Possible Australian Energy Futures – legacy, technology, market and policy drivers

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Energy - past

Australian electricity generation
(Australian Energy Update, 2016)

Macro Australian energy indicators
(Australian Energy Update, 2017)

Australian primary energy consumption by fuel and consumption sector
(Australian Energy Update, 2017)
Past to present

“Many of us who keenly observe the energy sector can take a pretty good guess at what our next big challenges are” Senior Australia Federal Minister, 2014

- Some Federal Government White paper predictions
  - **2004**: missed Coal Seam Gas takeoff, East Coast LNG export, falling demand, lower costs & growing uptake of wind
  - **2012**: missed East Coast LNG market impacts, falling demand, growing residential PV uptake
  - **2015**: missed climate change, wholesale price rises, success of wind and utility PV, growing security challenges

- Highlighting need for a becoming modesty about our ability to predict, let alone manage future challenges
Energy - present

- Significant ‘inertia’ but some emerging trends

Key Australian energy statistics and indicators
(Australian Energy Statistics Update 2017)
Particularly in electricity

Australia's electricity generation mix 2006 - 2017
(Australian Energy Statistics Update 2017)

Electricity demand forecasts by AEMO and actual consumption 2000 – 2015
(BZE Renewable Energy Superpower, 2012)

Generation Entry and Exit in the NEM
(AEMC/CCA, Towards the next generation, 2017)
..with surprises

- World leading residential PV penetration
- South Australia a world leading jurisdiction for integrating high variable renewables penetrations

South Australia’s generation mix, RE penetration
(IEEFA, Power industry transition, 2018)

Australia’s residential PV penetration
(Finkel Review into NEM Security, 2017)
..including high wholesale & retail prices, and emissions, & some security concerns

Australian NEM wholesale prices
(AER Status of the NEM Report, 2017)

Electricity emissions intensity comparison
(shrink that footprint)

Australian residential energy prices index
(Australian Energy Statistics Update 2017)
Other possible reasons
Energy futures – committed, expected

Committed, likely renewables build, pipeline
(Green Energy Markets REI and Clean Energy Regulator)

AEMO ‘central’ demand forecast to 2036
(Electricity Forecast Insights, 2017)

Australian generation mix projections
Present policy settings


APEC relevant policy objectives (APERC Sixth Outlook)

Table 1.3 • Summary of major energy policy drivers by APEC economy

| Australia | Increase energy productivity by 40% between 2015 and 2030; renewables target of 33 TWh by 2020. |

Australian State Government renewables and ‘aspirational’ emission reduction targets (Climate Council, 2017)

- WA: 23.5% renewable energy by 2020 (33,000GWh of large-scale renewable energy) 50% renewable energy by 2030 No net zero emissions target
- NSW: No renewable energy target No net zero emissions target
- NT: 7% renewable energy by 2020 50% renewable energy by 2030 Net zero emissions by 2050
- QLD: 7% renewable energy by 2020 50% renewable energy by 2030 Net zero emissions by 2050
- SA: 47% renewable energy by 2020 50% renewable energy by 2025 Net zero emissions by 2050
- VIC: 17% renewable energy by 2020 40% renewable energy by 2025 Net zero emissions by 2050
- ACT: 22% renewable energy by 2020 100% renewable energy by 2020 Net zero emissions by 2050
- TAS: 92% renewable energy by 2020 100% renewable energy by 2022 Net zero emissions by 2050

LEGEND
- Shaded regions show the percentage of renewable energy currently.
National Energy Productivity Plan (NEPP)

Improving Australia's energy productivity means more value from the energy we consume.

40% IMPROVEMENT BY 2030

Figure 7: Australian trend energy productivity and the 40 per cent NEPP target, $million/PJ, 1999–00 to 2029–30

- Boosting competitiveness and growth
- Helping families and business manage their energy costs
- Reducing greenhouse gas emissions

Encouraging smarter choices through
- efficient incentives
- empowering consumers
- helping business compete

Promoting better energy services through
- innovation support
- competitive modern markets
- consumer protections
Australia’s largest utility estimates of current generation costs, including firming for wind & PV
(AGL presentation, 2017)

AEMO generation cost scenarios
(Integrated System Plan datasets, 2018)

AEMO battery system uptake scenarios
(Integrated System Plan datasets, 2018)

AEMO EV uptake scenarios
(Integrated System Plan datasets, 2018)
Longer-term scenarios

Wide, growing range that can choose from

Figure 9: Preliminary projections of NEM generation capacity (left) and generation output (right), Neutral scenario

Figure 5: Proposed NEM emissions reduction trajectories to be examined in ISP scenarios

(AEMO Integrated System Plan, 2018)
Scenario space is broadening

(AEMO Integrated System Plan, 2018)
New scenario approaches

Some scenarios for Australia’s energy future, …and their risks
*(CSIRO Low Emission Technology Roadmap, 2017)*

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<td><strong>Buildings, industry and transport</strong></td>
<td><strong>Ambitious energy productivity improvements</strong></td>
<td><strong>Business as usual energy productivity improvements</strong></td>
<td><strong>Ambitious energy productivity improvements</strong></td>
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<td><strong>New build electricity generation</strong></td>
<td><strong>Existing low emissions technologies: wind, solar PV (45% limit) plus gas</strong></td>
<td><strong>Cheap, mature, low emissions generation: mainly wind and solar PV plus enabling technologies e.g. batteries, pumped hydro</strong></td>
<td><strong>All low emissions technologies allowed, with no limit on wind and solar PV</strong></td>
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<td><strong>Fugitive emissions</strong></td>
<td><strong>Uptake of cost-effective technologies</strong></td>
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**Pathways**

1. **Pathway 1: Energy productivity plus**
   - **Technology:** Technology needs development to overcome technical challenges or to bring down costs
   - **Commercial:** Technology not commercially mature in Aus, hence costs not well understood
   - **Market:** Revenue generated over the lifetime of the asset is uncertain

2. **Pathway 2: Variable renewable energy (VRE)**
   - **Technology:** Technological challenge to transform the electricity grid to support VRE at high share with acceptable security and reliability, with uncertain cost of transformation
   - **Social licence:** High reliance on expansion of domestic gas for electricity generation
   - **Stakeholder coordination risk:** Relies on behaviour change by millions of energy users

3. **Pathway 3: Dispatchable power**
   - **Technology:** Market risk with large, long lead time projects given uncertain demand
   - **Social licence:** Social licence risk with new build coal, CCS, nuclear and with expansion of domestic gas for electricity generation
   - **Stakeholder coordination risk:** Transformation of the grid to support high share of VRE requires overcoming regulatory and cultural challenges

4. **Pathway 4: Unconstrained**
   - **Technology:** As per P2
   - **Social licence:** Social licence risk with gas and CCS
   - **Stakeholder coordination risk:** Investor coordination typically required for large capital projects

**Timeframe in which risk becomes significant**
- **Before 2020**
- **2020–2030**
- **After 2030**
Summary – Australia’s energy sector

- **Past – trend is destiny**
  - Projections have largely proved reasonable for domestic energy supply and demand - high infrastructure ‘inertia’ but also ‘settings’
  - However, past decade suggests significant future change and increasing inadequacies of projections and ‘expert’ predictions

- **Present – new players, high uncertainties**
  - Demand growth uncertainties – user energy efficiency, price response
  - Renewables deployment; both consumer driven distributed, utility scale
  - Old coal plant exit with no future build, yet Q of gas competitiveness

- **Future – challenges, options & possible outcomes broadening**
  - Renewables appear increasingly competitive, regardless of policy but raising growing integration challenges
  - Demand likely to depend on industry, building, transport electrification
  - Energy efficiency options still improving but remains the ‘hard’ win win
Thank you… and questions

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