How do you persuade an existing market to move to a new technology?

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September 2011

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The electricity industry is abound with new technology

- The green revolution has given rise to many new potential renewable options
- Conventional EPC contractors are responding with new and improved machines
- Previously by-passed technologies such as reciprocating engines are returning with better and larger configurations
- Smart grid options, including the potential for batteries, electric cars and other grid storage are changing the way grids can be configured
- New contractors are entering the market – from countries such as India and China

What are the barriers these new technologies face entering a market?

The barriers may depend on the technology in question…

	New Renewables	Chinese kit	Fast Flexible Power
Challenge	**From concept to commercial**	**No track record outside home country**	**New technologies that have complex benefits and costs**
Obstacles	Finding funding Need a market that values CO_2 reduction for economics to work Proving up small scale demonstration projects into commercially viable size Dealing with intermittency and uncertain delivery issues	Participation rules may unduly limit the field in competitive tenders Concern about reliability and quality of product Finding funding for unproven kit Understanding new markets and cultural barriers	Omitting new technologies in generation expansion planning processes Omitting generation or demand-side options when evaluating network support applications Using valuation methodologies that under-value optionality and flexibility

But often the real barrier is "I don't want to choose something unknown"

The barriers to “newness” may be expressed in many ways

- **Costs** – new technology may be more expensive than existing technology to build and more expensive to maintain due to different parts or lack of experienced staff
- **Reliability** – new technology may be less reliable due to lack of time to bed down a new system
- **Regulatory** – there may be no regulations that encourage the use of cleaner equipment, or the Grid Code may not accept the characteristics of a new kind of plant; licensing processes may struggle with a new option and sometimes even carbon abatement schemes take time to come up to speed on new developments
- **Transmission requirements** – new plant may need to be in a different location away from other plants (for example, wind and solar) where there are no grid connections meaning that new infrastructure is needed to cope with new technologies
- **Perceptions** – new technology may be neither more expensive nor less reliable nor harder to permit, but the lack of experience or prejudice may result in perceptions of these that are as much a barrier to entry as a real issue resulting in difficulties financing new plants. This builds from the human experience of resisting change.

Uncertainty and unknowns may be scary, but missing opportunities is worse

If buyers limit their purchasing decisions to the "usual suspects"
they risk missing out on first mover advantages with improved technology

But buying new technology is harder
– how do you decide which is best?

A more rigorous analytical framework can help

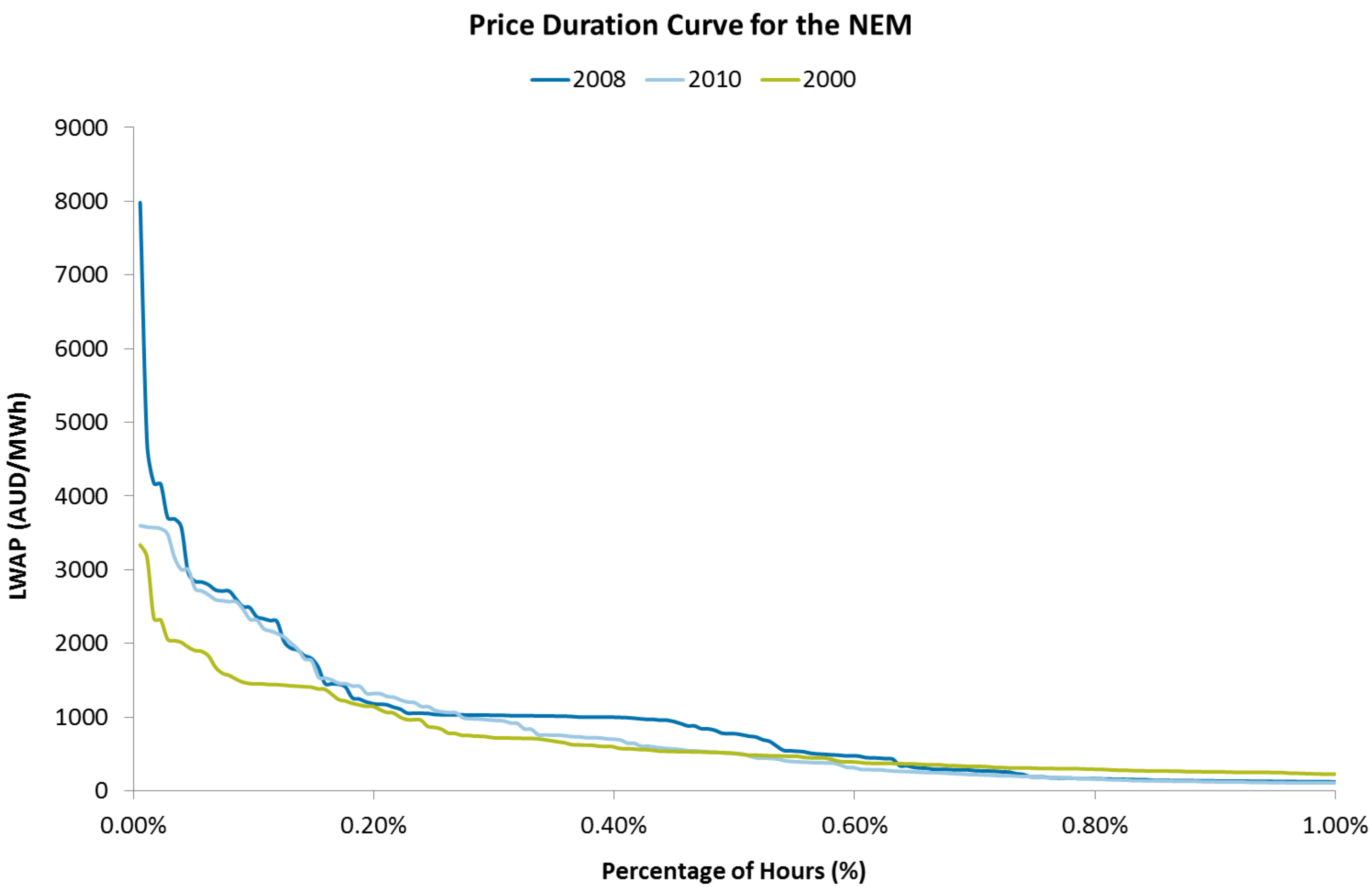
So what things do we need to think about in a “rigorous analytical framework”?

- Using the right data
- Understanding the market so you identify all the drivers
- Looking beyond the “average” figures
- Understanding how regulatory regimes impact on the outcomes
- Making sure your analytical framework captures the important attributes of your technology

We explore some of these issues in the following slides

Are we looking at the right data?

Example: Price Duration Curves in the Australian NEM

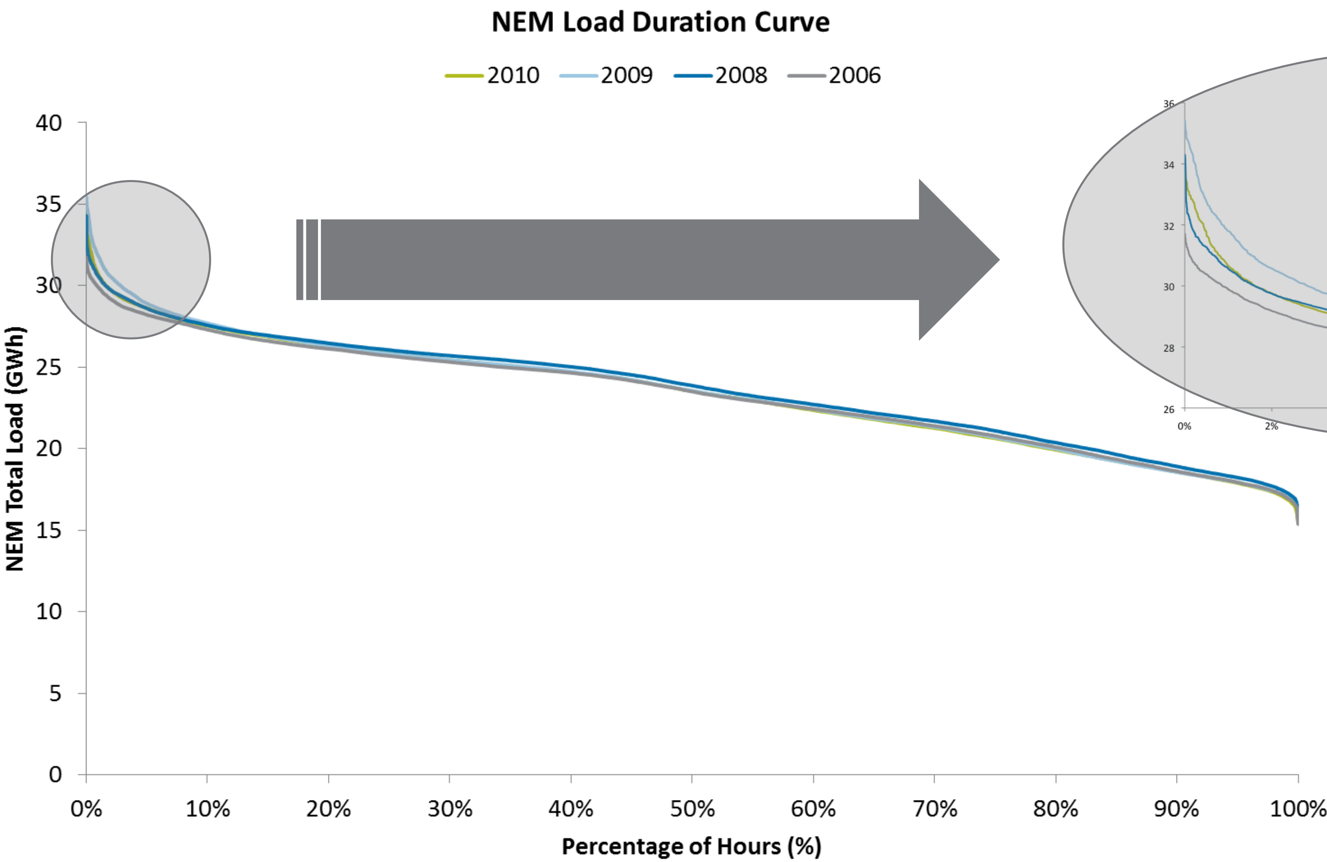


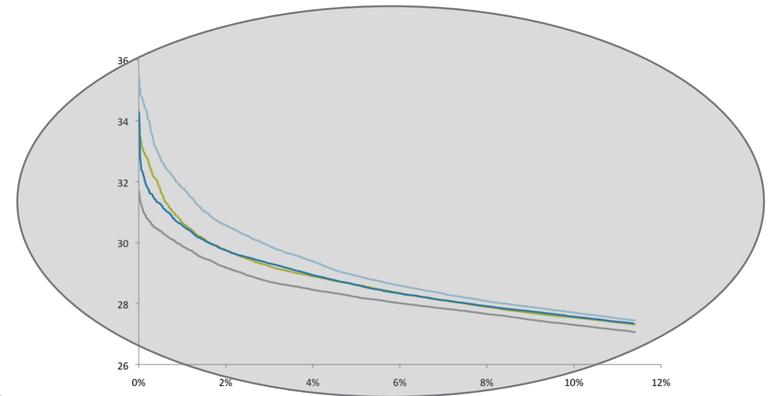
Extreme prices in one year can be significantly different from high prices in another year. Using an average price duration curve for modeling purposes to reflect a given year can thus be considerably inaccurate.

Which is the right data to pick?

If we had chosen a different year, we might be looking at quite a different outcome

Example: Demand curves in the Australian NEM





The top end of the demand curve drives most of the value but different years can be quite different due to recession, weather and other effects.   The start year for the analysis can drive significant effects if expanded over a long time horizon

No single point estimate in demand is going to be right to analyse a future long term solution because too many factors influence demand on a daily basis

Deep understanding of markets is necessary to do complex analysis

For example: What other drivers might have been making a difference in Australia?

How about WATER? We all recognise that in hydro systems, rainfall is a predictor of the output of hydro stations, but how many people spend time looking at rainfall in a predominantly thermal system?

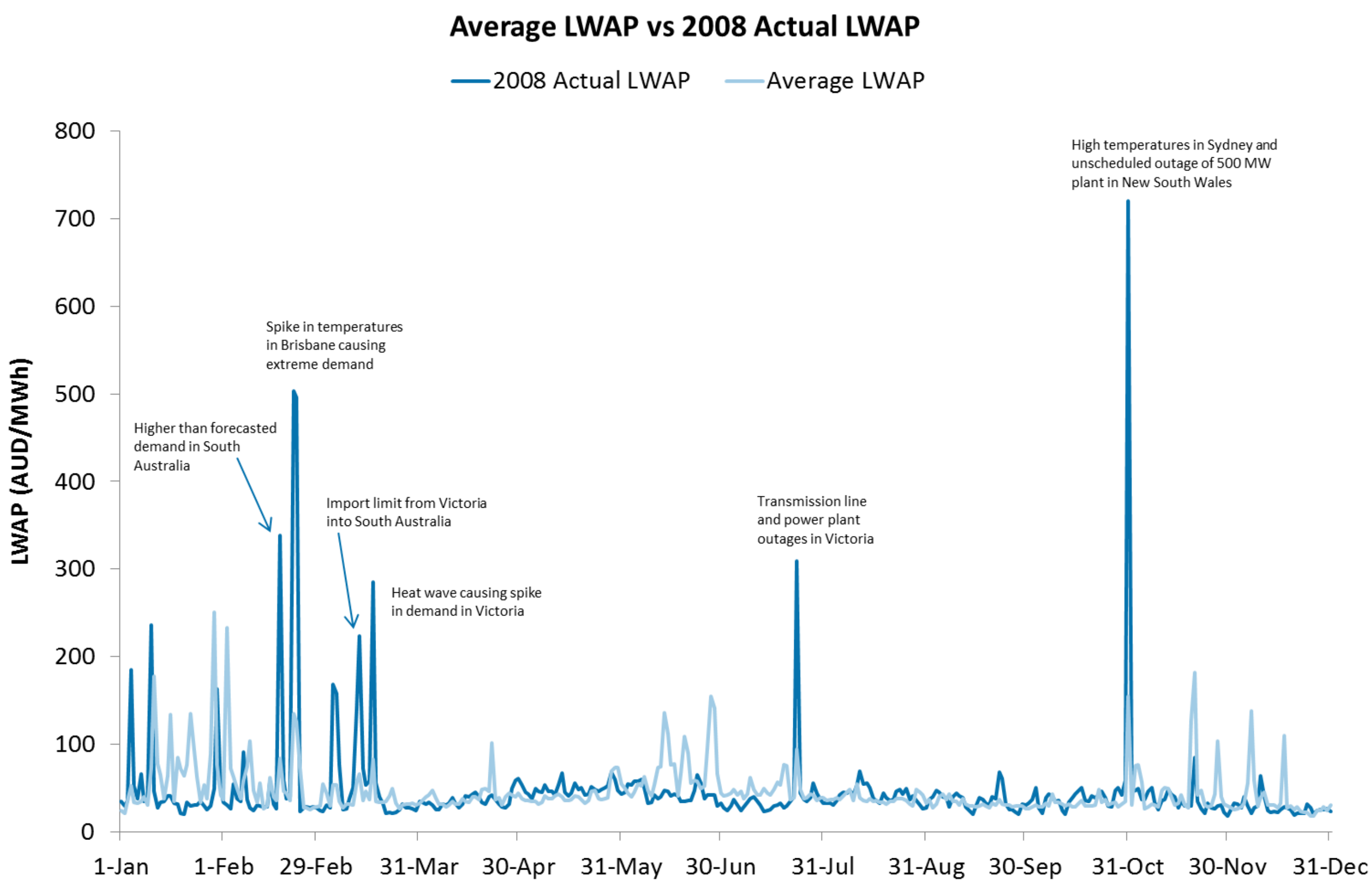
In March, 2007, two power stations in Queensland, Swanbank and Tarong, had to reduce power generation costing the Queensland government AUD$1 million per day and causing job losses in the coal mining sector.

By May 2007, Victorian power companies had to buy emergency supplies of water after the drought left them short of requirements to run major generators in the Latrobe Valley, which provides 85 per cent of Victoria's electricity.

Where outcomes are driven by volatile conditions, “average” representations do not capture all the value

- In our Australian example, just taking two key variables of demand and water have highlighted that some years are very different than others

- The value of a baseload technology needs to be evaluated in a way that ensures the different types of years are properly represented in any analysis:
  - If the basis of the analysis is a “good” year for baseload, then the overall valuation will be overly optimistic
  - If the basis of the analysis if a “poor” year then the overall valuation will underestimate the value



The regulatory characteristics of the target market become very important in such analysis

Wartsila had success using their fast, flexible plant for “wind-firming” to firm up the intermittency associated with wind farms in the USA – why do they struggle to achieve the same success in Australia, which also has a large number of wind-farms and acknowledged intermittency issues?

	Colorado	Australian NEM
Regulation	**Retailers in Colorado are traditional vertically integrated utilities, governed by rate of return regulations**	**The impacts of intermittency on the grid are managed through the operation of an ancillary services market**
Implications	Utilities do not buy electricity from the market, but rather have a portfolio of generation plants which together match the electricity demand The costs imposed on the system by intermittency are internal to the company, so an internal company solution which minimises the overall costs is appropriate	The National Electricity Market (NEM) in Australia separates the production of electricity from the retailing of electricity The costs of each service – including energy and ancillary services – are identified and priced separately Thus wind producers can operate as stand-alone entities and not need to balance their output The ancillary services market manages, and prices, the costs of this intermittency on a causer pays basis

Different markets tackle the same problem in different ways, which means the strategy to deploy a new technology to solve a problem may vary by market

Use the right framework to assess the technology in question

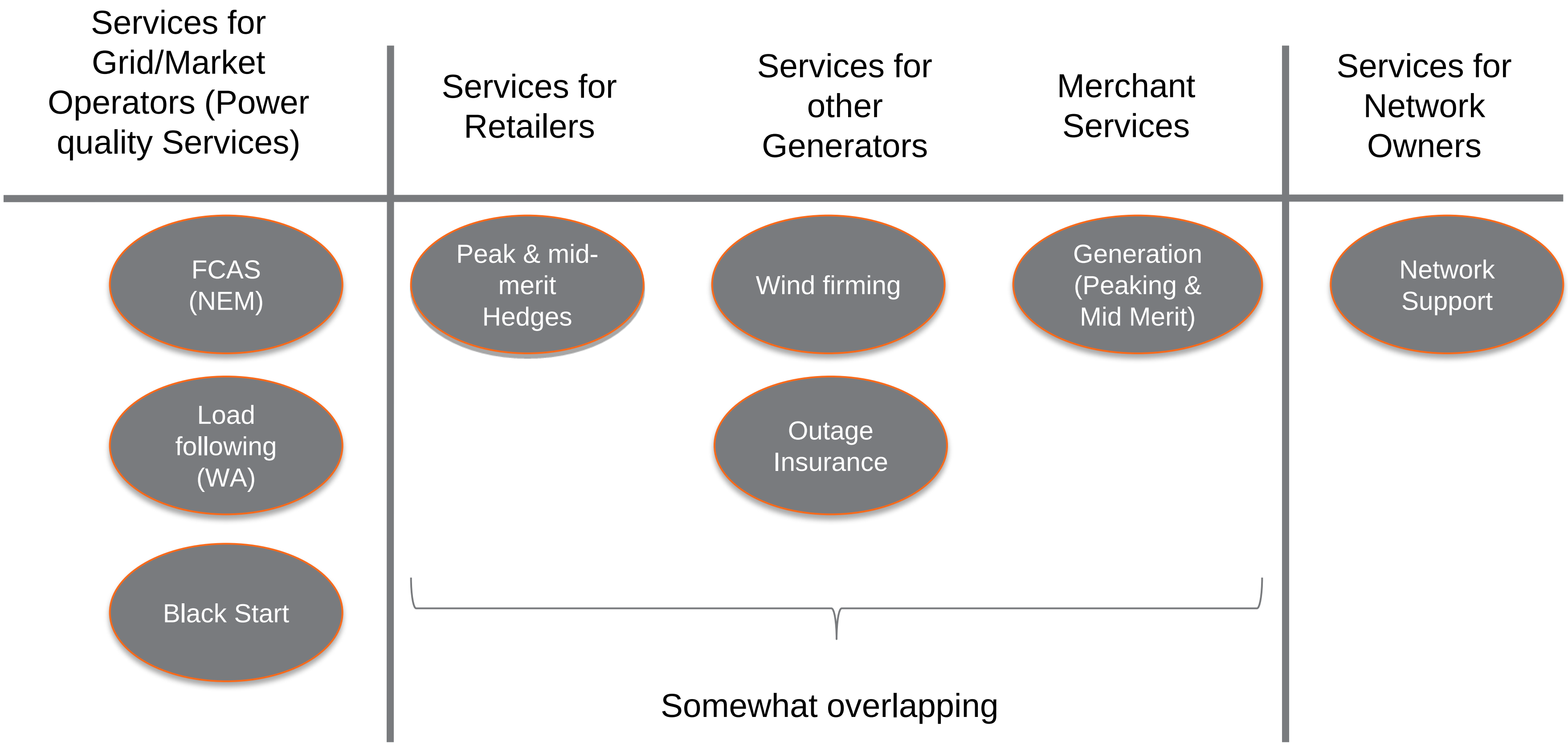
- As noted earlier, the value of a baseload technology needs to be evaluated in a way that ensures the different types of years are properly represented in any analysis
  - However, the variations within year may be less important if the plant is expected to be generating all the time and an “average” approach within-year has merit and reduces the complexity of analysis
  - For example, modelling spot markets using a load-duration curve “block” approach has merit for a baseload addition, as it focusses the analysis on the importance of new capacity entry over time and the shape of the demand curve which impacts on the price duration curve that the baseload option earns as a price taker
- However, some plant thrive on the differences themselves
  - Fast, flexible plant will be operating within the year – taking advantage of the things that an LDC approach “averages out”
  - For example – variable peaks; impacts of hydrology in different years; outages of other plant; entry of plant that drive up ancillary services requirements such as wind

Any analysis of the value of a new technology needs to dig more deeply into the benefits of that technology and look more closely at the target market to identify the sources of value and the probability of that value existing over the life of the plant

Case study: Bring it all together

- We have talked about some of the pitfalls of trying to enter a market with new technology
- So – how might we approach the problem?
- In a recent project, we reviewed the Australian market for Wartsila, who make reciprocating engines and are looking to expand from smaller, “off-grid” applications where they have a high market share into the “conventional” electricity market space
- These plant are:
  - Fast start – faster than a GT and can reach full load in less than 5 minutes
  - Flexible – modular nature means that plant can operate at different loadings with the same efficiency as baseload operation
  - Cost competitive with GT and CCGT alternatives (in the two different configurations)

We started by determining the list of Value Propositions that could be accessed by the technology



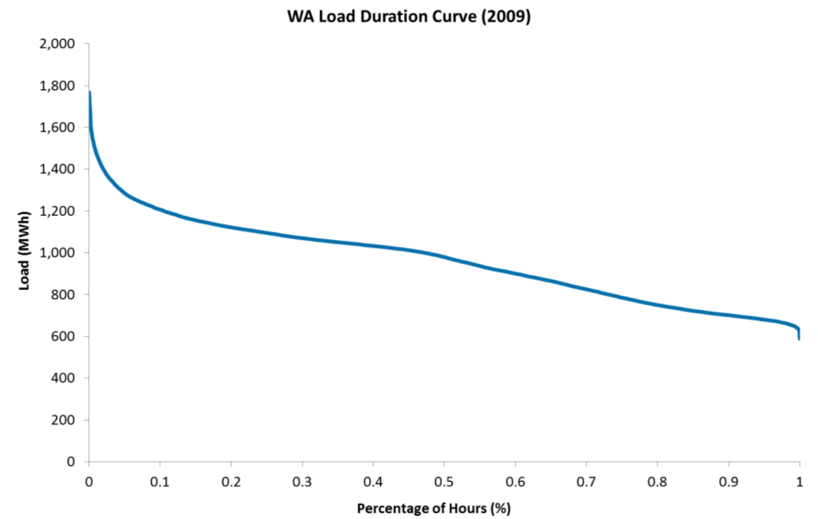
The next step is to identify the market size of each Value Proposition

This required us to review, in detail, each of the markets in Australia. The Western Australian market is one example

Electricity demand continues to grow

- The 2009 peak load demand reflected exceptionally high growth exceeding 8% which was, in part, driven by a single customer.
- However, excluding this customer, the system peak demand still grew at a substantial 4.2%. In comparison, the average 10 year historical growth rate has been 6.5% per annum.
- Given the number of emerging resource projects, in particular iron ore developments, high demand growth is expected to continue.
- Additionally, the annual demand profile shows an increasing tendency towards higher peaks for shorter durations.

Hot temperatures drive volatile summer peaks



The ESI is challenged by a changing energy landscape driven by

Ageing infrastructure	Customer expectations of high quality and reliability	The connection of small scale, intermittent renewable energy sources	Increasing price of energy driven by fuel constraints

Could "fast, flexible" plant be an answer for Western Australia?

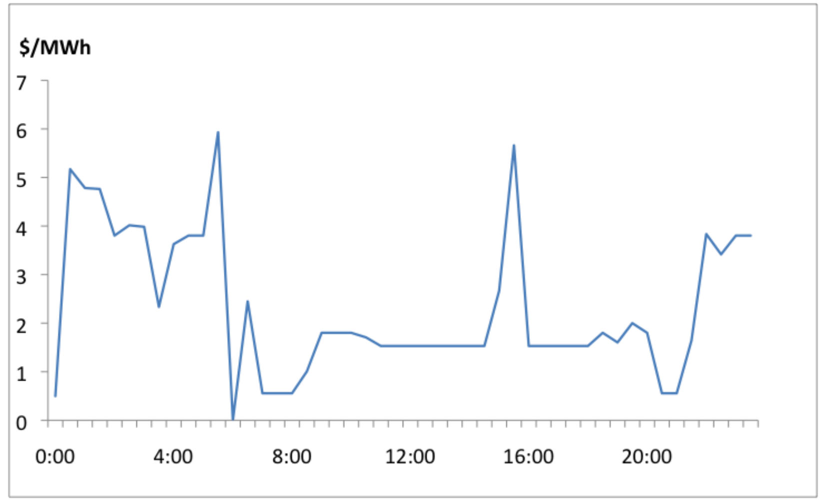
Source: Western Power Annual Planning Report

Market size of a Value Proposition: Contingency Reserve in Western Australia

Methodology

- Estimate the short-run marginal cost of meeting, say, a 5 min reserve requirement by half hour
- Calculate the total systems savings arising from the inclusion of reliable, fast response units – i.e. units that do not need to be 'spinning' to meet a 5 min reserve requirement
- Compare these savings to the capital costs and fixed O&M costs of fast response units
- Build fast response units if the system benefits exceed the capital and fixed O&M costs of those units.

Reserve Price – A typical day

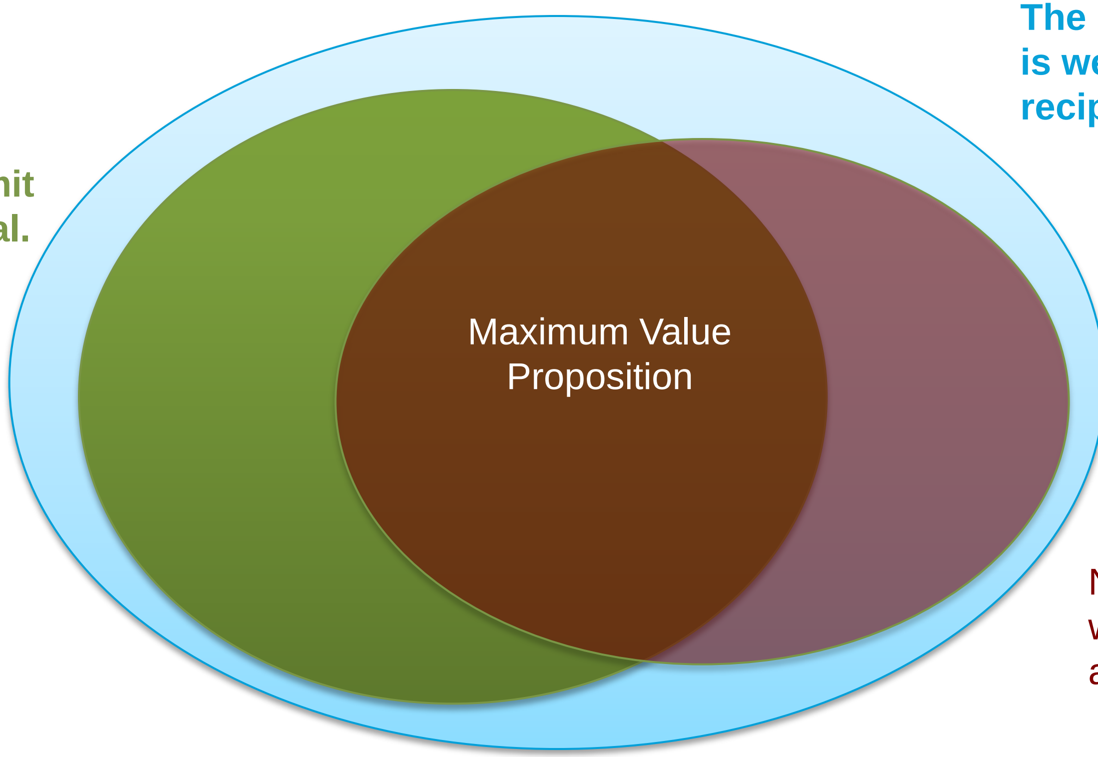


Some conclusions

- Our preliminary analysis suggests that there are sizeable system benefits that can be accessed by using fast response units to meet a contingency reserve requirement. These benefits compare favourably with the capital costs of those units
- Indications are that technology solutions exist that have low capital cost and that have the right operating characteristics to provide contingency reserve
- System benefits can only be accessed by these solutions if contingency reserve is priced and adequate contractual mechanisms are in place to allow investors to access those benefits

The Big Picture highlighted that Australia has a high degree of raw potential but various characteristics limit the size of opportunity available

The market designs and regulatory environment limit the raw potential.

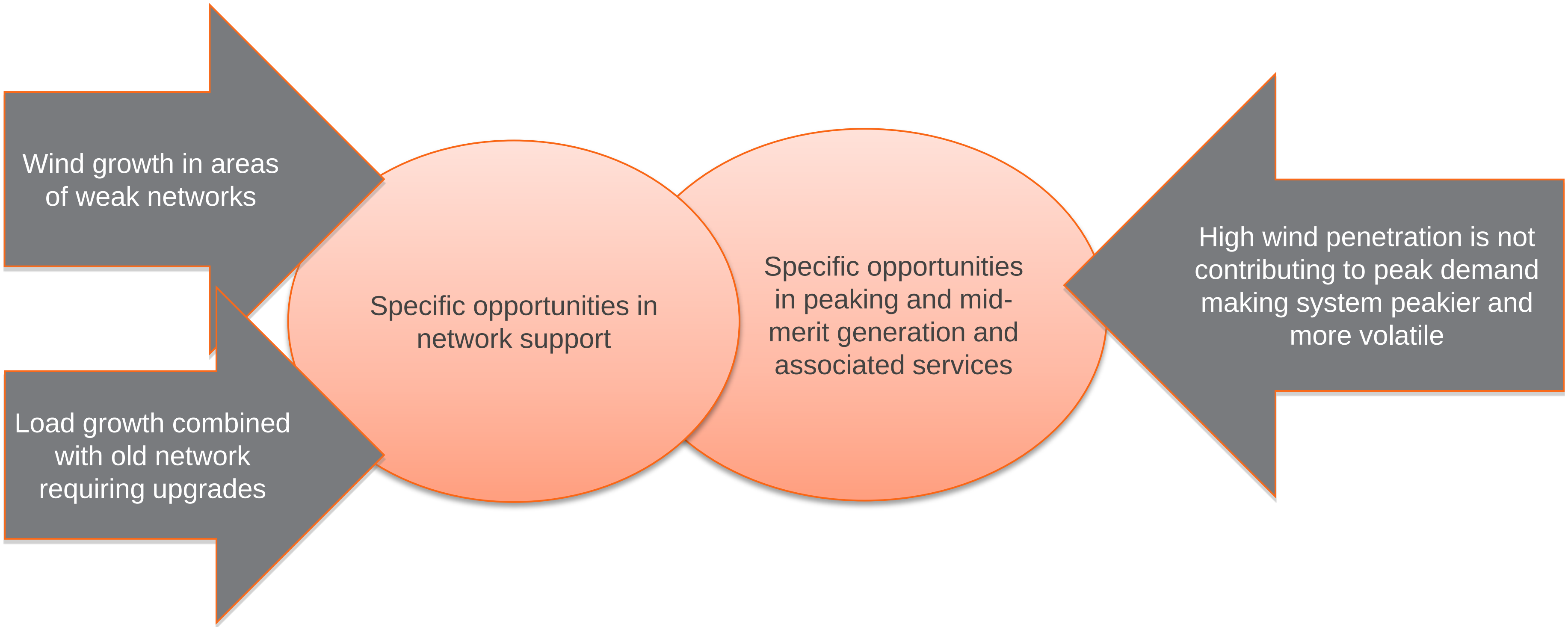


The market in both WA and the NEM is well placed to benefit from reciprocating engine technology

Not all value propositions fit with Warsila's desired approach

The remaining opportunities require Wartsila to find the niche opportunities in both markets

The compelling case came where the Value Propositions overlapped



The study highlighted how the benefits of fast flexible plant could fit into the Australian market and gave Wartsila some strategies for who and where to target and what value their plant might have for potential purchasers, to help them overcome the barriers to entry for new technology

Thank you

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