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:
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
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)

- Queensland
  - 750 MW
  - Directlink 180 MW (regulated DC)

- NSW/ACT
  - 3,000 MW
  - 1,100 MW

- Snowy
  - 1,100 MW
  - 1,500 MW

- Victoria
  - 1,100 MW
  - 250 MW
  - 500 MW

- South Aust
  - 250 MW

- Tasmania
  - 600 MW
  - Basslink (proposed unregulated DC, 2006?)
  - 300 MW

- SANI (proposed regulated AC)
- Murraylink (220 MW regulated DC)
## More accurate 16 region NEM model (NEMMCO, 2004)

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

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

- 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)

Inputs
- Previous APR and ANTS
- Market simulation data (bids, outage rates, cost data, network data etc)

Needs
- Regional transmission network (including NTFPs)
  - JPB analysis
  - Options developed

Options
- Coordination

Information
- APR
- ANTS
  - Conceptual augmentations
  - Simulated outlook (generation)

Proposal
- Augmentation proponent

Approval
- Regulatory Test process
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)

Positive net benefit indicated

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

Decision to build would be taken by TNSP following application of Regulatory Test.
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)

1. Inform the market via annual plan
2. Specify constraints, test the market & evaluate options
3. DR Offer(s) cheaper: Negotiate contract(s) with DR providers (revert to network option if negotiation fails)
4. Network option cheaper: Proceed with preferred network option
5. Report outcomes & update plans

Regulator reviews process & outcome
Typical NSW residential electricity bill
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 (%)

Actual summer demand growth

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

Uncertain weather-driven needle peak demand

<table>
<thead>
<tr>
<th>Summer of Year</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>2.8</td>
<td>1.7</td>
<td>8.1</td>
<td>-5</td>
<td>13.3</td>
<td>4.2</td>
</tr>
<tr>
<td>1998 Forecast</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2.6</td>
</tr>
</tbody>
</table>
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)
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
  - National Electricity Rules
  - Policy statements for electricity and gas industries
State-based regulators (*distribution-level*)

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.
- A services model of the electricity industry with particular attention to network services, *UNSW internal report*, 2002
Many of our publications are available at:
www.ceem.unsw.edu.au