Energy Markets of the Future

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Important factors in future energy markets

• High and increasing dependence of society and commerce on energy
  – *Valued at $30 000- $60 000/MWh*
  – *Compared to cost at retail level of < $400/MWh*
  – *Thus reliability and security of supply are key issues*

• Value ascribed to energy leads to a demand (rather than supply) focus for energy usage (capacity cf consumption)

• Indigenous resources can set a price cap for imported resources and for local consumption of indigenous resources, a key factor

• Current investments (in both supply and usage) set a need for a consistent framework for strategic, long-term investments

• Only about 15-25% of retail energy costs are supply and production costs – the majority are ‘distribution’ or taxation costs
Energy In Australia

- Largest type of final energy use is oil, of which over 90% is imported
  - *Future market structures need to deal with this dependence*
- High level of self-sufficiency in other forms of energy source – coal, gas, nuclear, renewables
  - *Future market structures need to build on this strength*
- Electricity, while currently only a moderate component of energy use, is becoming increasingly important in the Australian services economy
  - *Future market structures need to recognise this and the consequent market dependence on reliability and security of supply*
Common parameters in the various markets

<table>
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<tr>
<th>Energy Type</th>
<th>Production</th>
<th>Transport</th>
<th>Seller/buyer structure</th>
<th>Operating/Price context</th>
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<td>Electricity</td>
<td>Competitive</td>
<td>Regulated – capacity and energy components</td>
<td>Spot trading market/tariff</td>
<td>National</td>
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<td>Oil</td>
<td>Competitive</td>
<td>Competitive</td>
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<td>Gas</td>
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<td>Renewables</td>
<td>Limited competition</td>
<td>Regulated</td>
<td>Contracts</td>
<td>National</td>
</tr>
</tbody>
</table>

**Note:** There are many variations in these parameters across Australian markets, and the above are typical of the major market.
Some important issues in energy markets

Annual gas demand projections, by market (export versus domestic)

- LNG
- Total Domestic

Electricity

Annual energy consumption (GWh)

- Residential and commercial consumption per capita (kWh)

Oil Production and Imports

- Import
- Production

Gas → Electricity → Market

Oil → Transport

Production → Bulk transport → Market

Exchange
Consequences

• With gas and oil now predominantly global markets, price and market rules are set to a major extent by the global nature of the business
  — *In these sectors, for Australia, capacity security is really price security*

• The electricity market has become the only major Australian energy market subject to predominantly local regulation and local market conditions

• Gas is now moving to a position where it is too valuable (costly) to use in electricity generation (and maybe as a transition fuel for transport?)
  — *This has consequences for the capacity of the electricity grid to support many forms of renewable energy/electricity, and for the grid to service potential new demands*

• Stagnation of electricity demand means that few new generation sources will be required for many years, creating a difficult investment environment for new generation

• Changes in the energy ‘source’ mix for electricity have altered the nature of the grid and the market
A Short History of the Electricity Market

- **NEM designed over 20 years ago, based on system assumptions of the time**
  - Large generation sources
  - Stored energy structure (dynamic and static) of generation
  - Gross energy market (marginal cost basis for allocation of production, network constraints, mandatory reliability standards)
  - ‘Forecastable’ demands and production presented to market
  - High inertia systems
  - Transmission/distribution networks as regulated monopolies
  - Market driven investment
  - Retail tariffs regulated
  - Simplified system representation (IT limits?)

- **The NEM of today**
  - Rapid increase of smaller generation sources
  - Significant proportion of non-stored energy participants
  - Trend towards a nett energy market (sell/buy settlements outside of the market)
  - ‘Stochastic’ demands and production presented to market
  - Lower inertia systems
  - Regulatory driven investment (eg RET)
  - Retail tariffs regulation reduced (at least in cost, less so in structure)
  - More complex representation of the system and costs possible (IT advances)
Impact on Networks and Market Outcomes

• **Role of network is changing**
  – From supply of energy (in a reliable manner) to supply of reliability (and energy if required)
  – From energy distribution (flow one-way) to energy exchange (flow multiple ways)

• **Market has to change to ensure rewards relate to service provided**
  – TUOS and DUOS will need to align more with service (reliability) standards rather than mathematical constructs related to energy and capacity transfers
  – Marginal loss factors will need to be related to exchange-type power flows rather than distribution power flows
  – Tariffing will need to be aligned with service costs for reliability provision and costs relating to quantum of energy delivery
  – Use of capacity/wheeling charges will need to be available to users who have specific point-to-point needs eg power generators not located near existing grids or loads

• **Regulation**
  – Service reliability standards will need to be defined on a consistent basis throughout the market
  – Value of unserved/lost energy will need to be evaluated on a time dependent basis (that is, on a value basis rather than a cost basis) consistent with time of use tariffing and smart meter application rather than on an average basis
Impact on Generation (energy production)

• The parameters of the generation fleet are changing
  – Market signals to investors are being distorted by significant moves away from a gross market to a (often commercial in confidence) bilateral contract market driven by renewable energy investments
  – Inertia reductions are changing transient and dynamic responses on the system, and the impact of faults
  – Increased levels of generation without storage capacity is changing (increasing) needs for frequency, voltage and stability support
  – Load and generation requirement forecasting has become increasingly volatile as a consequence of diversifying and expanding factors determining load and generation capacity on shorter time scales, exacerbated by less stored energy in the system

• Market has to change to ensure costs are allocated to relevant participants rather than being spread to defined participants
  – Many auxiliary service costs are allocated to specific participant classes (eg to providers or consumers), rather than to those participants who are the drivers of the requirements
  – Reliability standards need to reflect and allocate the costs of unreliability/unavailability of energy producers and capacity providers to the differing class of participants
Impact on Consumers

• **Reliability issues will become an increasing focus of consumer behaviour**
  – Demand management (both active and passive) will assume increasing importance (especially for residential and commercial customers), vis-à-vis energy efficiency
  – *Note the impact on demand forecasting!*

• **Technology options will increasingly involve consumers as active players in the market**
  – eg rooftop solar systems, tri-generation, etc

• **Transformation of energy sourcing to different energy forms will change demand profiles and energy mix**
  – eg electric vehicles, heating and cooling, hybrid systems
The Electricity Market of the Future

• **Focus on reliability and availability rather than simply energy**
  – Major rethink of network costing and allocations
  – Valuing responsive capability and availability for generation
  – Evolution of consistent reliability standards

• **The evolution of capacity markets**
  – Rewarding of availability and responsiveness

• **The evolution of a nett market**
  – Increased focus of consumers on reliability and certainty (high value of electricity) will increase the number of (long term) contract positions
  – Separates conceptually the *System* (role to ensure reliability of supply) from the *Market* (role to settle buyer/seller transactions)

• **Better allocation of costs to ‘causers’ rather than ‘users’**
  – Ensure that impact on systems and markets is aligned with participants’ contributions to these impacts
What is needed?

- Determination
- A clean sheet of paper
- A strategy for change
- A transition plan

Questions?