Centre for Energy and Environmental Markets

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA



Australian Policy on Network Augmentation

Hugh Outhred, Presiding Director

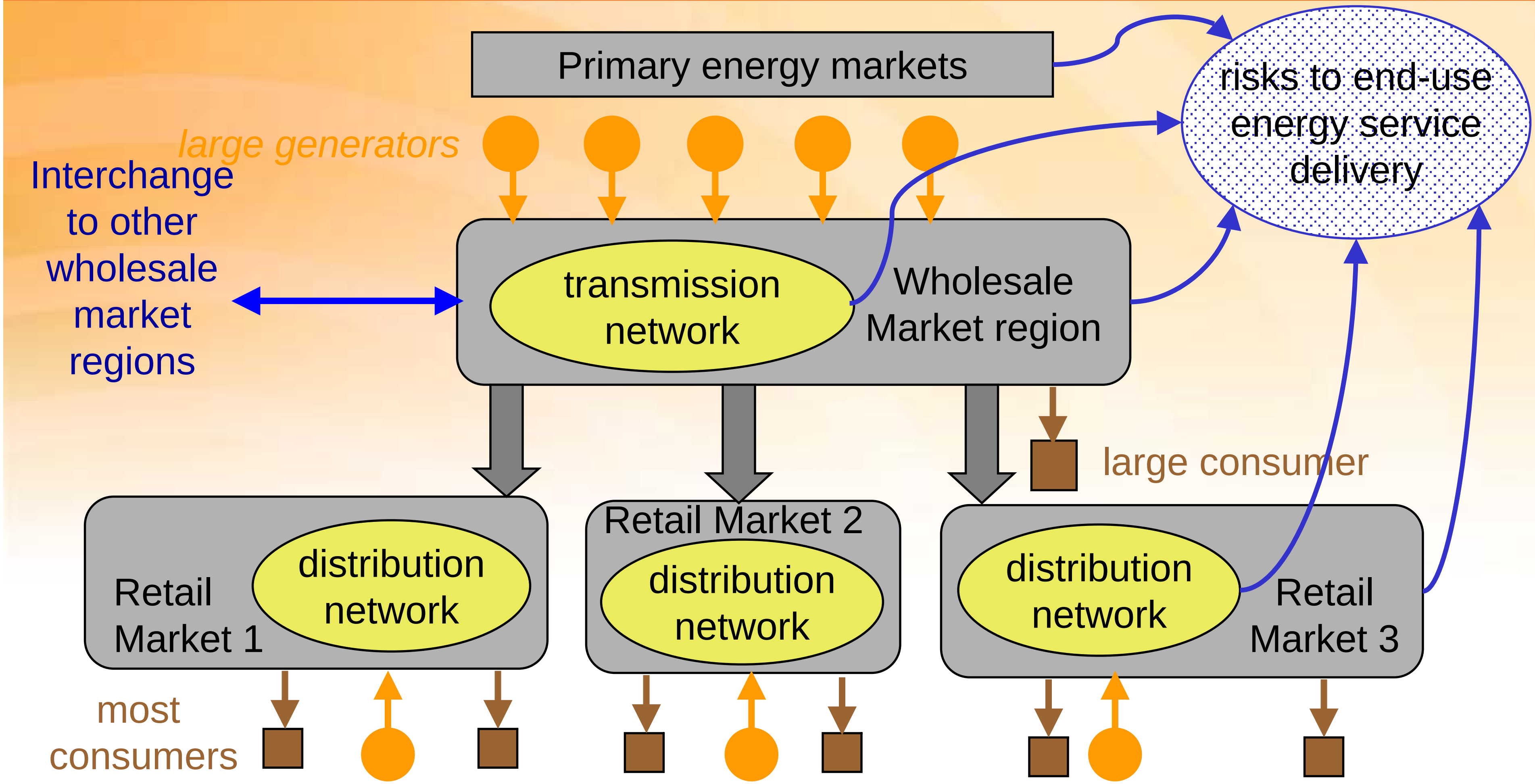
Centre for Energy and Environmental Markets, UNSW

Presented at the International Symposium on Enhancing the Stability & Reliability of the Taiwan Power System, Taipei, 28-29 November 2005

Outline

- Network services in a competitive electricity industry
- Ideal - nodal market at each connection point:
  - Ancillary services, spot energy, future risk
  - Network arbitrage versus local resources
  - Active demand-side participation
- Impractical near term, uncertain long term:
  - Complexity, market power, uncertainty
- Practical approaches depend on context:
  - Regional markets & negotiation frameworks
  - Network service regulation:
    - Operation incentives & investment protocols

A competitive electricity industry



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

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

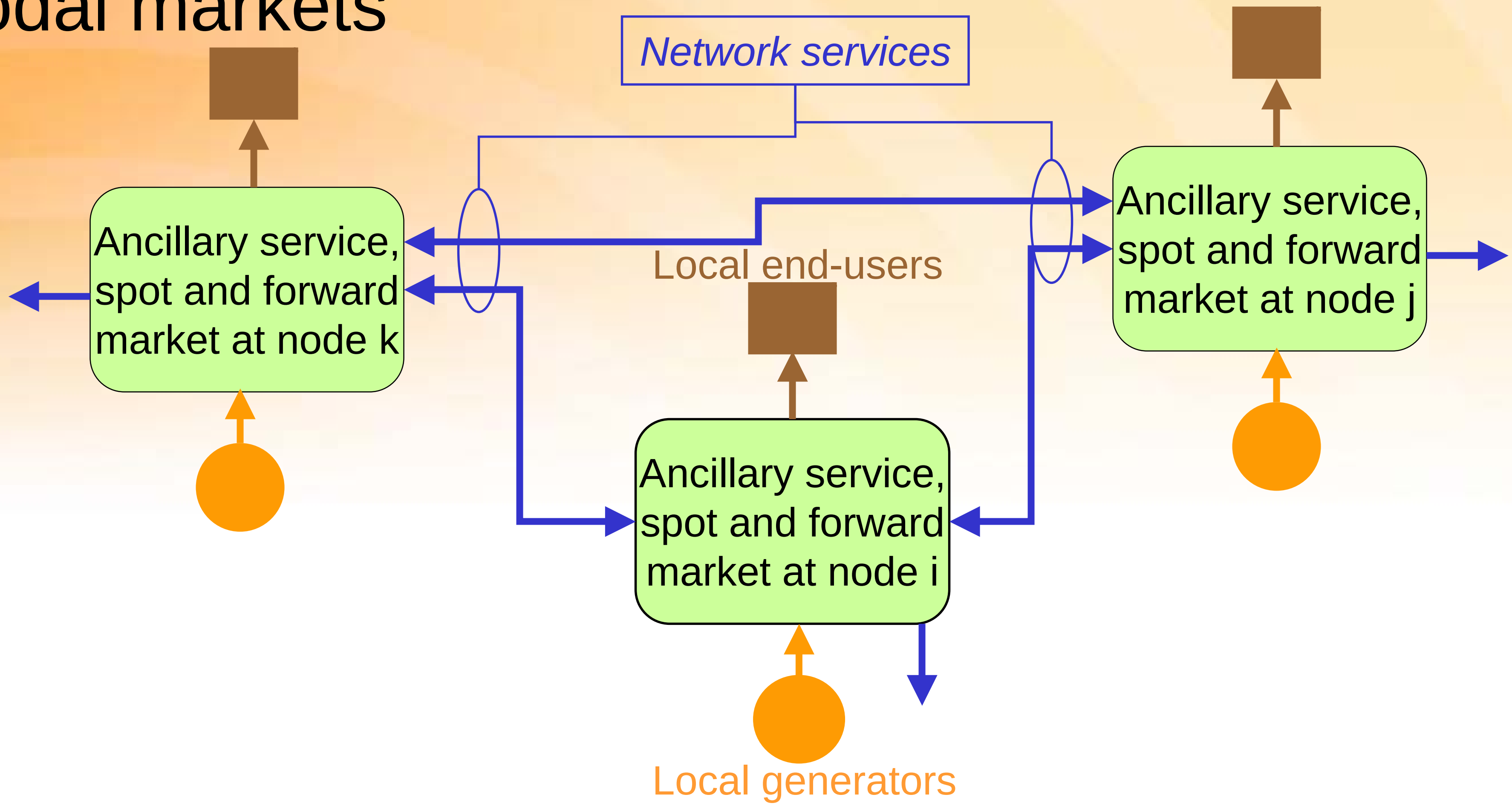
Network services in a competitive electricity industry

- Provide (collective) connectivity between all generator & all end-use equipment:
  - Support continuous flow of energy
  - Holistic rather than device-specific services
- Enhance availability, quality & security of supply:
  - Particularly in very short & very long time-scales
- Generator & end-use services are part substitutes:
  - Network services should be subject to competition
  - *However, competition difficult to achieve:*
    - *Outhred (2006): Managing Availability, Quality and Security in a Restructured Electricity Industry (www.ceem.unsw.edu.au)*

Ideal competitive model: *nodal markets in ancillary services, energy & derivatives*

- Based on a market at each node:
  - Local generators & end-users
  - Flows to & from the network
  - *The set of nodal ancillary service, spot & derivative markets would be solved by simultaneous auction*
- Network flows determined to maximise the benefits of trade (network-based arbitrage):
  - To exploit diversity in resource availability
  - Subject to network losses & flow constraints
- *In this model, network services are not regulated*

Network services as arbitrage between nodal markets



Much of the value of network services derives from the very short ancillary service & the very long investment timescales

Limits to the effectiveness of nodal markets

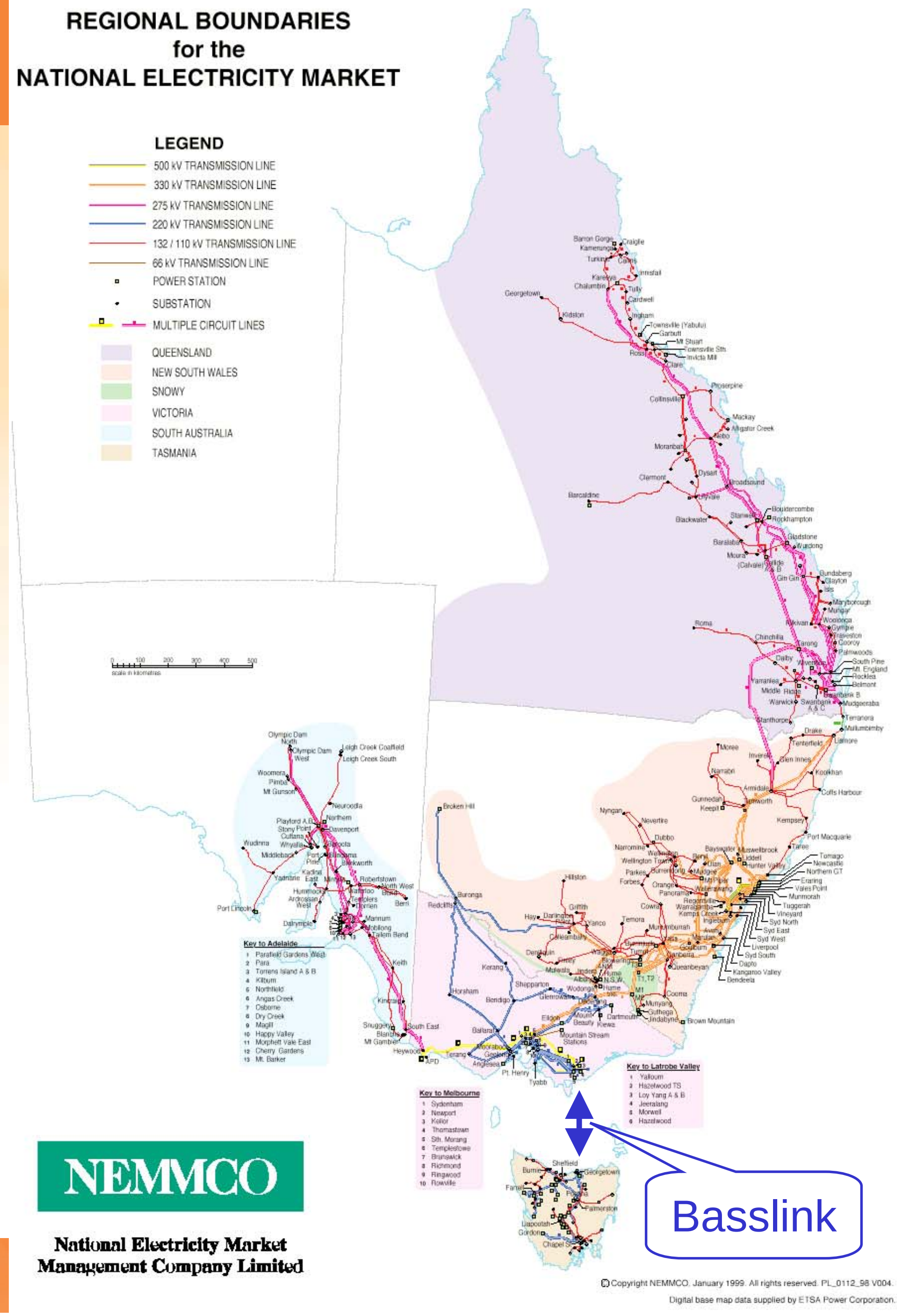
- For a given network, more nodal markets:
  - Mean fewer participants in each nodal market:
    - Local participants & network owners gain market power
    - Ancillary services, spot energy & risk harder to price
  - Require a more accurate network model
  - *There is a lower limit to the level of network detail that nodal markets can resolve*
- Regional markets provide one compromise:
  - Place major flow constraints on region boundaries:
    - Models of “notional interconnectors” then required
  - Resolve intra-regional network flow constraints by negotiation under regulatory supervision

Centre for Energy and Environmental Markets

Scope of the NEM

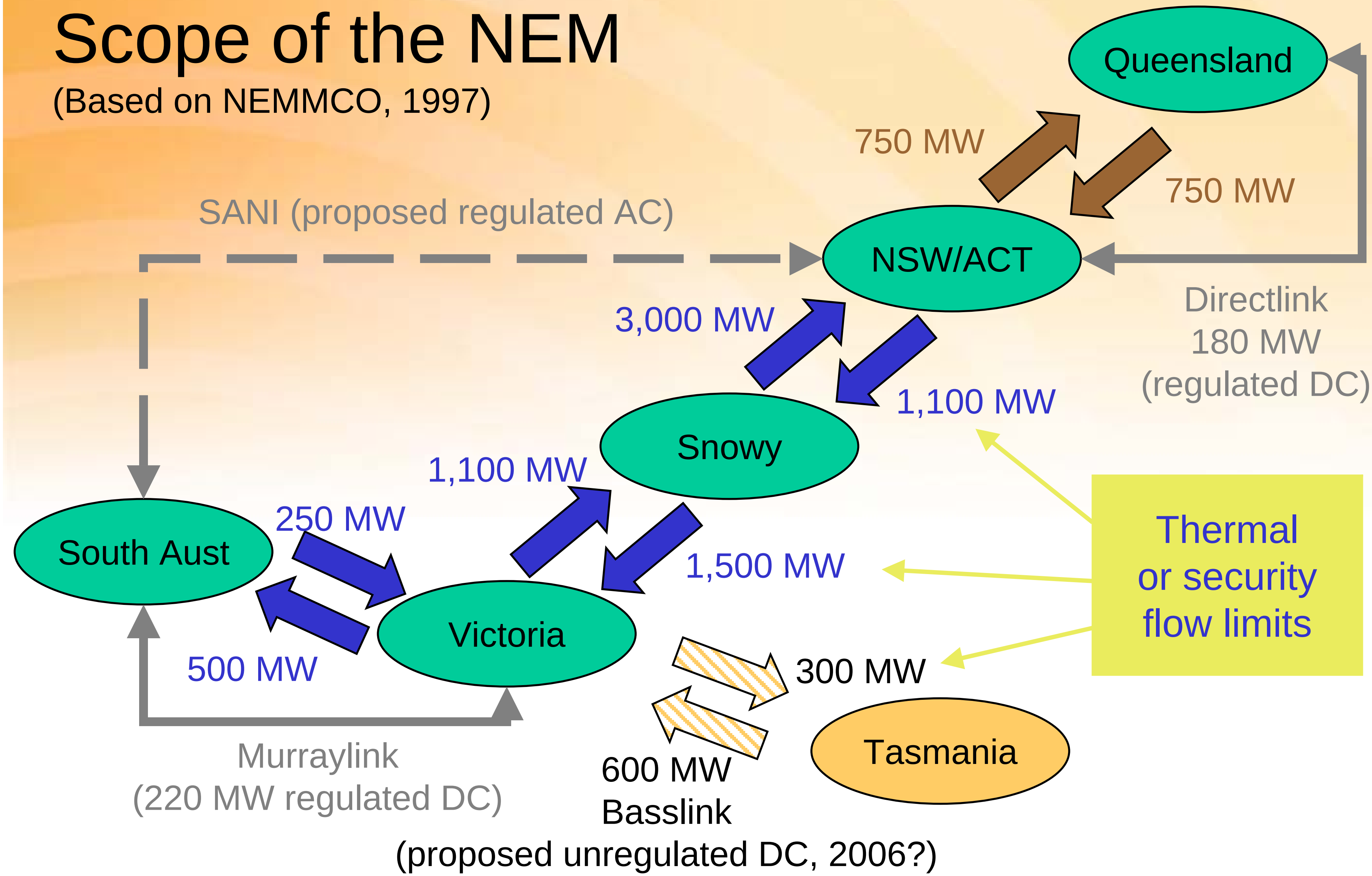
- Queensland
- New South Wales & ACT
- Victoria
- South Australia
- Tasmania
(Basslink in 2006)

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



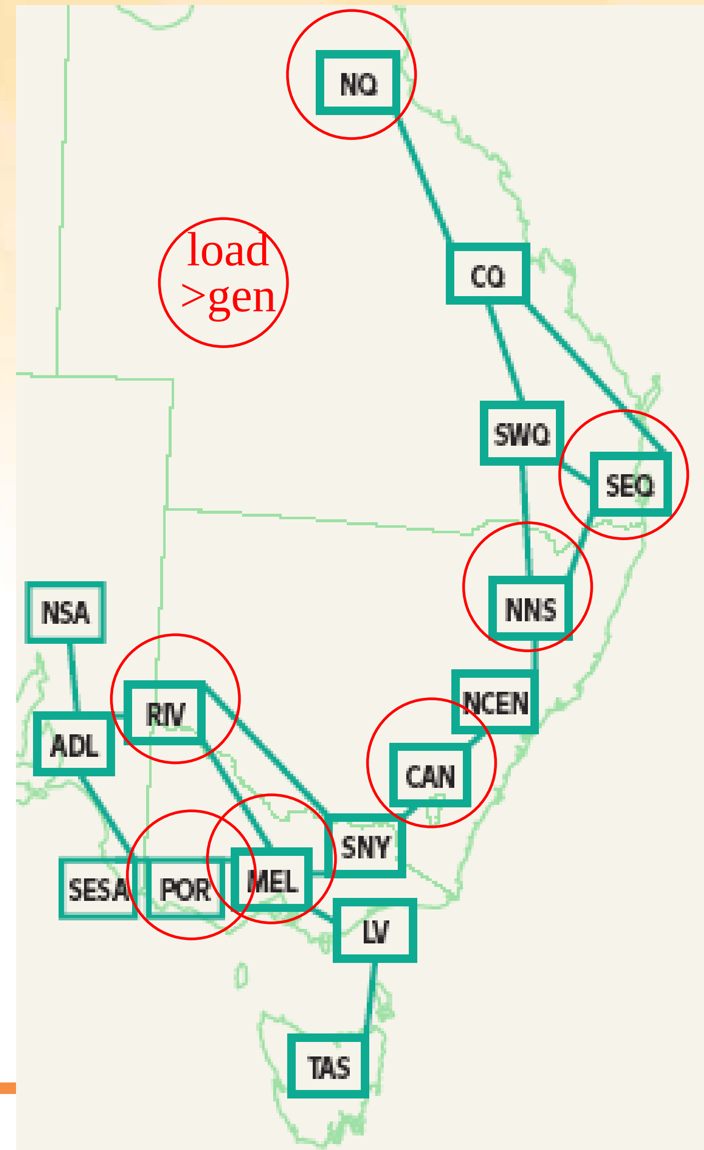
Scope of the NEM

(Based on NEMMCO, 1997)



More accurate 16 region NEM model (NEMMCO, 2004)

Node	Pk Ld (MW)	Gen Cap (MW)	Net Gen (MW)
NQ	1250	800	- 450
CQ	1900	4150	2250
SWQ	200	2150	1950
SEQ	4350	1450	- 2900
NNS	800	150	- 650
NCEN	10000	11650	1650
CAN	800	300	- 500
SNY	800	3900	3100
MEL	5750	800	- 4950
LV	900	7000	6100
POR	650	0	- 650
SESA	100	150	50
RIV	500	50	- 450
ADE	2100	2250	150
NSA	200	1100	900
TAS	1500	2500	1000



National Electricity Law: *Overall objective for the National Electricity Market (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 and the reliability, safety and security of the national electricity system*
- Implies efficient investment in network services:
  - *Refers to both technical and economic criteria but doesn't clearly define network services*
  - *Interconnectors modelled in the spot market*

NER treatment of network losses & capital costs

- NER contains market rules & an access regime:
  - Both address network issues
- National Electricity Market trading rules:
  - Notional regulated interconnectors & associated settlement residue auctions
  - Market network service provider (unregulated intercon) exposed to spot market outcome
  - Intra-regional network loss factors & constraints
- Network access regime:
  - Revenue cap for regulated network service providers

Inter-regional hedges for regulated notional interconnectors (between NEM market regions)

- A hedge against differences between regional spot prices for one direction of flow
- Based on interconnector settlement residue:
  - Difference between regional reference prices multiplied by interconnector energy flow in each market interval
- 3-monthly auctions of future settlement residue
  - Revenue goes toward allowed return on regulated network assets
- Incomplete hedge:
  - doesn’t cover interconnector losses or outages

NER Treatment of regulated transmission & distribution (Chapter 6)

- Principles for network regulation:
  - Promote competition in the provision of services
  - Be transparent & non-discriminatory
  - Seek similar outcomes to a competitive market
- Regulatory Test for T&D augmentation:
  - Reliability test for an augmentation proposal:
    - Minimises cost of meeting an objective reliability criterion

  Or

  - Market benefit test for an augmentation proposal:
    - Maximises NPV of market benefit having regard to alternative projects & market scenarios

Transgrid's interpretation of allowable market benefits (QNI preliminary assessment, 03/04)

Allowable Market Benefits	Description of Benefit
Production Efficiency Benefits	Reduction in fuel consumption of higher-priced sources Reduction in transmission losses Reduction in ancillary services
Capital Efficiency Benefits	Deferral of generation plant that would be required to maintain reliability reserve margins Deferral of generation plant that could be expected to enter the market in response to sustained high pool prices Reduction in capital costs Reduction in O&M costs Deferral of other transmission investments
Consumer Efficiency Benefits	Reduction in voluntary Demand Side Participation Reduction in involuntary load shedding

Transmission regulation: *revenue*
(existing arrangements; under review)

- Allowed annual revenue (AAR) for network
  - Set by regulator (ACCC), based on:
    - 'Optimal deprival' value of the network assets:
      - How would each asset be replaced today if it disappeared?
        - Considering network & distributed resource options
      - Existing assets and audited five-year expansion plan
    - Allowed rate of return:
      - Depends on the assessed risk of the business
  - Five year reset, (CPI-X) annual adjustment:
    - Pressure to control costs between assessments
    - Incentive to further reduce costs, because profits are retained at least until the next assessment

Transmission regulation: *network pricing*

(existing arrangements; under review)

- Recovering AAR from network users
  - Based on assessed use of the network
  - Network elements considered individually:
    - Overall network AAR is assigned to individual elements in proportion to their optimised replacement cost
  - Each network element allocated to a category:
    1. Serve particular network users (*entry or exit*)
    2. Provide a *common service* to all network users
    3. Shared by market customers in an identifiable way:
       - these costs to be allocated in an ‘equitable’ fashion
       - At present using “Cost Reflective Network Pricing”
- *Cost-recovery rather than economic efficiency*

Ministerial Council on Energy:

Statement on NEM transmission (May 2005)

- Identified three key issues for transmission:
  - Security & reliability; timely augmentation; incentives that align network performance with market impacts
- Annual National Transmission Statement:
  - Integrated overview of major transmission paths
  - AEMC to review regulatory test & have last resort power to direct its application
- AEMC to review regulation methodology
- Regional market structure to be stable, with refined change criteria based on economic benefit

Network planning process in NEM
(all processes to 10 year horizon)

NEMMCO Annual National Transmission Statement (ANTS)

↑

Transmission network service provider (DNSP) Annual Planning Review

↑

Distribution network service provider (DNSP) Annual Planning Review

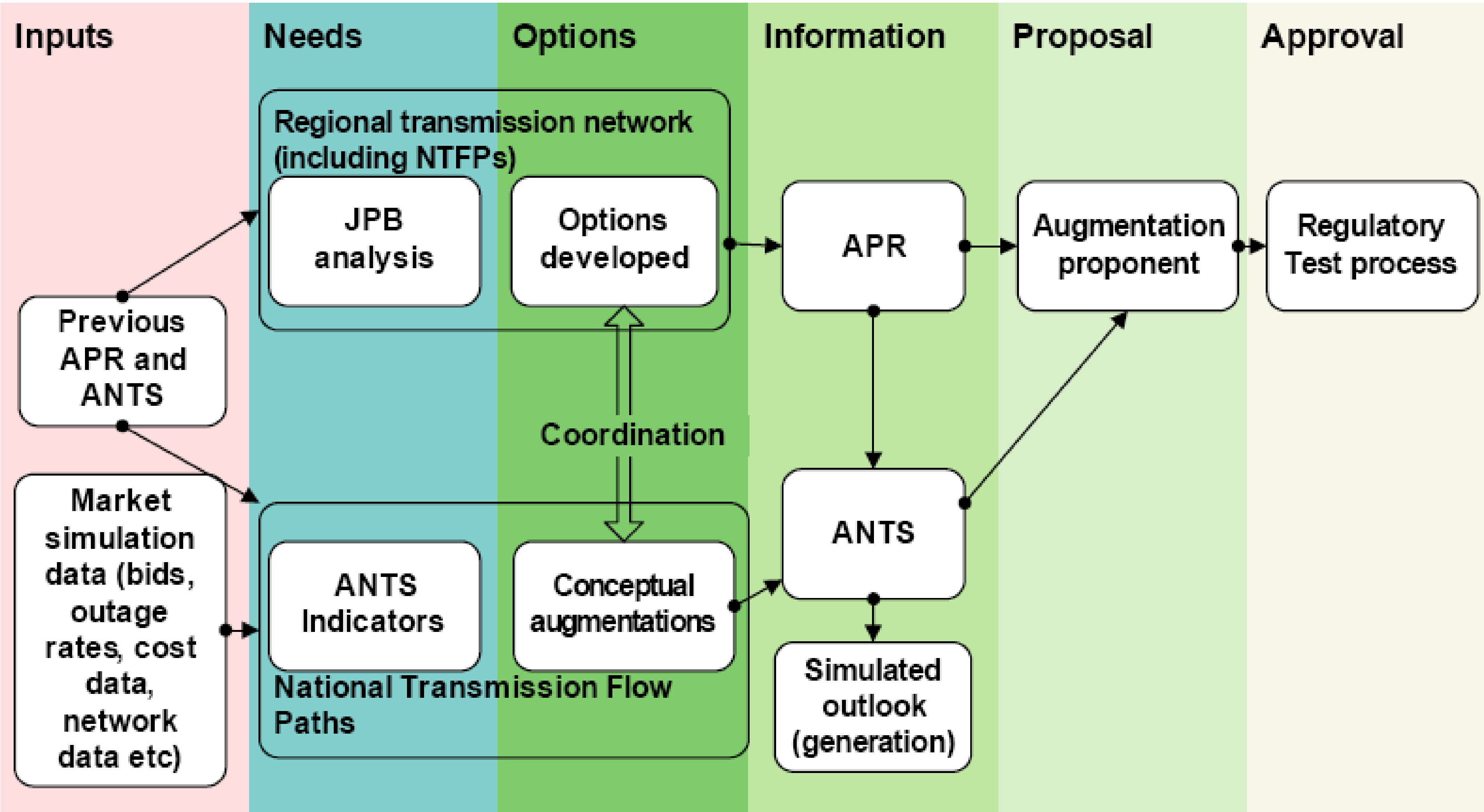
↑

Local demand forecasts that reflect aggregated end-user decisions

Network investment decision-making

- Each network service provider (NSP) takes own network augmentation (investment) decisions:
  – Subject to review by Independent Regulator:
    - AER (transmission) or State-based (distribution)
  – Accepted by Regulator if pass the Regulatory Test
- Required to consider distributed resource options:
  – Opportunities publicised through Annual Planning Reviews & case-specific Requests for Proposals
- Regulator-approved augmentation enters rate-base:
  – Including recovery of distributed resource expenditure

ANTS process (NEMMCO, 2005)

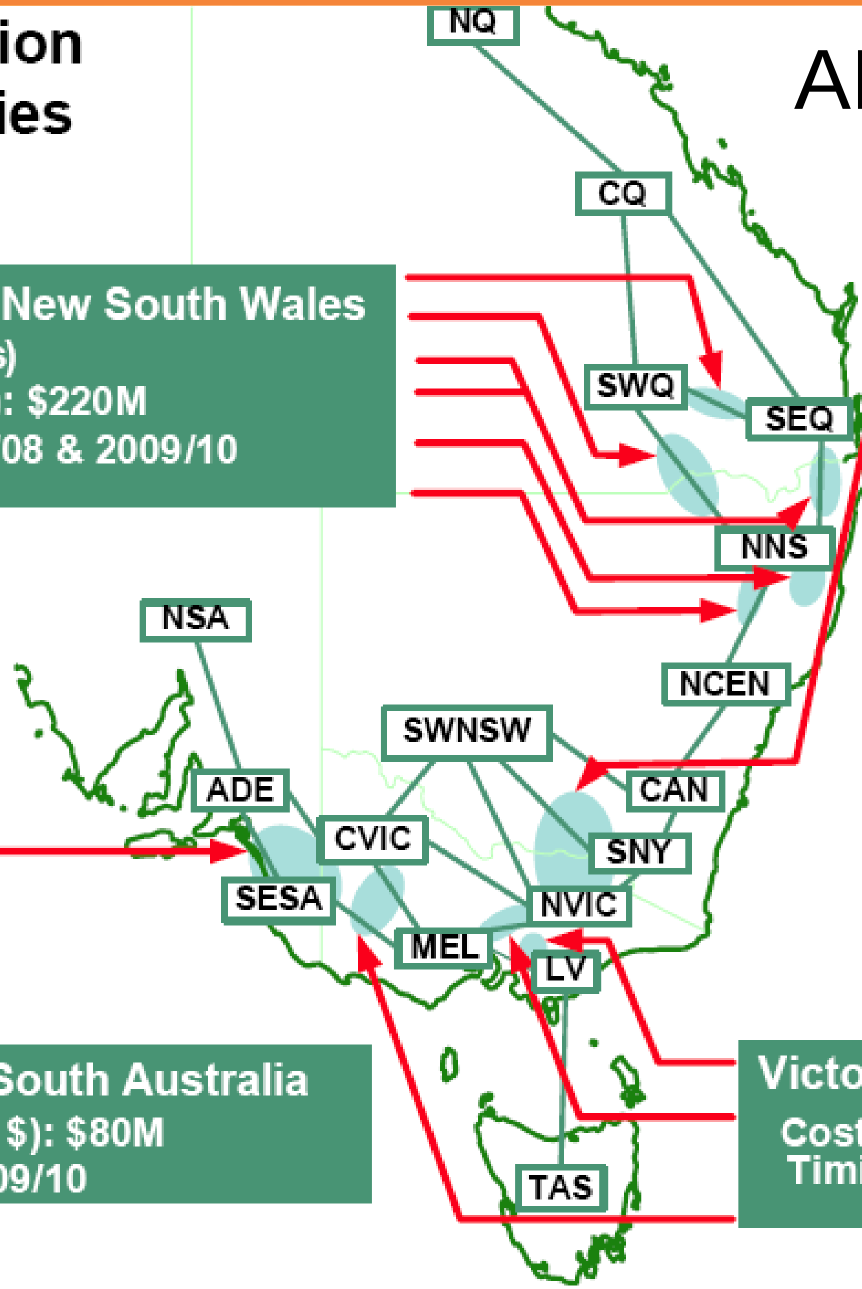


ANTS process (continued)

Augmentation Opportunities

Queensland – New South Wales (both directions)
Cost (05/06 $): $220M
Timing: 2007/08 & 2009/10

Snowy to Victoria
Cost (05/06 $): $75M
Timing: 2009/10

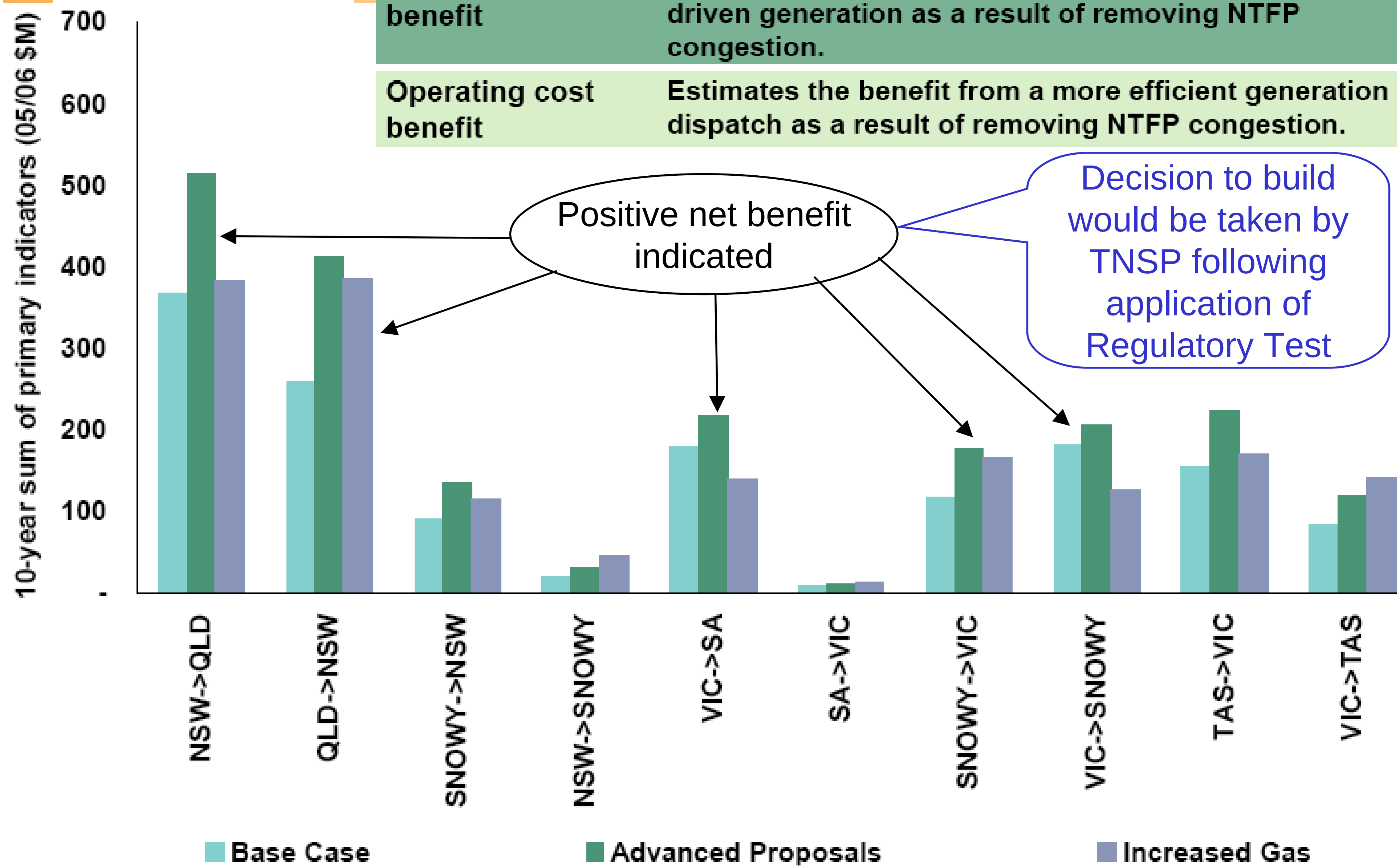


Victoria to South Australia
Cost (05/06 $): $80M
Timing: 2009/10

Victoria to Snowy
Cost (05/06 $): $50M
Timing: 2009/10

ANTS process (continued)

Primary Indicators	Net Benefit
Reliability benefit	Estimate the benefits from a reduction in unserved energy as a results of removing NTFP congestion.
Capital deferral benefit	Estimate the benefits from deferring some market driven generation as a result of removing NTFP congestion.
Operating cost benefit	Estimates the benefit from a more efficient generation dispatch as a result of removing NTFP congestion.



Summary of transmission augmentation

- Annual National Transmission Statement:
  - 10 year projection undertaken annually by NEMMCO
  - Identifies potentially cost-effective opportunities to augment major transmission flow paths
- Transmission network service providers:
  - Assess each investment option using Regulatory Test
  - Determine which option(s) to construct
- Australian Energy Regulator (AER):
  - Determines 5-year revenue for TNSPs:
    - Return on assets, operating costs, approved augmentations
    - Incentives for efficient network operation

Distributor investment considering distributed resources (NSW Demand Management Code of Practice, 2004)

Inform the market via annual plan

Regulator reviews process & outcome

Specify constraints, test the market & evaluate options

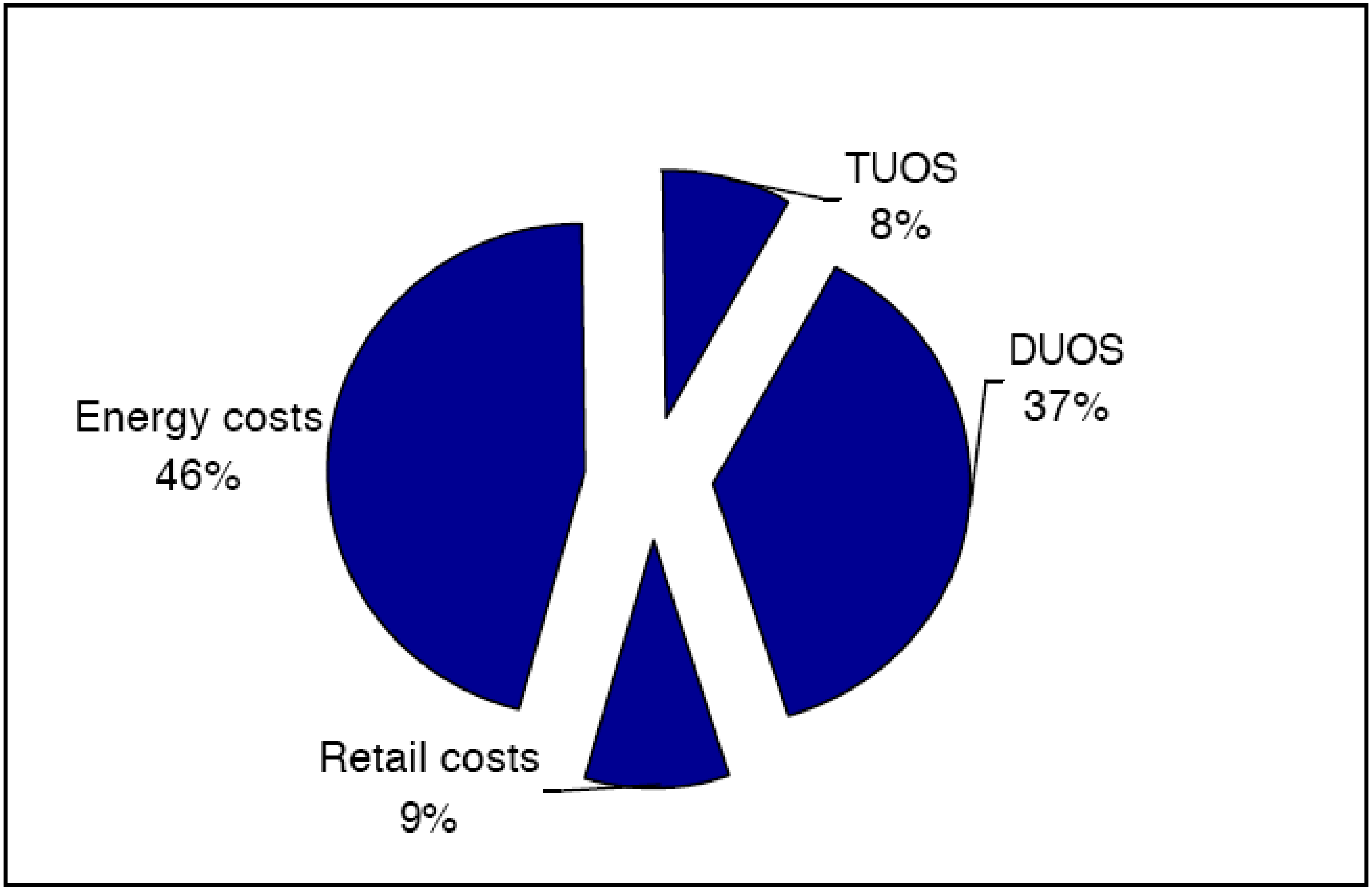
DR Offer(s) cheaper:
Negotiate contract(s) with DR providers
(revert to network option if negotiation fails)

Network option cheaper:
Proceed with preferred network option

Report outcomes & update plans

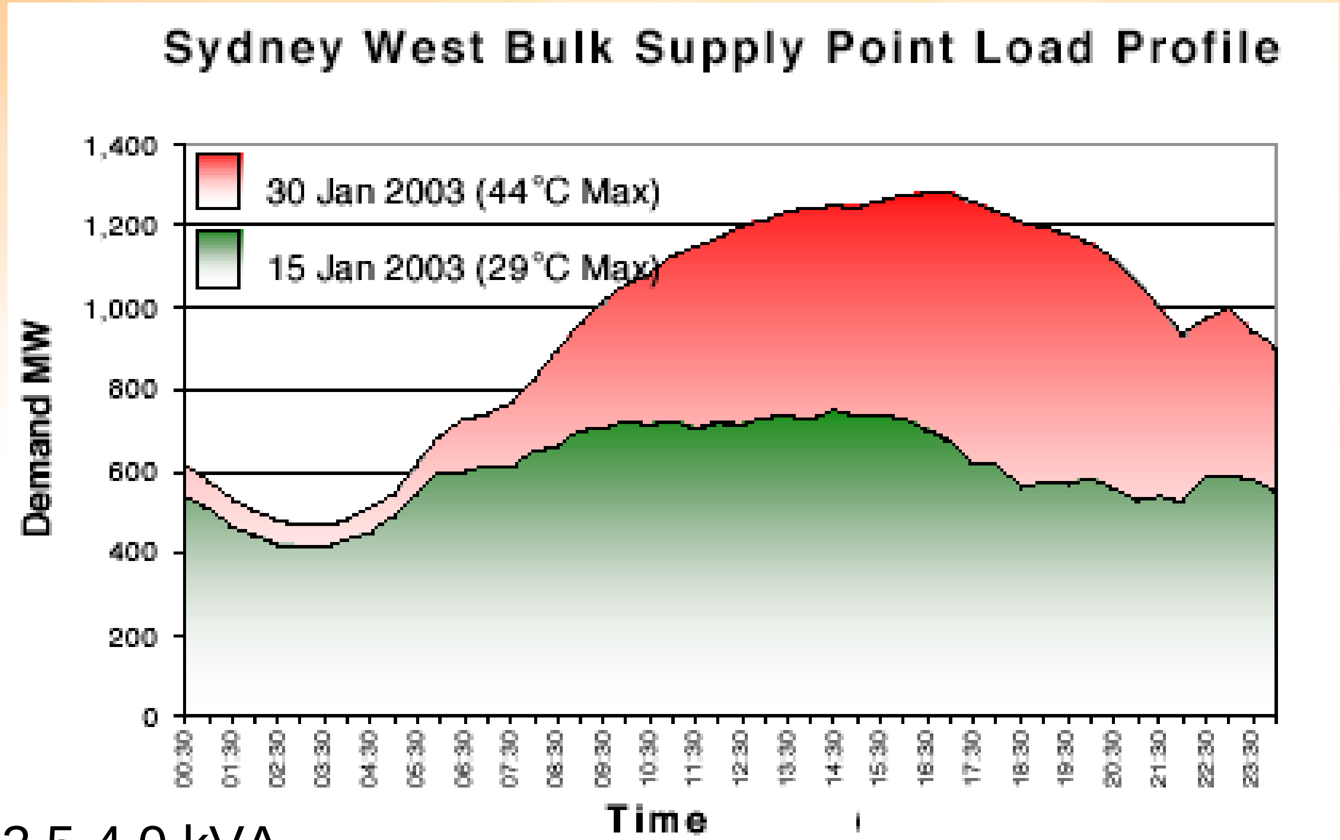
Typical NSW residential electricity bill

(IPART, DNSP Review Issues Paper, 2003)



Residential & commercial air conditioning is the key driver for peak demand growth

(IE Submission, IPART DNSP Review, 2003)



Residential ADMD:

Pre 2000 houses:- 3.5-4.0 kVA

Post 2000 houses:- 5.0-7.5 kVA

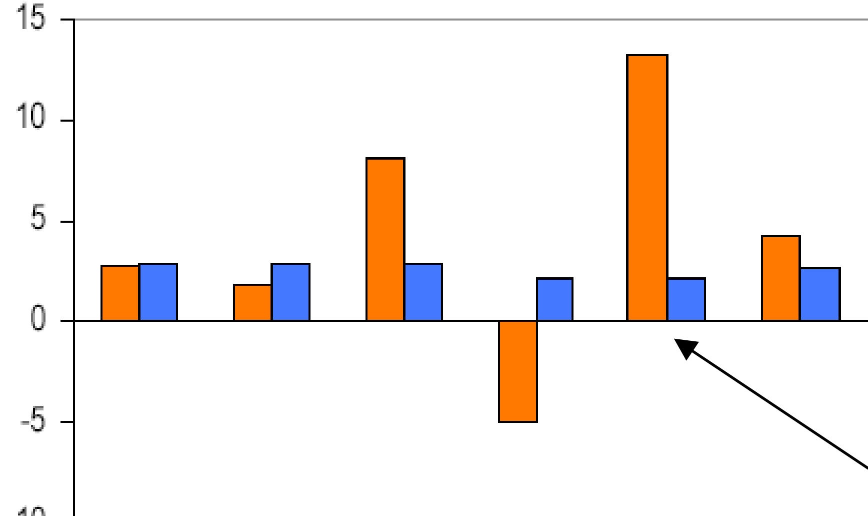
EnergyAustralia summer peak demand

(EA submission, IPART DNSP review, 2003)

Summer peak actual vs forecast

1999 - 2003

Annual Growth (%)



	1999	2000	2001	2002	2003	Avg
Actual	2.8	1.7	8.1	-5	13.3	4.2
1998 Forecast	3	3	3	2	2	2.6

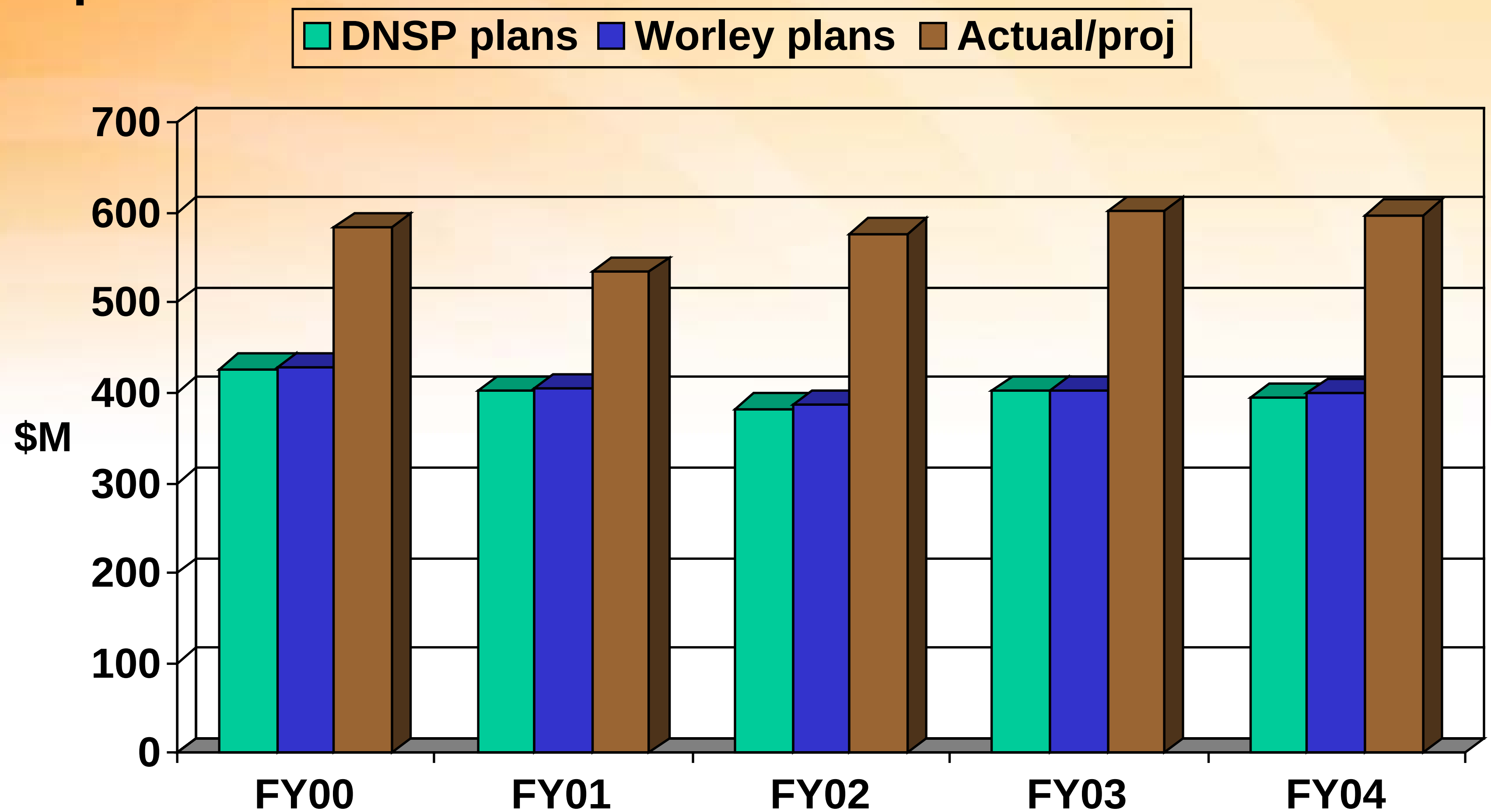
Summer of Year

Actual summer demand growth

- EnergyAustralia moving to summer peaking
- Shape of summer demand de-rates existing capacity.

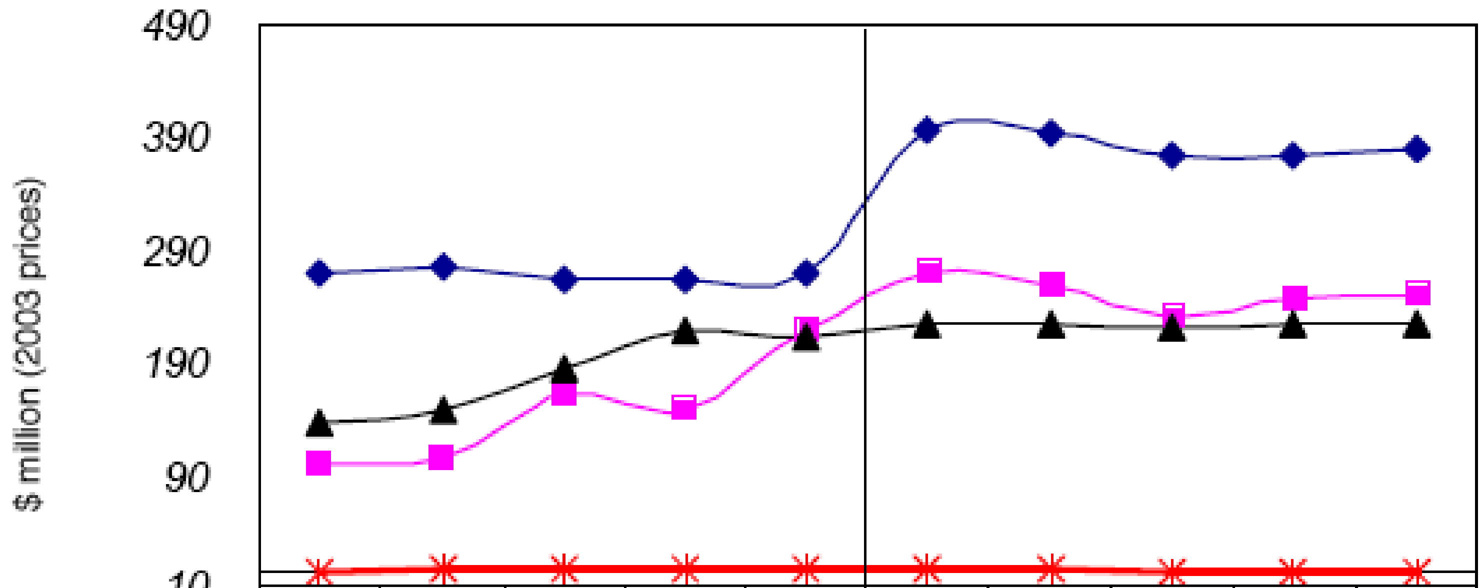
Uncertain weather-driven needle peak demand

Actual & projected DNSP capital expenditures (IPART, DNSP Review, 2003)



Capital expenditure greater than expected due to unanticipated growth in demand

NSW distributor actual & forecast capital expenditure (IPART, Dist Pricing Draft Rpt, 2004)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Energy Australia	271	275	264	263	270	398	394	374	375	379
Integral Energy	101	106	162	148	218	270	257	230	248	249
Country Energy	138	148	185	218	213	225	224	222	224	224
Australian Inland	3	3	4	3	5	3	3	3	2	2

Summary of distribution augmentation *(subject to State-level regulation at this time)*

- Demand growth is uncertain in time & location:
  - Five-year revenue paths are likely to be wrong
- Distributed resource options should be considered:
  - Allocation of risks & rewards is difficult
  - Obligation to serve compounds the problem
- Further progress requires:
  - Half-hour metering that also records quality & availability
  - Active end-user participation with contracted quality & reliability specification
  - Retail energy tariffs with spot & derivative format *(forward contracting for energy & peak demand)*

Conclusions

- Network services in a restructured electricity industry:
  - Vital, but hard to separate from services provided by generators or end-users
  - Hard to regulate:- capital intensity & future uncertainty
- HV transmission services:
  - Can be partly competitive but remain largely regulated
- Sub-transmission & distribution services:
  - Fully regulated at present, likely to remain so
  - Should be contestable by distributed resources
  - "obligation to supply" is a significant barrier to competition:
    - End-users should choose & pay for their preferred reliability

Australian Govt. & NEM web sites

- Australian Energy Regulator (AER): www.aer.gov.au:
  - *Compendium of Electricity Transmission Regulatory Guidelines*
- Australian Energy Market Commission (AEMC): www.aemc.gov.au:
  - *National Electricity Rules*
- National Electricity Market Management Company (NEMMCO): www.nemmco.com.au
- Ministerial Council on Energy: www.mce.gov.au:
  - *Policy statements for electricity and gas industries*

State-based regulators *(distribution-level)*

- Independent Pricing and Regulatory Tribunal of NSW (IPART): http://www.ipart.nsw.gov.au/
- Essential Services Commission, Victoria: http://www.esc.vic.gov.au/
- Queensland Competition Authority: http://www.qca.org.au/
- Essential Services Commission of South Australia: http://www.escosa.sa.gov.au/
- Office of the Tasmanian Energy Regulator: http://www.energyregulator.tas.gov.au/
- Office of Energy, Western Australia: http://www.energy.wa.gov.au/
- Northern Territory Utilities Commission: http://www.nt.gov.au/oiuc/

Relevant background papers from CEEM
(available from www.ceem.unsw.edu.au)

- Incorporating network effects in a competitive electricity industry, in *Electricity Pricing and Technology,* 1996.
- Observations on the Workshop for Markets in Electricity - Economics and Technology, Stanford University, August 2000.
- A services model of the electricity industry with particular attention to network services, *UNSW internal report,* 2002
- The evolving National Electricity Market - an Assessment, in *Power Progress: An Audit of Australia's Electricity Reform Experiment,* 2004.
- Managing Availability, Quality and Security in a Restructured Electricity Industry with Reference to the Australian National Electricity Market, *Proceedings of the 39th Hawaii International Conference on Systems Sciences,* 2006.

Centre for Energy and Environmental Markets

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA

Many of our publications are available at:
www.ceem.unsw.edu.au