Electricity market products and risk management in the NEM

Presented by
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Manager, Market Insights
Outline of this presentation

• Introduction to AEMO
• Brief overview of the spot market
• Generation business overview
• Retail business overview
• Risk mitigation
About AEMO

- AEMO is a member-based, not-for-profit organisation.
- We are the independent energy market and system operator and system planner for the National Electricity Market (NEM) and the WA Wholesale Electricity Market (WEM).
- We also operate retail and wholesale gas markets across south-eastern Australia and Victoria’s gas pipeline grid.

AEMO Services is an independent subsidiary of AEMO, established in 2021 to enable the transparent provision of advisory and energy services to National Electricity Market jurisdictions.
AEMO does not own or operate equipment nor retail electricity

Network asset owners and operators per region

- **TNSP**: Transmission Network Service Provider
  - ElectraNet
  - Powerlink
  - TransGrid

- **DNSP**: Distribution Network Service Provider
  - SA Power Networks
  - Ergon Energy, EnergyEx (Energy QLD)
  - Ausgrid, Endeavour Energy, Essential Energy, Evo Energy
  - AusNet Services Distribution, GitiPower, Jemena, Powercor, United Energy

- **TNSP and DNSP**: TasNetworks

Market participants own and operate generation equipment

- **TNSP**: TransGrid
  - Mortlake Power Station

- **DNSP**: Ergon Energy, EnergyEx (Energy QLD)
  - Nyngan solar farm

Market participants retail electricity to end consumers. Some market customers purchase directly from the wholesale market.

End use consumers are increasingly installing distributed energy resources (such as rooftop solar)
NEM dispatch and pricing model

• **40,000 km** transmission lines
• About **204 TWh** supplied each year
• **$11.5 billion** traded in FY2020-21
• About **10.7 million** customers
• Total generation **65.3 GW**
• Regional prices apply at each Regional Reference Node (RRN)
• Losses between regions calculated dynamically based on dispatched interconnector flow
• All prices within a region related to RRN by fixed (annual) Marginal Loss Factor (MLF)
Bidding, dispatch and pricing in the wholesale electricity market
How is the price formed?

- All these bids are dispatched
- Everyone is paid at the market price

<table>
<thead>
<tr>
<th>Station</th>
<th>Bids</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Solar Panel]</td>
<td>• 50 MW at -$10</td>
</tr>
<tr>
<td>![Coal Power Plant]</td>
<td>• 100 MW at -$10, 20 MW at $30, 30 MW at $50, 10 MW at $60</td>
</tr>
<tr>
<td>![Battery]</td>
<td>• 20 MW at -$10, 20 MW at $40, 30 MW at $70, 10 MW at $80</td>
</tr>
</tbody>
</table>

Graph:
- Power (MW) on the x-axis
- Market price on the y-axis
- Reserve: Available but not in use
- Demand
NEM pricing settings

Limits on allowable prices:
- Market price cap: $15,500/MWh
- Market price floor: -$1,000/MWh
  - Note that NEM frequency markets have a price floor of $0/MWh

Exceptional circumstances:
- In rare cases, AEMO can apply *intervention pricing*:
  - AEMO does an additional run of the NEM dispatch engine, so that it can determine what prices would have been without market intervention
  - When AEMO uses its reliability and emergency reserve trader (RERT) function, it often invokes intervention pricing
- If the cumulative price threshold (CPT: $1,398,100) is exceeded over a 7 day period, AEMO applies the administered price cap (APC: $300/MWh)*

*In June 2022, the cumulative price threshold was reached, and the administered price cap was applied. For further detail, see: nem-market-suspension-and-operational-challenges-in-june-2022*
Physical and financial flows in the market

Generator

Network Service Providers

End-Users

Retailers

Generators, Retailers, Traders

Risk

HV

LV

MW

MW

$C

$F

$S
Generation business overview
The generation function

• A generator generates electricity delivered to the notional pool of customers and retailers at a specific price.

• The revenue from selling electricity in the spot market fluctuates every 5 minutes.

• The role of a generator’s trading team is to:
  • Manage physical generation risk and load exposure using derivatives and generation
  • Maximise profitability within risk limits
  • Manage trade-off between reliability and risk.
Generation risk: defined

• Why do you need to hedge generation risk?
  • Increase net profitability for a given contract and plant position whilst minimising the risk of not achieving this

• Risks, trends, developments and changes
  • Fuel / supply risk
  • Plant risk, testing, maintenance, recall/start times
  • Network outages and constraints
  • Contracts and competitor behaviour
  • Government / Policy risks
    • Carbon
  • Environmental risks
    • Temperature, Wind, Rain, Bushfire
  • Capex and Opex risks
  • Demand and supply in electricity (FCAS and Energy), gas markets and international markets

Generation risk = physical plant risk
Generation risk: unplanned outage financial impacts

- Spot opportunity loss
- Spot and contract loss

Graph showing the impact of unplanned outages on plant capacity over time.
Retail business overview
The retail function

- A retail business sells electricity to customers at a fixed price
- The cost of purchasing electricity in the spot market fluctuates every 5 minutes
- The role of a Retailer’s trading team is to:
  - Manage fixed price exposure using derivatives, generation
  - Price customers according to their risk profile
  - Maximise profitability within risk limits
  - Manage trade-off between competition and risk
- The NEM supplies about 200,000,000 megawatt hours of electricity each year (an average household will use around 6 MWh per year), to approximately nine million customers
Retail risk: defined

• Why do you need to hedge retail risk?
  • To manage your costs of supplying electricity to customers

Questions retailers ask:
• How many customers do I have?
• What type of customer are they?
• How much load are they using and when?
• Would an extremely volatile day or extended period of poor cash flow outcomes on the whole sale side catastrophically affect cash flow?

Retailers generally can’t turn customer demand on/off if customer consumption changes
• Many risks: Forecasting customer load and unknown customer usage
• Manage through spot price - derivatives, weather hedges, customer curtailment
• Exceptions to this do exist, such as contracts with large C&I customers e.g. a smelter, which will provide the retailer with the options to ask their customer to reduce usage by a certain amount for a specific period time

Retail risk = load risk
Retail risk example: Customer Type

Hypothetical Gentailer customer type load

- C&I
- SME (Peak) e.g. small manufacturing plant
- SME (Off-Peak e.g. small bakery)
- Retail
Risks and mitigation
Trading terminology

• Contracts
  • Swap
  • Cap
  • OTC (Over the Counter)
  • Exchange traded (i.e. Futures Contract)

• Hedging
  • Short
  • Square
  • Long
Trading terminology: Swap contract

Simple Swap Contract (CFD)

- Buyer pays seller the difference between the strike price and the spot price.
- Seller pays buyer the difference between the strike price and the spot price.

Graph showing Spot Price ($/MWh) and Strike Price over time from 0:30 to 23:30.
Trading terminology: Cap contract

Simple Cap Contract (Option)

Generator pays buyer difference between strike price and spot price in exchange for a fixed premium.
Trading terminology: why hedge?

- High spot prices strongly correlated with high demand (hot summer days, cold winter evenings)
- Potential for retailer to incur massive pool costs in times of spot price volatility
- Example: 7 hours of high prices
Trading terminology: unhedged

Scenario: Unhedged

- Retailer did not hedge any of its customer load
- Average spot price for the day was $700/MWh
- Average revenue from customers is around $100/MWh
Trading terminology: short

Scenario: **Short**

- Retailer thought it hedged all its customer load, but was really 100MW short at the peak (equivalent to the demand of about 40,000 residential customers)
- Cost of Swap is $70/MWh.
- Result: Pool cost is $950k higher than it would have been had the retailer hedged fully
- Swaps and caps normally come in blocks, so you need to determine how much risk is appropriate?
Trading terminology: square

Scenario: “Square”

• Retailer perfectly hedges its customer load and does not incur any unbudgeted pool costs.

• Wholesale purchase costs would then simply be the sum of its swap and cap costs.
Trading terminology: long

- **Scenario: Long**
- Retailer was over-hedged during the high prices and received payments on its contracts that more than offset its pool costs.
- Example: If retailer was 100MW long over the peak at an average price of $1,200 they would receive $1.8m (over 15 hours).
- This is generally an unlikely outcome for a pure retailer, as they won't own generation assets to run. This is an operational advantage of a Gentailer.
Electricity derivatives: Forward vs Futures, OTC vs Exchange traded

<table>
<thead>
<tr>
<th></th>
<th>OTC</th>
<th>Exchange Traded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customisation of terms</td>
<td>High</td>
<td>None</td>
</tr>
<tr>
<td>Liquidity</td>
<td>Less liquid</td>
<td>More liquid</td>
</tr>
<tr>
<td>Counter Party</td>
<td>Riskier - credit etc</td>
<td>Minimal risk - the exchange acts as a clearing house</td>
</tr>
<tr>
<td>Settlement</td>
<td>Delivery</td>
<td>Financially closed out</td>
</tr>
<tr>
<td>Margin</td>
<td>No margin system</td>
<td>Required</td>
</tr>
<tr>
<td>Mark to Market</td>
<td>Not Marked to Market</td>
<td>Marked to Market on at least a daily basis</td>
</tr>
</tbody>
</table>

ASX Futures price volatility

- Futures exchanged traded swaps and caps are liquid
- Can be very volatile
- Set the basis for retail prices
Electricity derivatives: Exotics and insurance

There are many other financial derivative products that participants and non-participants will use to either speculate on the volatility outcomes, or use these products to manage risk:

- Option contracts
- Asian options / average-price options
- Swaption
- Weather derivatives
- Plant insurance
Questions? and Where to find out more

Energy Explained
• Fact sheets
• Energy 101 series: complex topics in simple language

Initiatives
• Current major programs, and trials and initiatives, as well as our strategic partnerships and key industry submissions

Major Publications
• Integrated System Plan (ISP)
• Quarterly Energy Dynamics (QED)
• Renewable Integration Study (RIS)

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