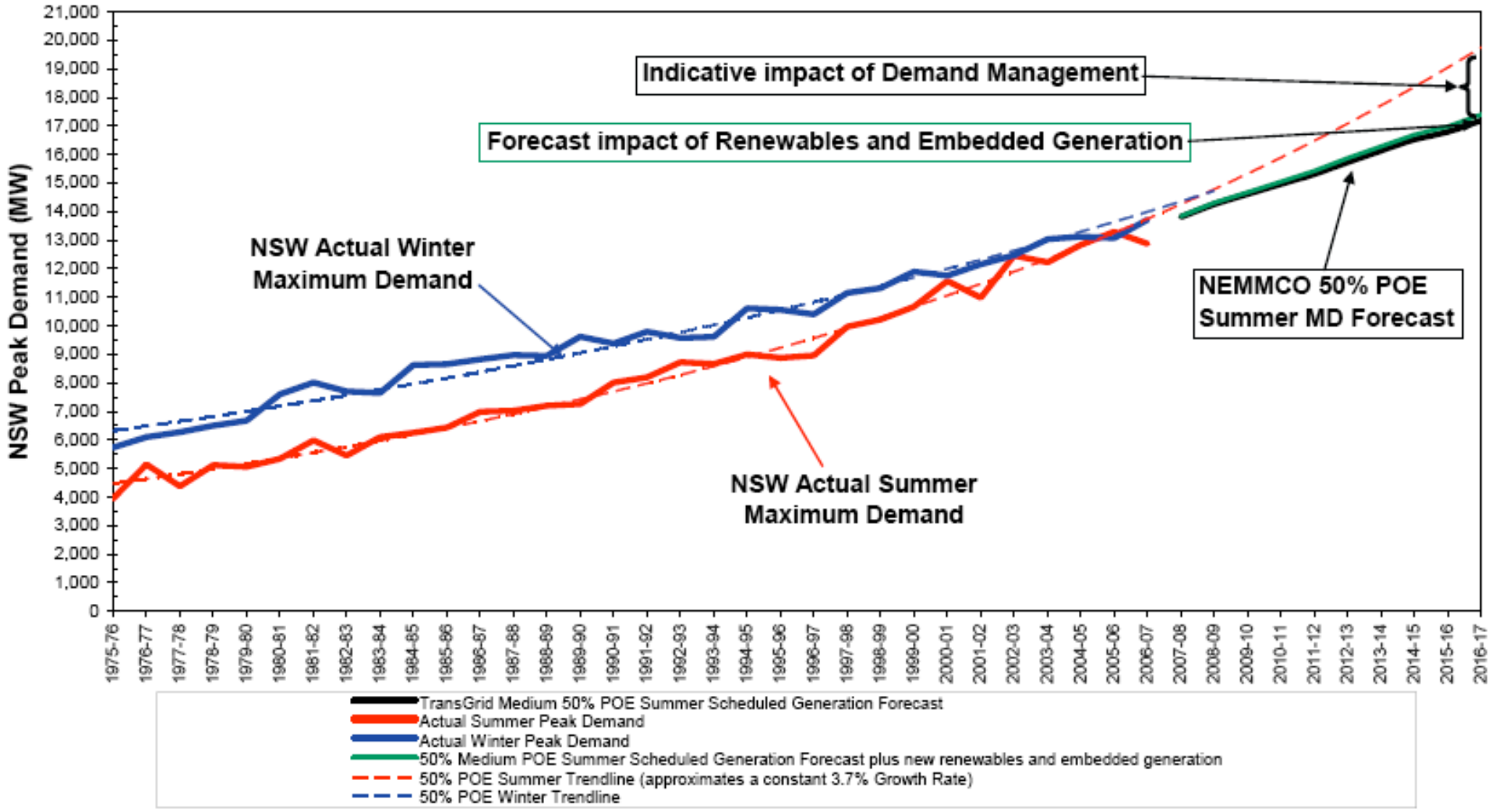


Residential electricity bill cost components
(IPART, DNSP Review, 2003)



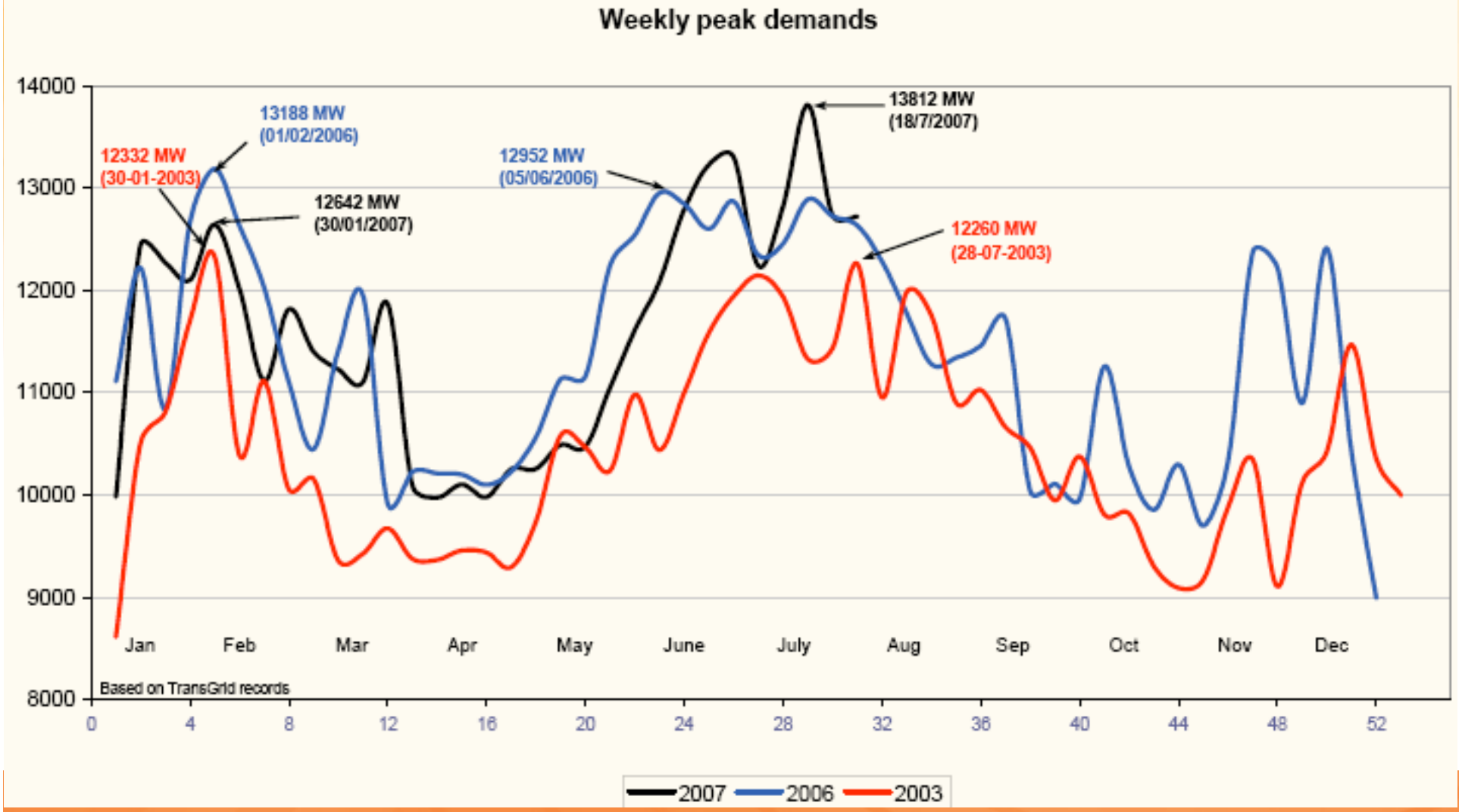
NSW summer & winter peak demand

(Owen Inquiry Report App 2, 2007)



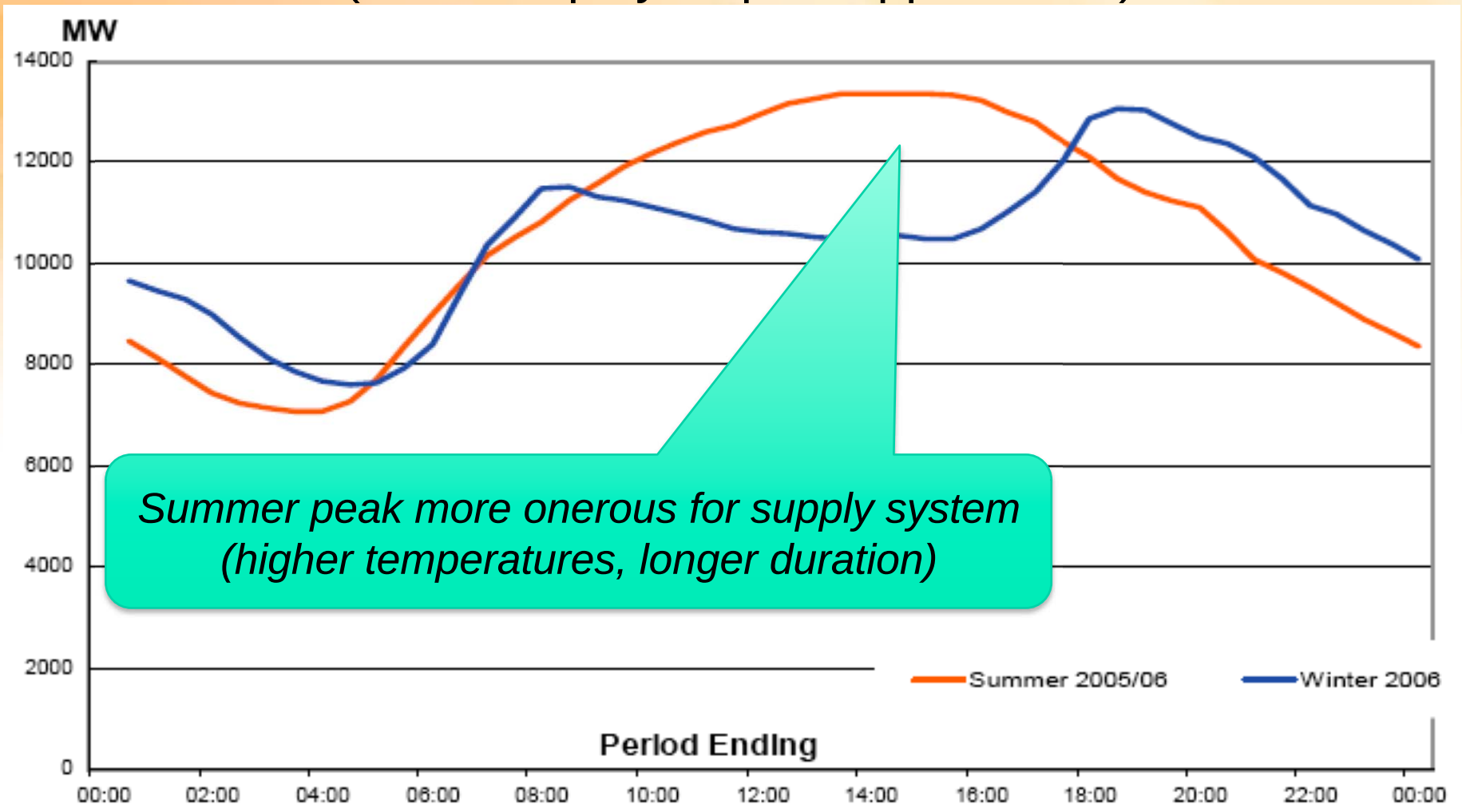
Weekly peak demand in NSW: 2003, 2006, 2007

(Owen Inquiry Report App 2, 2007)



Load curves for 2006 summer & winter peak days

(Owen Inquiry Report App 2, 2007)



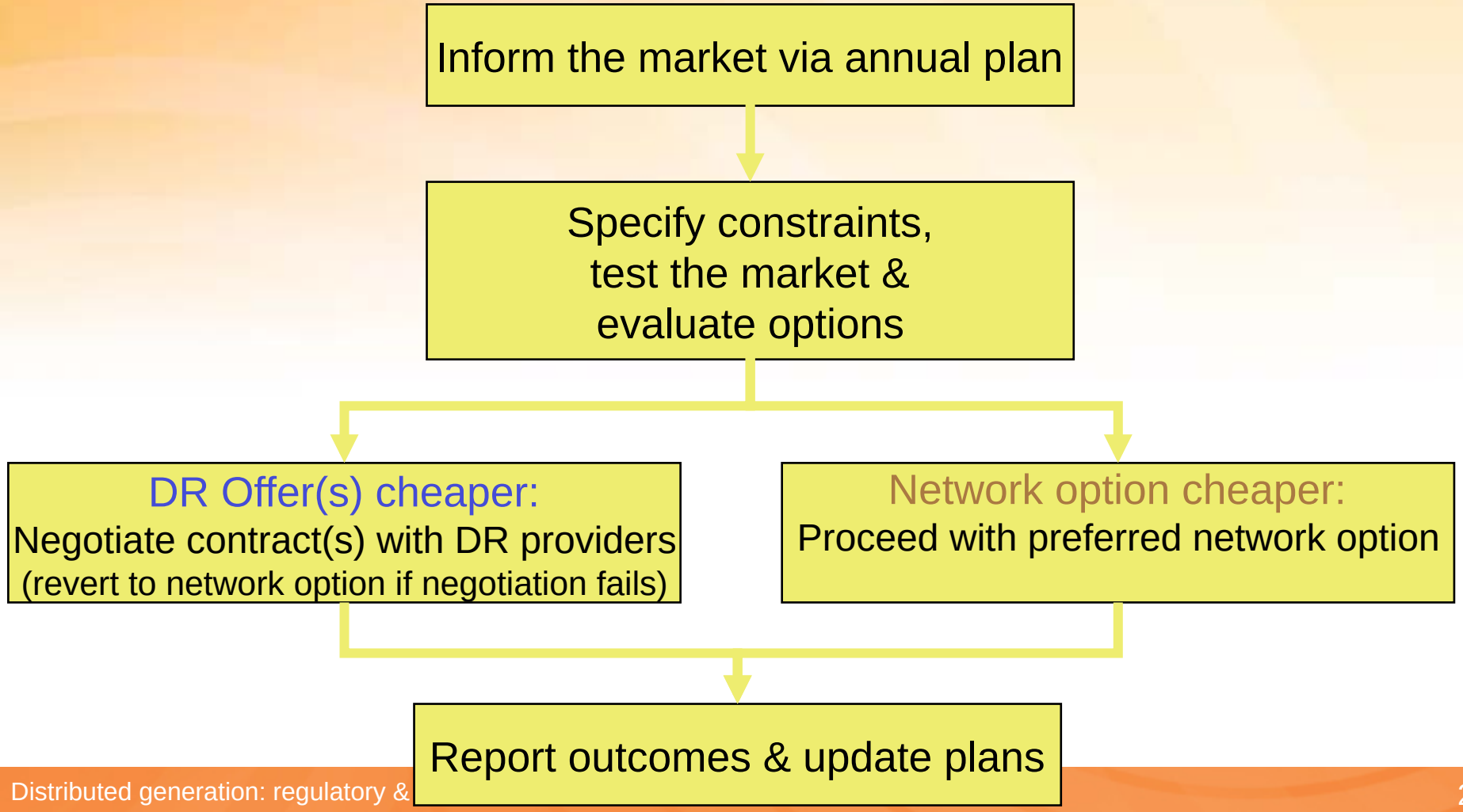
NSW Demand Management Code

(to be replaced & extended to other states by COAG policy)

- DNSPS required to develop DR expertise
- DR options to be developed in-house & externally
- Market to be tested for options when reasonable
- Market to be informed well in advance of constraint
- Network & DR options to use the same database
- Clear & transparent option comparison
- Process assessed by IPART as DNSP regulator:
  - IPART allows full cost recovery for cost-effective options as well as additional incentives for DR activities

Distributor investment considering distributed resources

(NSW Demand Management Code of Practice, 2004)

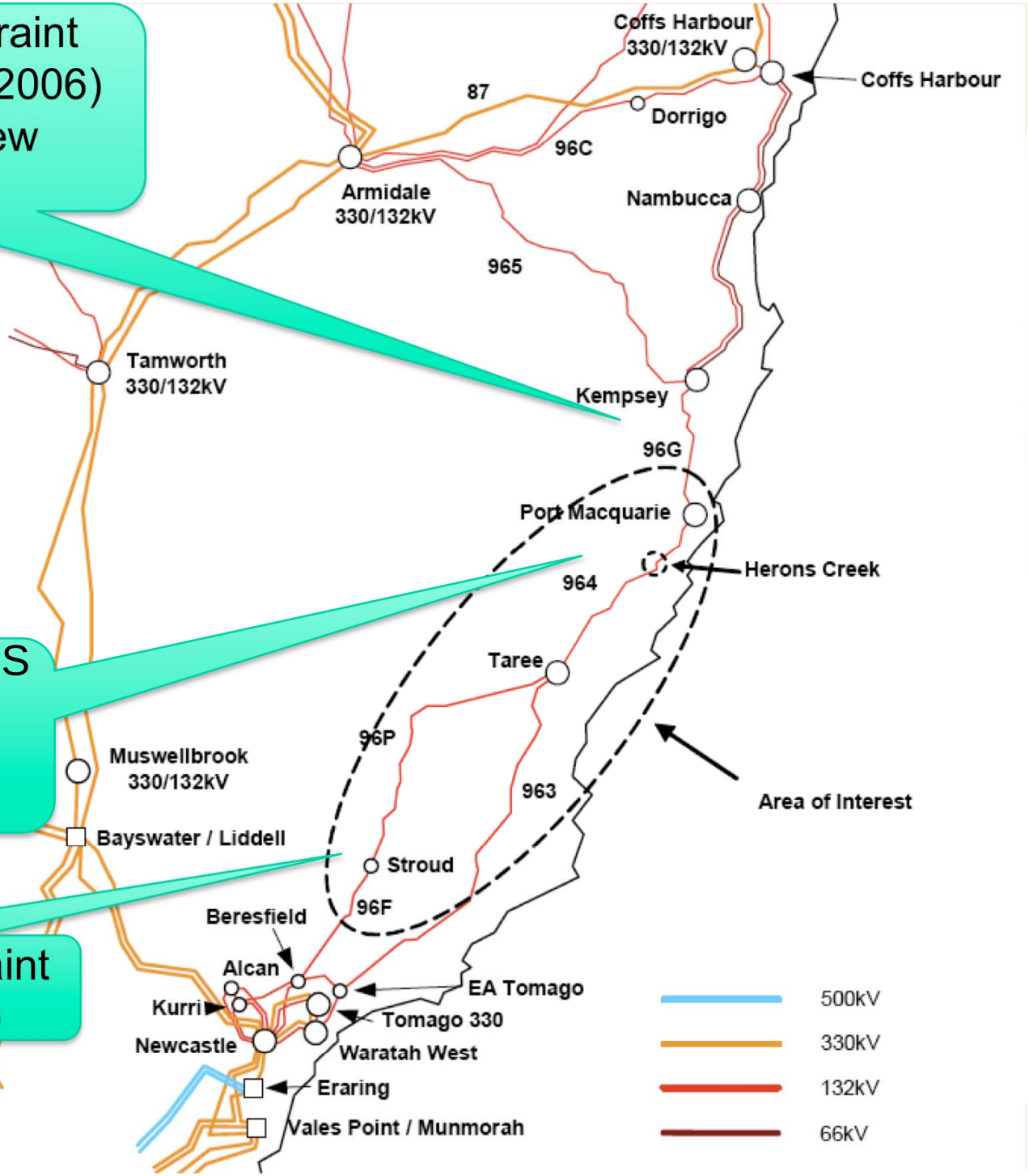


Existing network constraint
Port Macquarie region (2006)
(to be resolved by new transmission line)

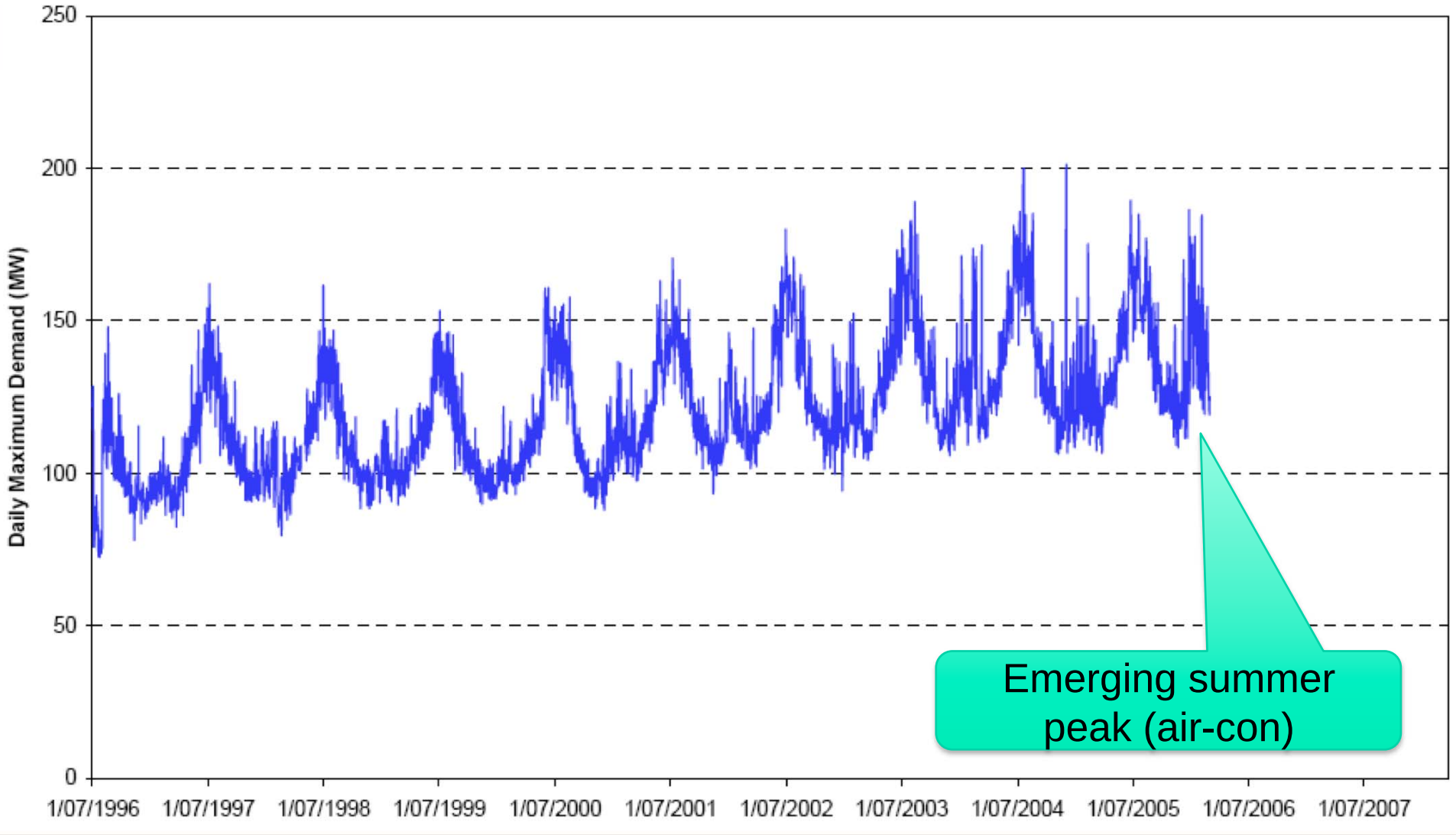
Example: Transmission Network Mid North Coast (Transgrid, 2007)

Proposed Herons Creek PS
3x50MW CT-diesel fuel:
strong community opposition

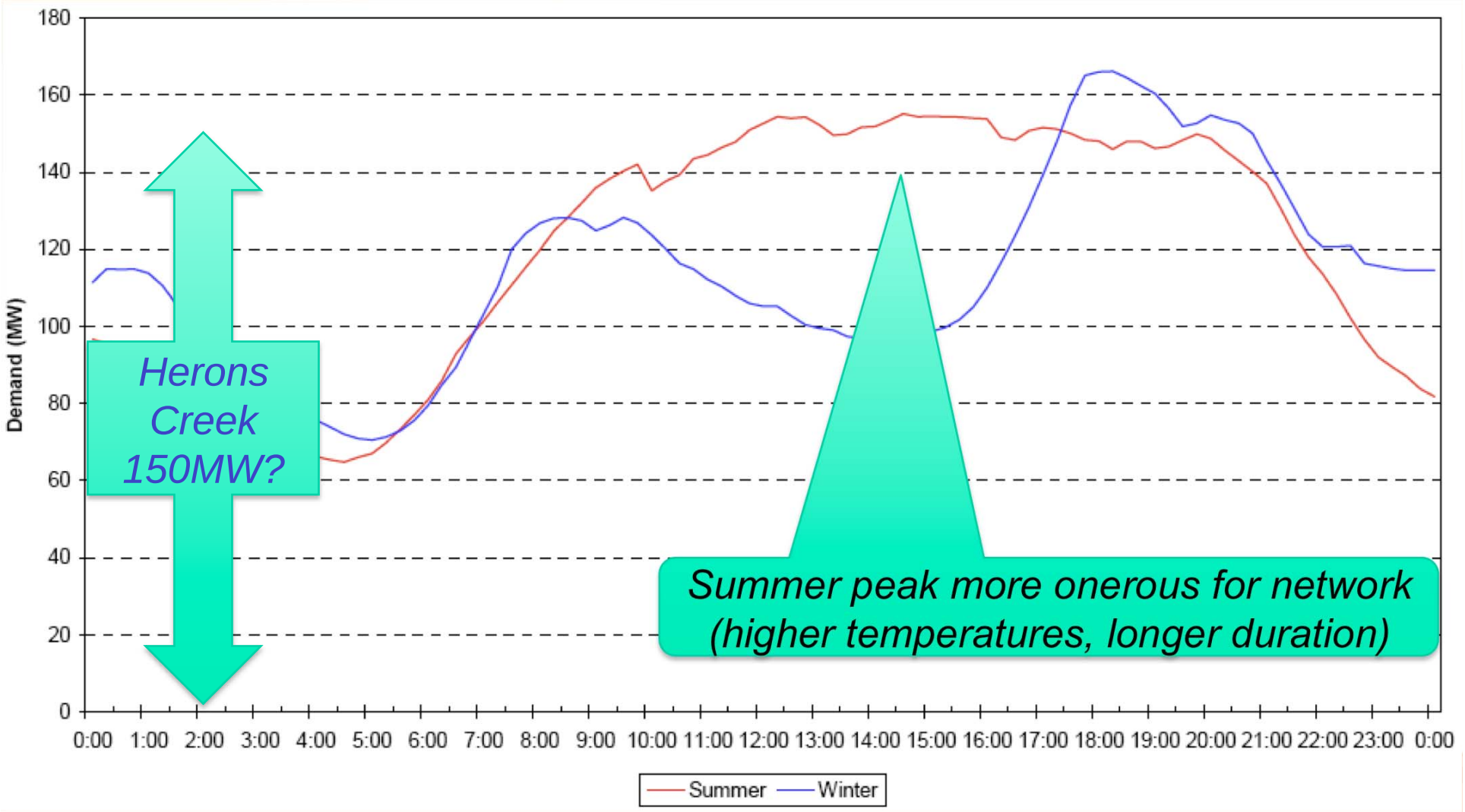
Emerging network constraint
Beresfield-Taree (2008)



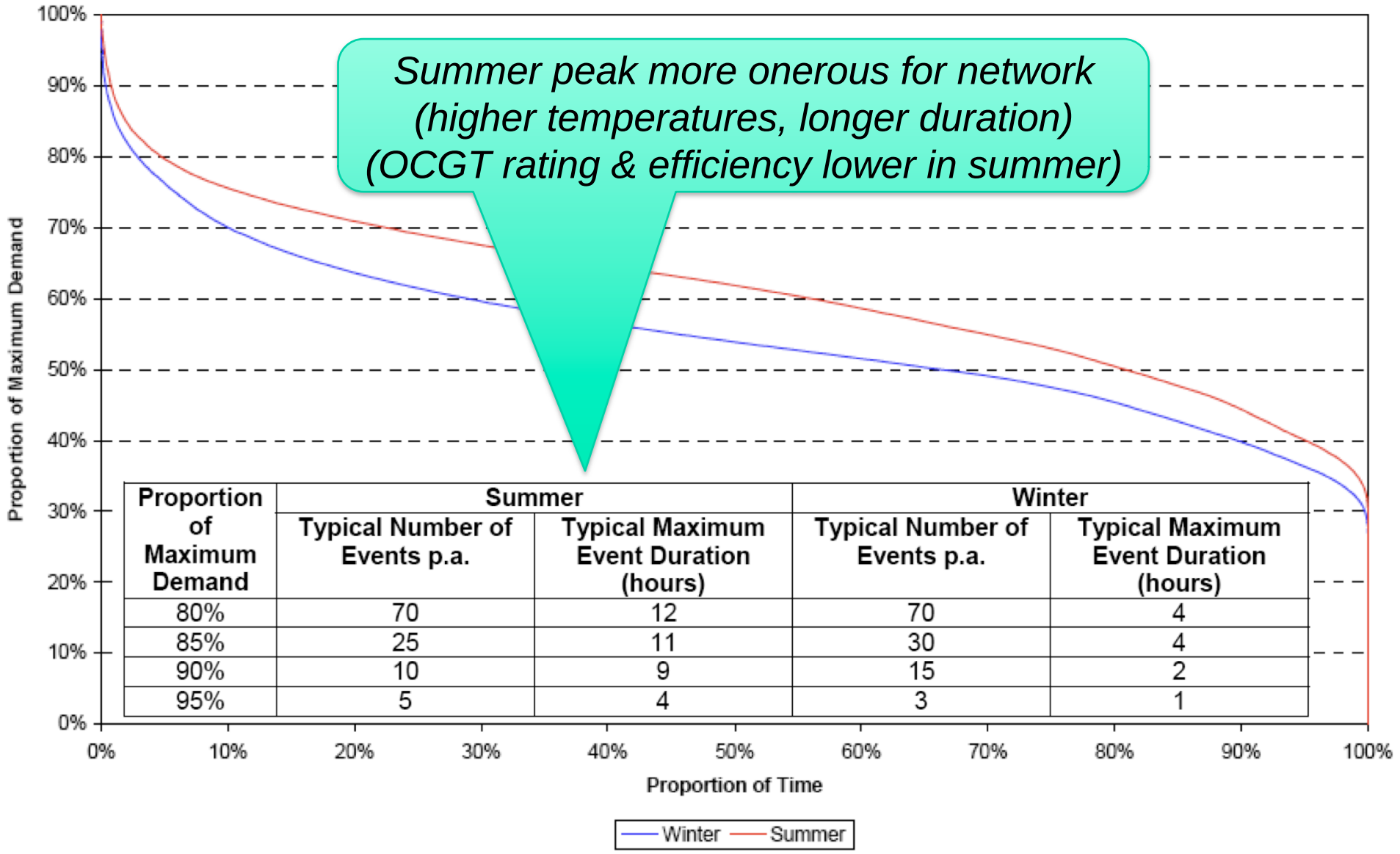
Stroud to Port Macquarie load history
(Transgrid, 2006)



Taree to Port Macquarie peak load shapes
(Transgrid, 2006)



Taree to Port Macquarie load duration curves (Transgrid, 2006)



Proportion of Maximum Demand	Summer		Winter	
	Typical Number of Events p.a.	Typical Maximum Event Duration (hours)	Typical Number of Events p.a.	Typical Maximum Event Duration (hours)
80%	70	12	70	4
85%	25	11	30	4
90%	10	9	15	2
95%	5	4	3	1

Load growth & load reduction effectiveness
(Transgrid, 2006)

Area	Relevant Network Outage(s)	Forecast Summer Load Growth (MW p.a.)	Forecast Winter Load Growth (MW p.a.)
Coffs Harbour to Stroud Area	(Future) Armidale – Coffs Harbour 330 kV line	21	13
Stroud to Port Macquarie Area	Kempsey – Port Macquarie 132 kV line	14	8
Stroud to Taree Area	Beresfield – Stroud 132 kV line Tomago – Taree 132 kV line	6	3
Taree (66 kV)	Taree 132/66 kV Transformer	4.5	2.5
Kempsey (33 kV)	Kempsey 132/33 kV Transformer	2	1.3

Herons Creek PS: location sound but large compared to load growth

Line Outage	Location of Load Reduction				
	Coffs Harbour	Kempsey	Port Macquarie	Taree	Stroud
Armidale – Coffs Harbour 330 kV line	0.2	0.6	0.9	1.0	0.4
Kempsey – Port Macquarie 132 kV line	No Effect	No Effect	1.0	0.5	0.25
Beresfield – Stroud 132 kV line	Negligible	0.25	0.5	0.75	1.0

Transgrid near-term augmentation options for Stroud – Port Macquarie

(Transgrid, 2007)

Option	Description	Scenario 1		Scenario 2	
		PV of Costs ($M)	Rank	PV of Costs ($M)	Rank
Option 1	Kempsey – Port Macquarie Line	13.5	1	13.5	1
Option 2	Kempsey – Herons Creek Single Circuit Line	19.3	2	22.9	3
Option 3	Kempsey – Herons Creek Double Circuit Line	23.5	3	22.0	2

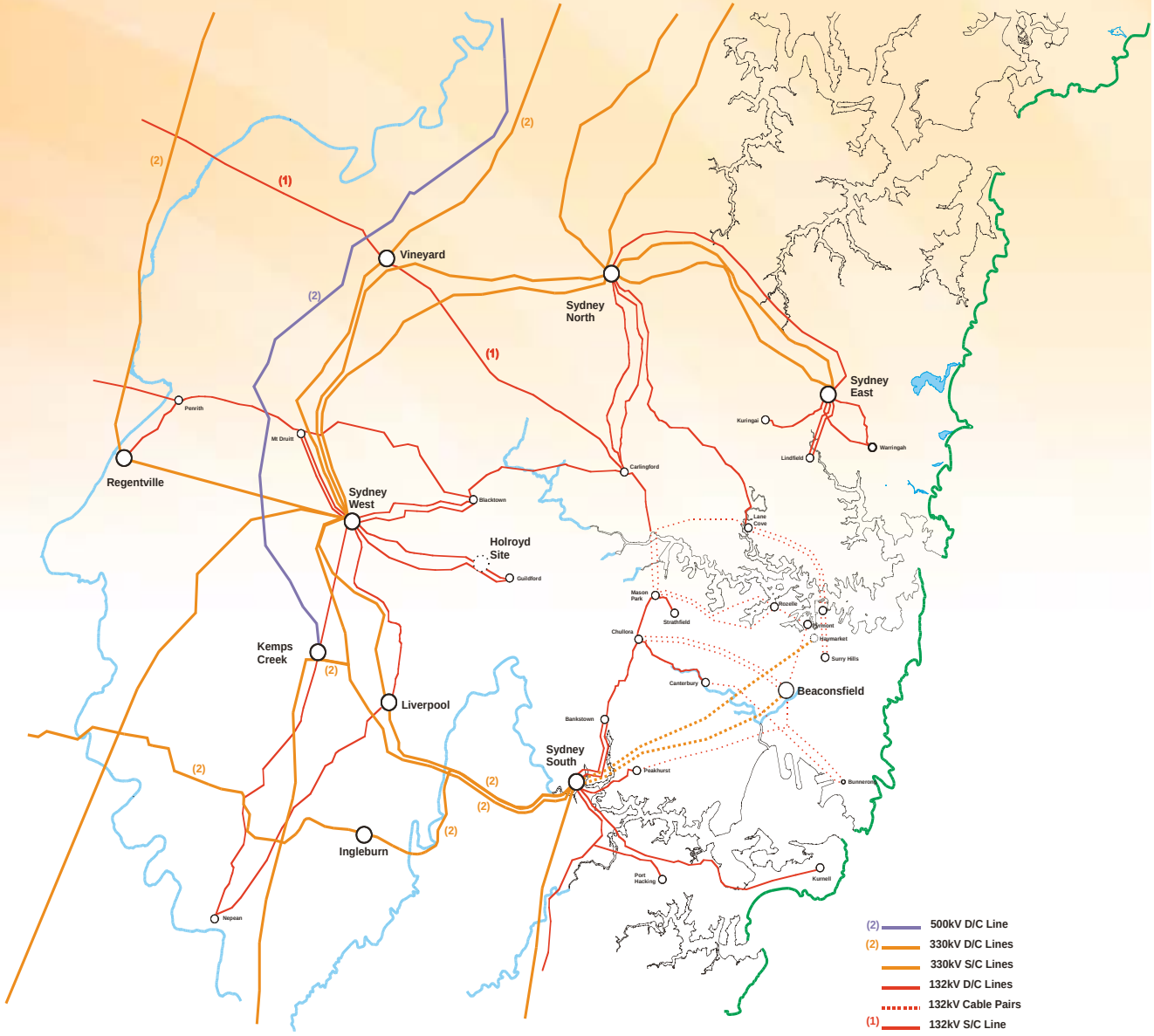
- *Option 1 presently out for tender, to be commissioned by mid 2010*
- *Further augmentation likely south of Herons Creek at a later date*

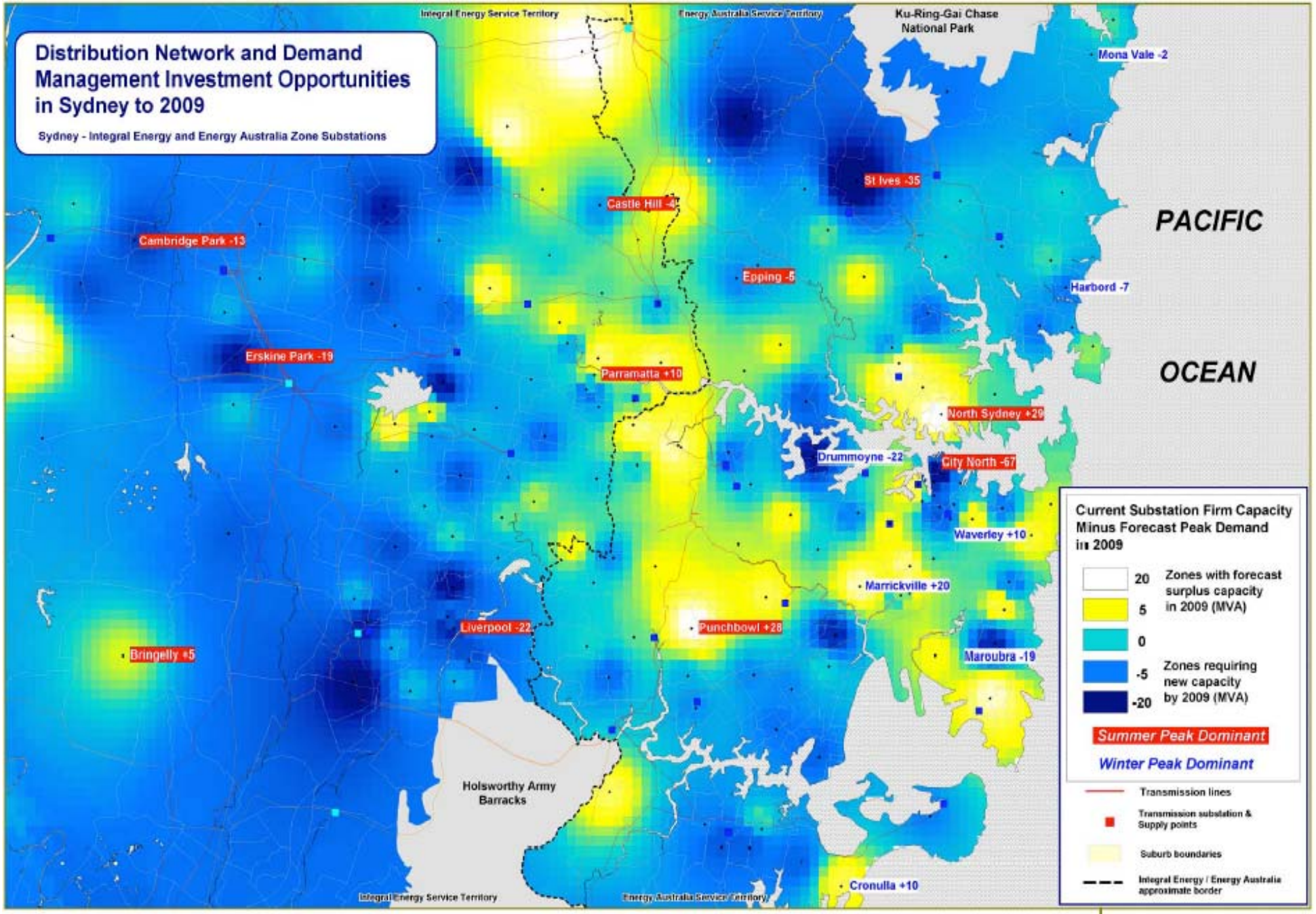
Example: Sydney region DM project

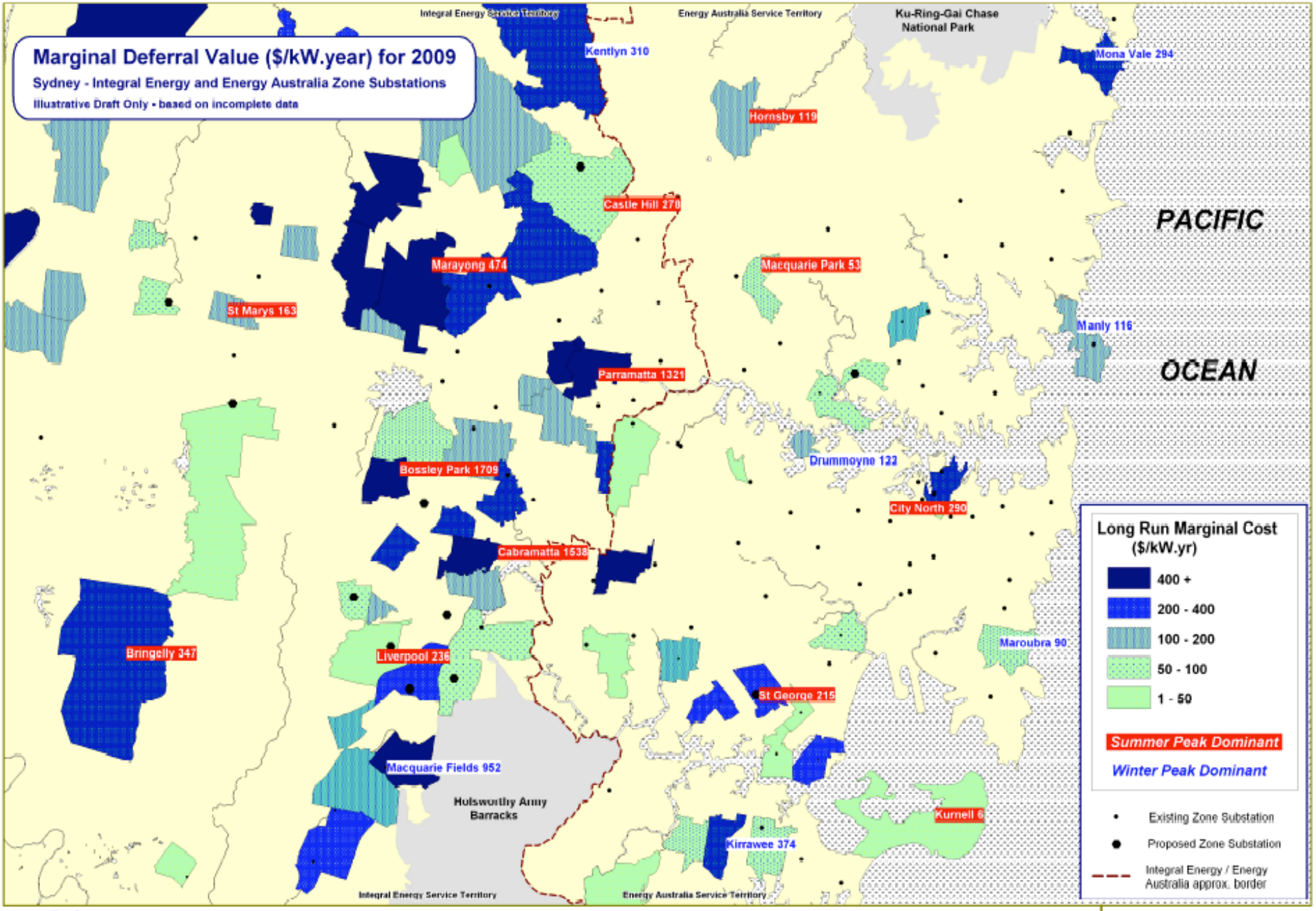
- Participants:
  - Transgrid, EnergyAustralia (distributor), NSW Dpt of Industry, Planning & Natural Resources (DIPNR)
- Objectives:
  - Identify & develop cost-effective DR options to defer or avoid network augmentation in inner Sydney region
- Options considered (12/03 to date):
  - Stand-by generation, interruptible load, power factor correction, innovative HVAC, building design (Basix)

NSW transmission network, Sydney region

(M Park, 2005)




Distribution Network and Demand Management Investment Opportunities in Sydney to 2009
Sydney - Integral Energy and Energy Australia Zone Substations
Integral Energy Service Territory
Energy Australia Service Territory
Ku-Ring-Gai Chase National Park
Mona Vale -2
St Ives -35
Castle Hill -4
Cambridge Park -13
Epping -5
Hasbord -7
PACIFIC
OCEAN
Erskine Park -19
Parramatta +10
North Sydney +29
Drummoyne -22
City North -67
Waverley +10
Marrickville +20
Liverpool -22
Punchbowl +28
Maroubra -19
Bringelly +5
Holsworthy Army Barracks
Cronulla +10
Integral Energy Service Territory
Energy Australia Service Territory
Current Substation Firm Capacity Minus Forecast Peak Demand in 2009
20
Zones with forecast surplus capacity in 2009 (MVA)
5
0
-5
Zones requiring new capacity by 2009 (MVA)
-20
Summer Peak Dominant
Winter Peak Dominant
Transmission lines
Transmission substation & Supply points
Suburb boundaries
Integral Energy / Energy Australia approximate border
SEDA
NSW Government
© SEDA 2003
0
4
8
kilometres
Source: Integral Energy ESDR 2003
Energy Australia ESDR 2002
DEPARTMENT OF ENERGY, UTILITIES AND SUSTAINABILITY
NEW SOUTH WALES GOVERNMENT
Substations - Available Capacity (MVA) for 2009
Prepared for Ministry of Energy and Utilities Statement of System Opportunities



SEDA

0 4 8
kilometres

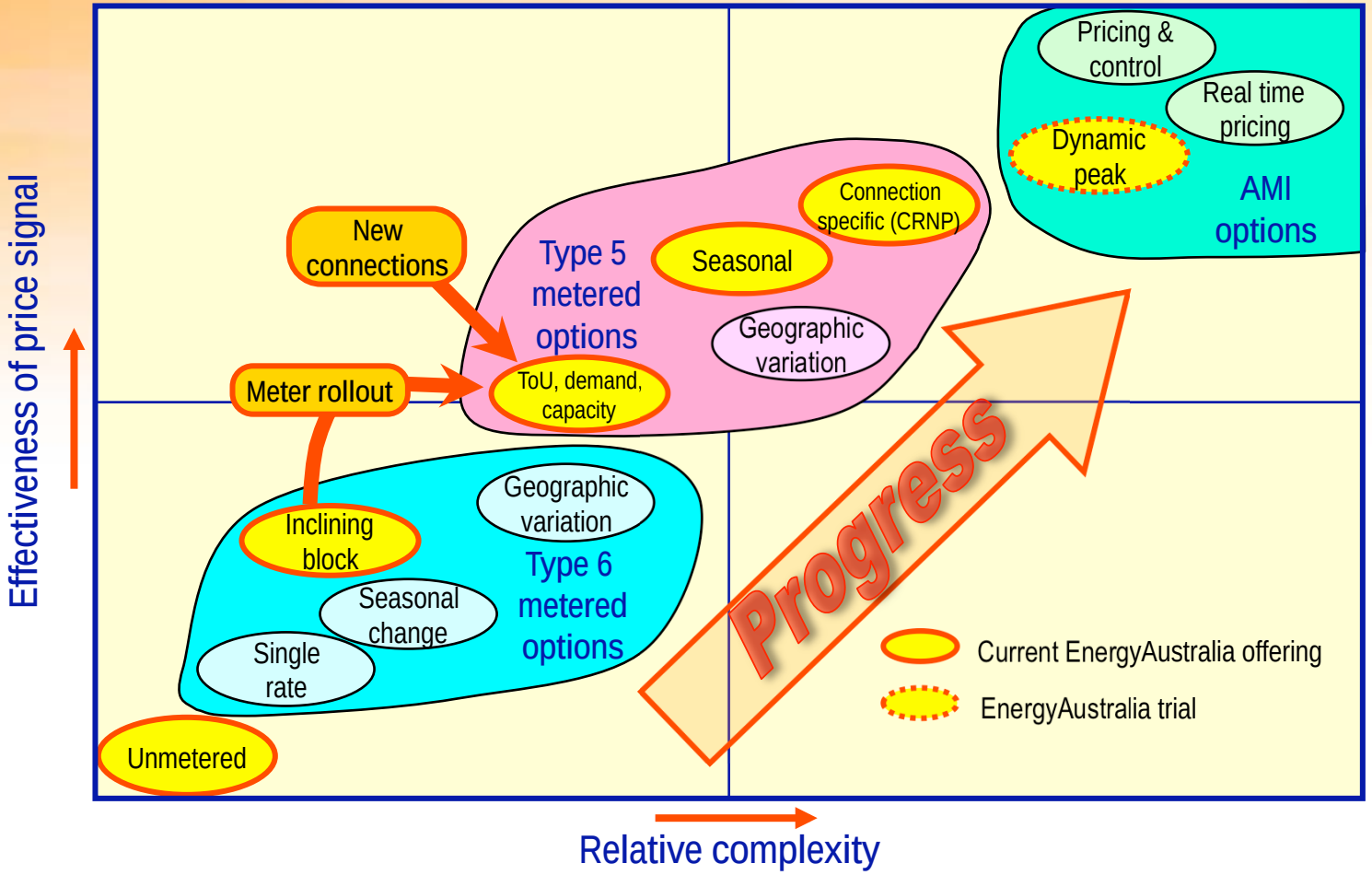
Source: Integral Energy ESDR 2003
Energy Australia ESDR 2003

DEPARTMENT OF ENERGY, UTILITIES AND SUSTAINABILITY
NEW SOUTH WALES GOVERNMENT

Marginal Deferral Value - ($/kW.year) for 2009

Projection / Datum: AGD66 Zone 56
Author: Chris Loty

EnergyAustralia vision for network pricing
(Colebourn, 2006)



EnergyAustralia distributor meter & network tariff strategy (H Colebourn, 2005)

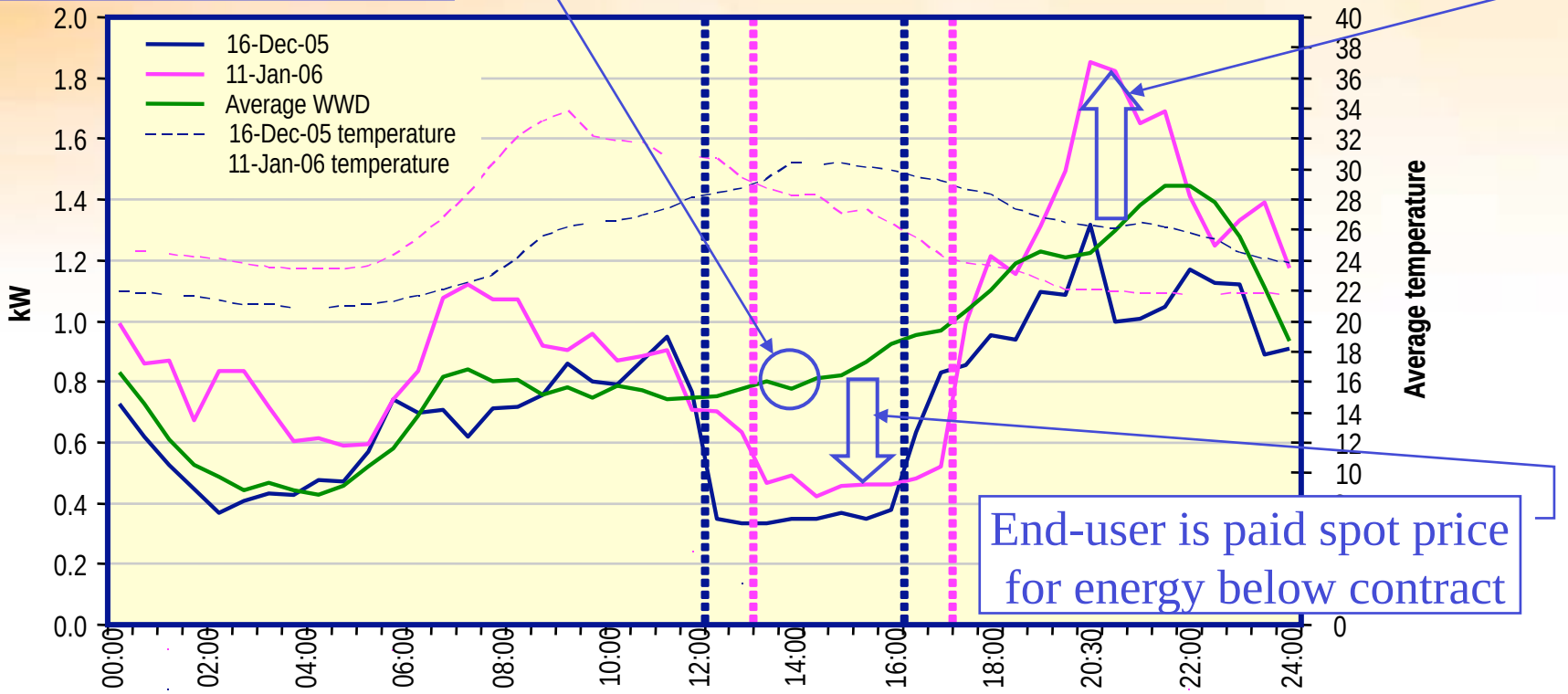
- Only half-hour meters installed since July 2004
- Replacement half-hour meters for most of 25,000 40-160 MWH end-users installed by June 2005
- Replacement half-hour meters for 110,000 15-40MWH end-users by June 2010
- 3-rate TOU network tariff from March 2005
- Seasonal TOU network tariff from July 2005
- Tests of communication systems to support non-predetermined pricing & interruptible loads

Spot & derivative access contract based on EA trial of residential dynamic peak pricing

(Colebourn, 2006)

CFD profile based on ave WWD demand

End-user pays spot price for energy above contract



End-user is paid spot price for energy below contract

Possible residential NSP forward contracts

- Forward demand profile to meet basic household needs for normal weather conditions:
  - May include a location-influenced allowance for air-conditioning
  - May be a function of household size
  - May include energy as well as network pricing
- Forward price profile determined by area-specific network LRMC estimate for cost of supply:
  - Considering economically efficient investment
- Forward term to be 3-5 years with annual update
- To be determined by regulator & offered by DNSP:
  - As default derivative aggregator if energy pricing included

Climate change implications

- Aust. already affected by climate change impacts
- Need rapid & deep reductions in emissions:
  1. End-use options: frugality, enhanced efficiency, CHP, fuel-switching, renewable energy at point of end-use
  2. Currently available low-emission supply-side options:
     - Gas CCGT, large-scale renewable energy generation
  3. Convert coal-fired power stations to gas CCGT (as at Tallawarra) with industrial use of waste heat
  4. Convert retailers to ESCOs
- Emission trading too slow – better used for fine-tuning once major reductions achieved

Conclusions on valuing DG contribution

- Three important issues in valuing DG:
  - Time-varying value of energy should reflect flow constraints
  - Quality of supply, particularly voltage & frequency
  - Obligation to serve
- DG role can be facilitated by coordinated technical & market mechanisms
  - Non-predetermined prices for energy & ancillary services:
    - Value DG improvements to availability & quality of supply
    - Penalise disturbances to availability & quality of supply
  - Communication & interval metering with QOS measurement
  - ESCOs would assist end-users to respond efficiently

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