Some regulatory and market design insights from the Australian experience of integrating high renewable penetrations into its National Electricity Market

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A destination – shaped by energy trilemma
Choose any two? .... but you may get none

Balancing the ‘Energy Trilemma’

**Energy Security**
The effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of energy providers to meet current and future demand.

**Energy Equity**
Accessibility and affordability of energy supply across the population.

**Environmental Sustainability**
Encompasses the achievement of supply and demand-side energy efficiencies and the development of energy supply from renewable and other low-carbon sources.

“To promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to –

- price, quality, safety, reliability, and security of supply of electricity; and
- the reliability, safety and security of the national electricity system.”

National Electricity Law (Schedule to the National Electricity (South Australia) Act 1996), s.7

(Word Energy Council, 2016)
For electricity, no agreed path…
The NEM path - ‘fit for purpose’?

Objectives of technology and participant neutrality, but always challenging…

*Exogenous and endogenous drivers that seem to be accelerating*

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**Pathways to a clean energy future**

(AEMC, 2015)
The NEM – a single near-national market

Wholesale value of electricity traded
$11.7 billion

National maximum summer operational demand
32,859 MW

National maximum winter operational demand
31,977 MW

Installed capacity
47,148 MW

40,000 kilometres of transmission lines

Number of metered customers
9.6 million

NEM emissions
162 Mt CO$_2$-e

(Finkel Review, 2017)
NEM market and Network arrangements

(adapted from Outhred, 2010)

Wholesale Market

Retail Market

Distribution sector

Generation Sector: large generators

Transmission Sector

Retail sector

Retail Markets

AEMO: market & system operator

Economic regulation

End-use sector (including DR)

Embedded generators

End-users

Retailer Z

Retailer 1

Intentions, offers & payments

Intentions, bids & payments

Multi-region five-minute energy & FCAS markets

Derivative trading (cashflow?)

End-use sector

Economic regulation

(Finkel Review, 2017)
Competitive Generation and Retail ‘markets’?

- Predominant private ownership of both generation and retail
- A mix of local + international firms, and foreign government vehicles
- A mix of State and Federal Government participation

(AER, 2017)
Two ‘worlds’ for renewables integration

(adapted from Outhred, 2010)

Centralised Renewables eg. Wind, CSP

Derivative trading (cashflow?)

Multi-region five-minute energy & FCAS markets

Intentions, offers & payments

cash flow

AEMO: market & system operator

Retail sector

Retailer 1

Retail Markets

Retailer Z

Embedded generators

End-users

Distributed Renewables eg. PV, CHP

Energy flow

End-use sector (including DR)

Distribution sector

Energy flow

Transmission Sector

Energy flow

Generation Sector: large generators

Energy flow

Clean energy future
Success to date in low carbon transition?

Lessons on sustainable electricity industry transition

(Australian Energy Statistics, 2016)
Residential PV penetration

(Finkel Review, 2017)
Overall governance challenge

Comprehensive and coherent policy development process

1. Regulation
   - Transmission network planning
   - Distribution network planning
   - Grid codes

2. Market Design
   - Fundamental market design
   - Spot market rules
   - Ancillary service market rules

3. External Policy Drivers
   - Carbon policies
   - Renewable & energy efficiency policies
   - Fuel policies

Robustness and Resilience: ability to perform reasonably well under a wide range of possible futures

(Riesz, 2016)
Changing status of large-scale RE in NEM

- **Non-scheduled**
  - *Original category for intermittent gen – RE treated as negative demand*
  - Can only be curtailed for system security or key network issues
  - Don’t pay for FCAS
  - *Recent changes: technical connection standards relevant to wind generators*
    - Historical windfarm outputs published
    - Centralised wind forecasting system (AWEFS)

- **Scheduled**
  - *All major generation SA formerly required new wind farms to register as scheduled*
  - Submission of dispatch offers
  - Compliance with targets
  - Causer-pay for ancillary services
  - Ability to offer ancillary services
  - Publication of individual outputs: forecast, offered & actual

- **Semi-Scheduled**
  - *Specifically intended for intermittent gen >30MW + compulsory from March 2009*
  - Submission of dispatch offers
  - Causer-pay for ancillary services
  - Ability to offer ancillary services
  - Are treated as positive supply
  - If involved in a constraint
    - Compliance with targets if less than forecast

(adapted from Outhred, 2010)
Retail pricing – does this look like success?

(AER, 2017)

Electricity retail price index

Index 1991 = 100

(AER, 2017)

(The Australia Institute, 2017)
Facilitating greater consumer engagement – demand-side participation *in principle*

Efficient markets are characterised by effective participation of both the supply and demand side. The supply side of the market provides a product or service at a price, and the demand side (i.e., consumers) responds to the price/value of the product or service being offered.

While there is some evidence of uptake of DSP in the NEM over recent years, the efficiency of the electricity market can be improved by more active participation by the demand side. This will require changes to some aspects of how the supply side of the electricity market operates and interacts with consumers.

*(AEMC, Power of Choice, 2012)*

The Power of choice review has identified opportunities for consumers to make more informed choices about the way they use electricity. Consumers require tools - information, education, and technology, and flexible pricing options - to make efficient consumption decisions. Recommendations presented in this report will support these conditions and enable consumers to have more control of their electricity expenditure.
Facilitating greater engagement in practice?

CRT proposals to date:
- steep declining block
- higher fixed charges
- ‘non-peak demand’ demand charges
- special ‘solar’ household tariffs

While some cross-subsidies are not to be discussed
- eg. locational between urban and regional consumers

All may limit consumer options to invest in new technologies and behave in ways that reduce bills while also reducing longer-term network expenditure
Resource adequacy tightening

(Grattan Institute, 2017)
SA blackout – Was it wind?

- A complex question

- *Electricity industry run to remain secure, major failures almost always involve multiple factors*

- *Wind and residential PV added to the challenges*

NEM lessons for liberalisation and regulation
South Australian Government intervention

**Battery Storage and Renewable Technology Fund**

Australia’s largest battery will be built in South Australia to store renewable energy and add stability to supply as part of a new $150 million Renewable Technology Fund.

**State-Owned Gas Power Plant**

The South Australian Government will build its own gas power plant to have government-owned stand-by power available in South Australia for emergencies.

**New Generation: More Competition**

The State Government will use its bulk-buying power to attract new electricity generation to increase competition and put downward pressure on prices.

**South Australian Gas Incentives**

The State Government will offer incentives to source more gas for use in South Australia, replacing coal-fired energy from Victoria.

**Local Powers Over National Market**

The State Government will legislate to give the Energy Minister direction over the market so South Australia’s best interests always come first if there is an electricity shortfall.  

*(South Australian Government, 2017)*

**Energy Security Target**

A new target will increase South Australia’s energy self-reliance by requiring more locally generated, cleaner, secure energy to be used in South Australia.
Renewed focus on competition challenges

**Figure 7 Addressing Affordability**

<table>
<thead>
<tr>
<th>Contribution to C&amp;I electricity costs</th>
<th>Contribution to household electricity costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>10%</td>
<td>21%</td>
</tr>
<tr>
<td>50%</td>
<td>6%</td>
</tr>
<tr>
<td>38%</td>
<td>42%</td>
</tr>
</tbody>
</table>

**Retail**
- Get lower income people off high offers
- Reduce switching costs
- Improve customer understanding

**Green**
- Reduce the smeared costs and inequity of current (and future) green schemes

**Generation**
- Lower gas prices
- Address or reduce the effects of market power
- Explore barriers to C&I-led investment
- Establish what demand-side measures are best

**Network**
- Remove Limited Merits Review (LMR)
- Reduce inefficient costs
- Reconsider asset values

*(ACCC, Sims speech to National Press Club, 2017)*
NEM Governance – fit for purpose?

Commitment to a clean energy future?

Balancing security vs market tradeoffs? Distributed resource integration into market operation?

COAG Leaders

COAG Energy Council

Australian Energy Market Agreement (AEMA)

National Electricity Law (NEL)

Australian Energy Market Operator

Australian Energy Market Commission

Australian Energy Regulator

Reliability Panel

Currently no explicit env. objective? Speed of rule changes? Balancing incumbent vs new entrant impacts?

Managing market power?

Containing network expenditure?

Balancing incumbent vs new entrant impacts?

Coherence and comprehensive framework?

(Finkel Review, 2017)
Possible lessons for RE integration

**Wholesale market arrangements**
- *RE just one of the challenges facing electricity industries*
- As RE penetrations increase, require greater integration into formal ‘energy’ market arrangements
- External RE policy should retain ‘exposure’ to energy market signals
- Distributed RE particularly challenging, needs more formal integration

**Retail market arrangements**
- Need to accept, work within ‘social construct’ for small energy users
- Network businesses have key role – currently conflicted b/n existing and possible new business models; *Need to revisit interface b/n monopoly regulation + retail mkt competition given new technologies*

**More generally, market limitations wrt integration across policy objectives, longer term perspectives mean greater govt. involvement essential for effective low-carbon transition**
Thank you… and questions

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