What went wrong with Australia’s National Electricity Market?
The Missing Money & Missing Policy

Prof. Paul Simshauser
Overview of Australia’s National Electricity Market

- Mandatory energy-only gross pool, no formal day ahead or capacity market
- Very high VoLL (currently $14,500)
- Covers Eastern Seaboard (Queensland, New South Wales, Victoria, South Australia, Tasmania, Aust. Capital Territory)
- 46,000 MW of generation plant, 196 TWh Load
  - Coal 80% and falling, Gas 10%, Renewables 10% and rising
  - Customers 8.8 million households (~28% load)
The NEM in 2016-2018

- After two decades of consistent economic & technical performance, NEM wholesale market prices doubled, and the SA grid collapsed (Sept 2016)
  - Nov 2016 Hazelwood Power Station closure announced (5 months notice)
- The NEM’s wholesale market has been the centrepiece of Australia’s energy market reform, a world-class market and market design
- For policymakers, an energy market crisis was unfolding. Context is important:
  - From 2007-2014 residential retail-level tariffs doubled (networks & envir. policy)
  - Just as network charges & environmental costs stabilised, wholesale prices surged
  - Change in political strategy at Commonwealth level
- To understand what happened in the NEM, we need to trace through a decade of policy decisions vis-à-vis impact on investment
Policy backdrop: climate change policy discontinuity

- Australia’s Renewable Energy Target
  - Formally reviewed on 6 separate occasions
  - Fundamentally changed 3 times (20%, Large/Small, 33TWh)

- Emissions Trading in Australia
  - Policy can be traced at least as far back as 1997
  - 1 false start (2011-2014).

- Five State-based schemes (a tech set-aside scheme, baseline & credit ETS, 3 separate energy efficiency schemes and 4 Premium FiT schemes for rooftop solar PV)
Policy-induced plant: 2% to 20%

The Sequence:
1. Policy induced plant

**Diagram:**
- **Generation Plant (MW):**
  - **Renewable Plant**
  - **OCGT Peak Plant**
  - **CCGT Base Plant**
  - **Coal**

**Graph:**
- **2006 FY (ETS, 2% RET):**
  - Renewable Plant: 2,000 MW
  - OCGT Peak Plant: 4,000 MW
  - CCGT Base Plant: 6,000 MW
  - Coal: 8,000 MW
- **2009 FY (ETS, 20% RET):**
  - Renewable Plant: 10,000 MW
  - OCGT Peak Plant: 8,000 MW
  - CCGT Base Plant: 6,000 MW
  - Coal: 6,000 MW
## Into an oversupplied market...

<table>
<thead>
<tr>
<th>Operating Duty</th>
<th>Optimal (MW)</th>
<th>Actual (MW)</th>
<th>Imbalance (MW)</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base load plant</strong></td>
<td>25,000</td>
<td>29,000</td>
<td>4,000</td>
<td><strong>Overweight</strong></td>
</tr>
<tr>
<td><strong>Intermediate</strong></td>
<td>3,600</td>
<td>6,000</td>
<td>2,400</td>
<td><strong>Overweight</strong></td>
</tr>
<tr>
<td><strong>Peak load plant</strong></td>
<td>10,700</td>
<td>10,200</td>
<td><strong>-500</strong></td>
<td><strong>Underweight</strong></td>
</tr>
<tr>
<td><strong>Renewables</strong></td>
<td>985</td>
<td>2,200</td>
<td>1,215</td>
<td><strong>Overweight</strong></td>
</tr>
<tr>
<td><strong>Aggregate Supply</strong></td>
<td>40,285</td>
<td>47,400</td>
<td><strong>7,115</strong></td>
<td><strong>Oversupplied</strong></td>
</tr>
<tr>
<td><strong>Capital stock</strong></td>
<td>$45,909.70</td>
<td>$55,248.80</td>
<td>$9,339.10</td>
<td><strong>Overcapitalised</strong></td>
</tr>
</tbody>
</table>

Source: Simshauser (2010)

The Sequence:
1. Policy induced plant
2. Into an oversupplied market
With contracting final demand...

The Sequence:
1. Policy induced plant
2. Into an oversupplied market
3. With contracting final demand
Investments moved from market signals to policy signals

The Sequence:
1. Policy induced plant
2. Into an oversupplied market
3. With contracting final demand
4. Investment responding to policy
Adding to the pressure: 2P Coal Seam Gas Reserves

The significance of this was the triggering of LNG plants, and a need for a temporary home for ramp gas…

The Sequence:
1. Policy induced plant
2. Into an oversupplied market
3. With contracting final demand
4. Investment responding to policy
5. Large gas discoveries
Gas-fired generation increased, adding more supply

The Sequence:
1. Policy induced plant
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5. Large gas discoveries
6. Gas needing a temporary home
Solar PV hollowing out daytime load, FiT recovery adding to price

The Sequence:
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7. With a Solar PV boom
Wholesale prices fell well below ATC...

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7. With a Solar PV boom
8. Elongated price collapse
The missing money: mounting losses for thermal plant

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6. Gas needing a temporary home
7. With a Solar PV boom
8. Elongated price collapse
9. Missing money compounds

<table>
<thead>
<tr>
<th>Year</th>
<th>ATC ($/MWh)</th>
<th>NEM Price ($/MWh)</th>
<th>Shortfall ($/MWh)</th>
<th>Generation (GWh)</th>
<th>Missing Money ($ Billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>43.30</td>
<td>39.11</td>
<td>-4.19</td>
<td>197,380.7</td>
<td>-0.730</td>
</tr>
<tr>
<td>2010</td>
<td>44.23</td>
<td>39.46</td>
<td>-4.76</td>
<td>192,848.5</td>
<td>-0.812</td>
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<tr>
<td>2011</td>
<td>45.18</td>
<td>31.96</td>
<td>-13.22</td>
<td>187,438.1</td>
<td>-2.190</td>
</tr>
<tr>
<td>2012</td>
<td>46.15</td>
<td>28.83</td>
<td>-17.32</td>
<td>184,892.2</td>
<td>-2.829</td>
</tr>
<tr>
<td>2013</td>
<td>47.14</td>
<td>39.61</td>
<td>-7.53</td>
<td>173,965.5</td>
<td>-1.158</td>
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<tr>
<td>2014</td>
<td>48.16</td>
<td>33.78</td>
<td>-14.37</td>
<td>168,160.4</td>
<td>-2.135</td>
</tr>
<tr>
<td>2015</td>
<td>49.19</td>
<td>39.60</td>
<td>-9.59</td>
<td>173,369.7</td>
<td>-1.469</td>
</tr>
<tr>
<td>Total</td>
<td>46.09</td>
<td>36.06</td>
<td>-10.03</td>
<td></td>
<td>-11.322</td>
</tr>
</tbody>
</table>
Reverse Gear
Strained P&L: pensioner plant & reduced health care spending

Sequence (reverse gear)
1. Missing money compounds
2. Maintenance cutbacks
Exit: average warning period: 5.2 months

<table>
<thead>
<tr>
<th>Coal Plant</th>
<th>Capacity (MW)</th>
<th>NEM Region</th>
<th>Exit (Year)</th>
<th>Enter (Year)</th>
<th>Age at Exit (Years)</th>
<th>Warning (Months)</th>
<th>Notice Date</th>
<th>Closure Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swanbank B</td>
<td>500</td>
<td>Qld</td>
<td>2012</td>
<td>1972</td>
<td>40</td>
<td>23.6</td>
<td>26-Mar-10</td>
<td>27-Mar-12</td>
</tr>
<tr>
<td>Playford*#</td>
<td>240</td>
<td>SA</td>
<td>2012</td>
<td>1960</td>
<td>52</td>
<td>6.9</td>
<td>7-Oct-15</td>
<td>8-May-16</td>
</tr>
<tr>
<td>Collinsville</td>
<td>180</td>
<td>Qld</td>
<td>2013</td>
<td>1972</td>
<td>41</td>
<td>5.9</td>
<td>1-Jun-12</td>
<td>1-Dec-12</td>
</tr>
<tr>
<td>Munmorah~</td>
<td>600</td>
<td>NSW</td>
<td>2013</td>
<td>1969</td>
<td>44</td>
<td>0.0</td>
<td>3-Jul-12</td>
<td>3-Jul-12</td>
</tr>
<tr>
<td>Morwell</td>
<td>195</td>
<td>Vic</td>
<td>2014</td>
<td>1958</td>
<td>56</td>
<td>1.0</td>
<td>29-Jul-14</td>
<td>30-Aug-14</td>
</tr>
<tr>
<td>Wallerawang~</td>
<td>1000</td>
<td>NSW</td>
<td>2014</td>
<td>1978</td>
<td>36</td>
<td>0.0</td>
<td>1-Nov-14</td>
<td>1-Nov-14</td>
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<tr>
<td>Redbank</td>
<td>151</td>
<td>NSW</td>
<td>2015</td>
<td>2001</td>
<td>14</td>
<td>0.0</td>
<td>31-Oct-14</td>
<td>31-Oct-14</td>
</tr>
<tr>
<td>Anglesea</td>
<td>150</td>
<td>Vic</td>
<td>2016</td>
<td>1969</td>
<td>47</td>
<td>3.6</td>
<td>12-May-15</td>
<td>31-Aug-15</td>
</tr>
<tr>
<td>Northern#</td>
<td>540</td>
<td>SA</td>
<td>2016</td>
<td>1985</td>
<td>31</td>
<td>6.9</td>
<td>7-Oct-15</td>
<td>8-May-16</td>
</tr>
<tr>
<td>Hazelwood</td>
<td>1600</td>
<td>Vic</td>
<td>2017</td>
<td>1967</td>
<td>50</td>
<td>4.8</td>
<td>3-Nov-16</td>
<td>1-Apr-17</td>
</tr>
<tr>
<td><strong>Total / Average</strong></td>
<td><strong>5156</strong></td>
<td></td>
<td></td>
<td><strong>1972</strong></td>
<td><strong>42.5</strong></td>
<td><strong>5.2</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Mothballed in 2012

# Original notice 11 June 2015 with planned closure date of March 2018

~ Mothballed, Notice was therefore immediate

Sequence (reverse gear)
1. Missing money compounds
2. Maintenance cutbacks
3. Sudden coincident coal plant exits
Final gas demand triples

Sequence (reverse gear)
1. Missing money compounds
2. Maintenance cutbacks
3. Sudden coincident coal plant exits
4. Just as LNG exports commence
LNG fleet was overbuilt: short gas

Sequence (reverse gear)
1. Missing money compounds
2. Maintenance cutbacks
3. Sudden coincident coal plant exits
4. Just as LNG exports commence
5. Creating gas shortages
Gas prices increased sharply

Sequence (reverse gear)
1. Missing money compounds
2. Maintenance cutbacks
3. Sudden coincident coal plant exits
4. Just as LNG exports commence
5. Creating gas shortages
6. Causing a gas price shock
In slow motion...

Sequence (reverse gear)
1. Missing money compounds
2. Maintenance cutbacks
3. Sudden coincident coal plant exits
4. Just as LNG exports commence
5. Creating gas shortages
6. Causing a gas price shock
Contraction in gas generation

Sequence (reverse gear)
1. Missing money compounds
2. Maintenance cutbacks
3. Sudden coincident coal plant exits
4. Just as LNG exports commence
5. Creating gas shortages
6. Causing a gas price shock
7. Gas generators reduce output
   (had pre-sold fuel at #1)
Renewable entry lags (policy uncertainty)

Sequence (reverse gear)
1. Missing money compounds
2. Maintenance cutbacks
3. Sudden coincident coal plant exits
4. Just as LNG exports commence
5. Creating gas shortages
6. Causing a gas price shock
7. Gas generators reduce output (had pre-sold fuel at #1)
8. Policy uncertainty (at #1) delayed RE entry
Coal exit + gas contraction + RE entry lags = high spot prices

Sequence (reverse gear)

1. Missing money compounds
2. Maintenance cutbacks
3. Sudden coincident coal plant exits
4. Just as LNG exports commence
5. Creating gas shortages
6. Causing a gas price shock
7. Gas generators reduce output (had pre-sold fuel at #1)
8. Policy uncertainty (at #1) delayed RE entry
9. Coal exit, gas shortages & RE entry lags cause spot prices to surge
With coincident LGC prices rise (so much for equilibrium theory)

Sequence (reverse gear)
1. Missing money compounds
2. Maintenance cutbacks
3. Sudden coincident coal plant exits
4. Just as LNG exports commence
5. Creating gas shortages
6. Causing a gas price shock
7. Gas generators reduce output (had pre-sold fuel at #1)
8. Policy uncertainty (at #1) delayed RE entry
9. Exit, gas shortages and RE entry lags cause spot prices to surge
10. RE entry lags causes coincident RE Certificate price surge
Supply responded and so prices will fall…
Conclusion

- The NEM’s wholesale market was the centrepiece of the energy industry reforms of the 1990s.
- Has delivered consistent economic and technical performance for two decades
- Problems that emerged:
  - Disconnect between energy policy and climate change policy
  - Excess (i.e. uncoordinated) coal plant exit with little warning
  - Excess LNG plant entry
  - VRE entry lags (i.e. policy reviews)
Conclusion

- How could this have been averted with the benefit of hindsight?
  1. Transparency around plant exit, and a policy mechanism to manage the pace of specific plant closures if market failure is predictable (vis-à-vis entry lags)
  2. Closer link between energy policy and climate change policy
  3. Link LNG capacity approvals to export 2P reserves
  4. Substantial revision of regulation, 6 second, 60 second and 5 minute FCAS volumes (increase & localise vs minimise and global)

Available at https://www.eprg.group.cam.ac.uk/