The Criticality of Electricity Network Infrastructure

Why we need it and
What we must do to get optimum value from it

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Note: This presentation reflects the personal views of the presenter

Agenda

- The network value proposition
- Distributed Generation
- Network Pricing and Competition
- Ideal and Pragmatic Tariffs
- Electric Vehicles and Batteries
- Conclusion

The Network Value Proposition

- Networks exploit the economies of shared capacity to deliver cost effective reliable supply of electricity.

The Network Value Proposition

Connects Users Together

Customers to
To other
Customers

with

A diverse
Portfolio of
Generators

Exploits
Diversity
(intra and inter
Class)

Optimum generation
mix &
Enables intermittent
renewables

Diversity of Consumers Demand

- Domestic Customers
  - All time peak demand 25kVa
  - Typical annual peak demand 12kVA
  - Average contribution to System Peak .. 3kVa
  - Average demand 1kVa
- Load Factor
  - Ratio of Average to Peak Demand
- Density – the third network economic driver

Portfolio of Generation

- **Networks connect different generation technologies together, thereby enabling their efficient and optimal despatch to match load profile**

- **Enable the sharing of generation redundancy**

- **By utilizing the load following capability of OCGT and hydro, they enable the effective use of intermittent sustainable energy resources such as wind and PV**

Distributed Generation

- **Individual Customer Level**
  - PVs (with or without storage)
  - Gas fired micro turbines, fuel cells etc.
  - With and without grid supplement
  - Not all premises can be efficient prosumers
- **Medium Scale co-gen and tri-gen**
  - Has its place – particularly if HT heat load
- **Community sustainable energy micro grids**
  - Require a local network and governance
    - Redundancy in the local generation or access to the mainstream grid

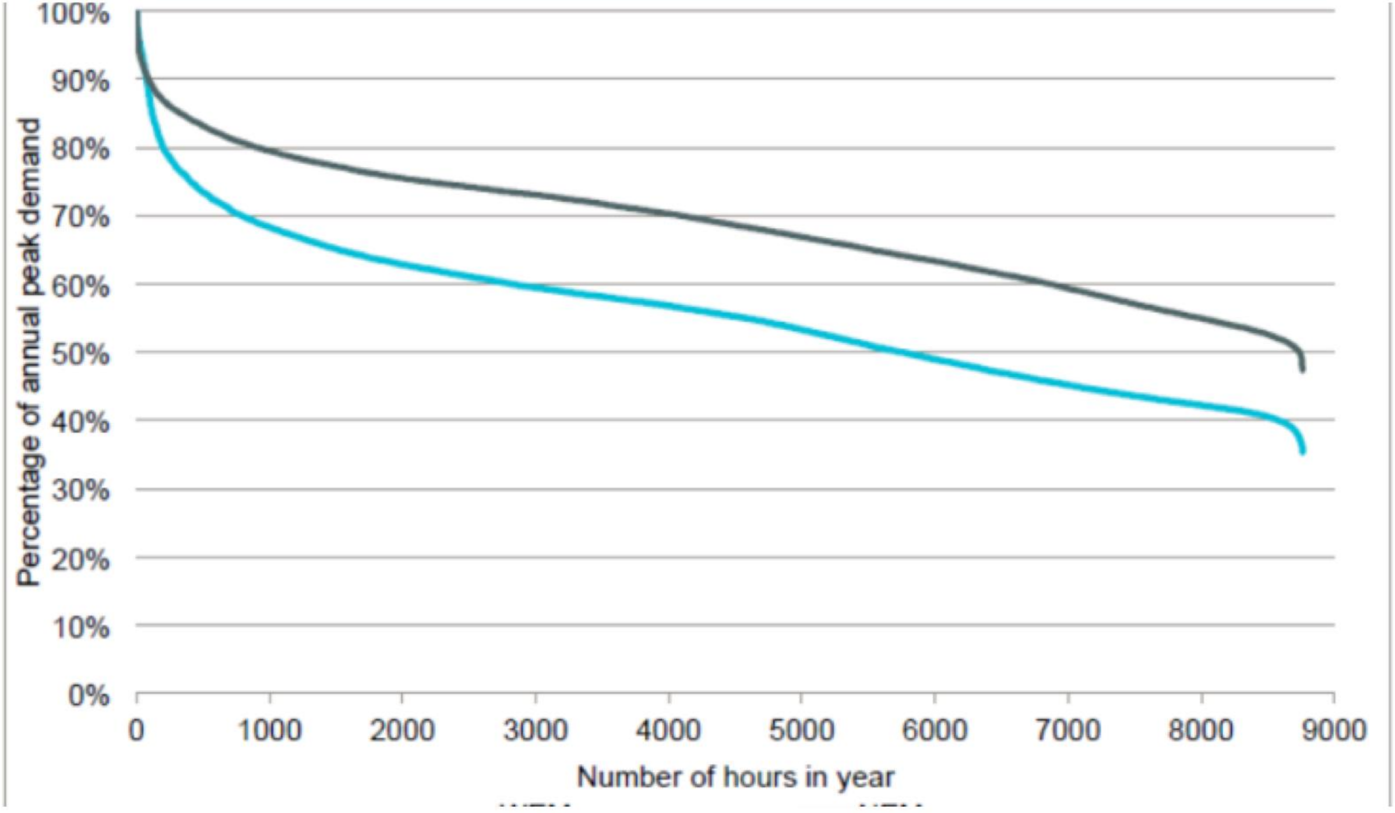
Relevance of the Different Network Levels

Network Level (No of Cust.)	Customer Diversity Benefit (Diversity) (Ann. MD)	Generator Optimization	Investment per Customer (RAB)
Premises **1 customer**	**1.0** **12.0kva**	**Stand Alone**	Nil
Local **1 to 200**	~ **0.4** **4.8kVa** (intra class diversity)	Enables sharing of **local generation** (e.g. PV) and local redundancy	~ **$4000**
Zone **10 to 20 000**	~ **0.9** **3.8kVa** (intra & inter class diversity)	Enables sharing of **MW scale DG** (e.g. gas co-gen) and local redundancy	~ **$3000**
Regional **1 to 3 million**	~ **0.9** **3.4kVa** (inter class diversity)	Provides access to **"sunk cost" generators including WIND & HYDRO.** Manages intermittency	~ **$2000**
National	~ **0.9** **3.0 kVa** (inter, temporal & climatic)	Access **to lower SRMC generation** & sharing of generator redundancy	~ **$1000**

Incumbency -Sunk Cost Assets

- Network Infrastructure already exists
  - They are a sunk cost
- It is better to use what you've got, rather than build something new – even if the cost of the new is less than the (now sunk) cost of the existing.
  - Will return to this theme under the heading of pricing

Load Duration Curves - NEM & WEM 2013



Spatial Distribution of Network Assets

- Loads and generators are spatially distributed
- Growth is not uniform
  - Volatility of the distributed demand is greater than that of the aggregate demand
  - Economic Increments of capacity are lumpy
- The network is where it is because customers are where they are
- A large part of distribution asset investment is driven by location, rather than demand
  - None is driven by kWh
  - PRICING IMPLICATIONS

Network Pricing – the legacy

- Traditional mass market metering was "energy accumulation" metering
  - It was the affordable technology
  - It didn't really matter
    - No real competition
    - Low price elasticity
- Network costs are not driven by energy, but by location and demand
  - Energy was a "rough" surrogate
- Uniform pricing policies meant no geographic segmentation
  - Network costs are density (therefore location) dependent

Today we have Competition

- Roof Top PVs
- Micro grids (Inset Networks) AND
- Price elasticity
- Therefore critical that we price network services accurately
  - Otherwise we lose overpriced loads
  - Keep underpriced loads
- Under the current regulatory compact
  - Loss of load leads to price escalation
  - POTENTIAL DEATH SPIRAL

Domestic Air Conditioning

- AC has poor load factor (low kWh/kW of demand) and diversifies poorly
- AC has driven the need for ongoing investment in system capacity, even in recent times of declining energy demand
- Flat rate kWh charges under recover the cost of providing that network capacity
- Consequently kWh charges have been driven up – with price elasticity effects

Domestic Roof top PVs

- Their success is due to subsidies
  - Overt (such as SREC & past FITs) and
  - the hidden Network Subsidy
- Under current pricing and metering arrangements PV owners avoid paying the full variable energy rate on every kWh consumed internally and earn the FIT on export
- Thus avoid paying their full network cost contribution (typically @ 20 cent/kWh)
- But still use their network connection and capacity.

Micro grids & Inset Networks

- Much is made of the benefits of co-gen, as the economic driver of micro grids
- But it is the avoidance of inherent geographic cross subsidies that provides much of the benefit
- Inset networks, such as airports, enjoy the economies of serving very high densities
- Yet are able to charge tenants at the going retail rates and profit from not paying geographic subsidies

Response to Competition

- **When an industry faces competition, particularly competition that thrives on the cross subsidies and imperfections of traditional pricing structures**
  - it is vital that truly cost reflective pricing be adopted
- **When an industry has large "shared" sunk cost assets**
  - it is vital that market based approaches be adopted

Underutilization of Sunk Costs

- **The economic argument is that it is better to discount the cost recovery of sunk cost assets, to levels which ensure they are used, rather than price their usage at full cost recovery if at that price customers choose not to use (or to underutilise) them.**
- **The argument is sound – better to use what you've got, rather than build something new – even if the cost of the new is less than the (now sunk) cost of the existing.**
- **But better still, price the sunk cost assets to meet the market – that way its use reflects its value to customers – as the alternative to building something new that is really redundant**

Interval Metering

- Modern metering technology has given us the mass market ability to measure customer demand and TOU energy.
- It thus provides the opportunity to implement more cost reflective pricing.
- But it will require political will as well as metering to address geographic cross subsidies.

Ideal Network Tariffs

- AEMC – LRMC based tariffs
- Jurisdictional "let out" re "Uniform Pricing"
- Ideally
  - Tariffs will signal the LRMC of incrementing load
    - But what is LRMC – particularly @ times of low load growth
  - Locational costs and customer service costs recovered as differentiated fixed charges per customer
  - Use Of Shared System Capacity will be charged at the long run cost of augmentation/replacement – that's what LRMC means
  - Any residual recovered in a non distortionary way
  - Scope for controlled load tariffs

Practical Implementation

1. Know where you are headed
2. Incorporate need for simplicity and technology limitations
    - Existing Metering Stock
3. Know where you are and the social and regulatory constraints on "rate of change"
    - Side constraints
4. Decide a transition path

TOU or Capacity/Demand Tariffs

- Conceptually the ideal Capacity/ Demand Tariff will charge for demand measured at the times of likely MD (about 40 days and 200 hours per annum)
- Conceptually a TOU tariff that truly signals LRMC will charge for energy consumed during those 200 hours only
- There is virtually no difference between the two – other than perception

Time Based "Customer Value" Pricing

- Airlines do it
- Having invested in a fleet of planes their objective is to fill seats 24/7
- So they price differentially depending on popularity of the flight time
  - floor price being SRMC
- We could do the same – the floor would be ZERO, and
- Time varying price elasticity is such that our prices at most times other than the 200 hours of likely maximum demand would be zero

Transition Tariffs

- In transition we are likely to see
  - Higher fixed charges
  - Continue use of Energy only tariffs, but with seasonal elements
  - Continued use of traditional TOD TOU tariffs, but with stronger TOU “seasonal” signaling
  - Some use of “Contract Demand” - Take or Pay
  - Greater use of Controlled Load Tariffs
- Specific hardship Policies
- CPP and direct incentives for Controlled load

Controlled Load Tariffs

- A problem with TOU tariffs is that they incentivize synchronized customer behaviour
- Not currently an issue because of low penetrations of TOU customers
- But image a street full of electric vehicles – all programmed to charge in sync with the 10.00pm TOU price change
- Natural Diversity would be destroyed – and an artificial MD created

Electric Vehicles

- **We need a much more sophisticated approach to tariff setting for the electric vehicle load than anything currently on offer**
  - Simple TOU will destroy diversity
  - Traditional controlled load tariffs will not deliver all of the customers requirements
- **We need a tariff offering that gives the customer the opportunity to charge at anytime (and anywhere) that suits him and pay “full fare”, but which also incentivizes him to regularly hand over the control of charging to the Network with the confidence of having a “full tank” in the morning.**

Battery Storage

- Could make PV “stand alone” viable and potentially render the network redundant or underutilized. – True “stand alone” (un other than remote) is considered unlikely…BUT??
- Battery installation by customers, motivated by TOU tariffs…. Is bad economics
  - Rarely is more than 5 or 10% by geographical segment of a network constrained
  - Investment in batteries to improve load profile in the other 90% is a waste of resources
  - Will it happen???

Conclusions

- Despite growing competition and the new technologies on the horizon

- The Network Value Proposition will endure

- Provided that the industry embraces tariff reform as envisaged by the new AEMC rules and that, the jurisdictions and regulators have the steel to deal with the tough issues of “winners and losers”