Economics of Microgrids

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The Network Today
Assumptions of Regulatory Framework

• Framework assumes top to bottom flow
• Requires that a retailer is appointed for each connection point
• There are exemption guidelines, but they contemplate embedded networks
• Network built with redundancy on the basis of peak usage (i.e. those short periods where supply peaks to meet demand peaks)
Possible Future
Potential Scenario: Large Volumes of Distributed Storage

• Hypothetical
  – What if there was enough distributed storage to supply all electricity demand for 4 or 5 hours?
  – What if there was enough distributed renewable energy that produced enough electricity to cancel out the need for centralised generation?
  – Is centralised economic dispatch required?
  – Is N-1 or N-2 planning required?
  – Retailer and Network business models?
Some Problems with Relying on Price
Poor Correlation of Pool Price and Network Costs

The scatter plot shows a poor correlation between pool price and daily peak network cost. The line of best fit has a $R^2$ value of 0.29, indicating a weak linear relationship between the two variables.
Distribution Regulation: The Challenge of Sunk Costs

Chart 2- Building Block Cost Components

- Net Tax Costs
- Regulatory depreciation
- Opex
- Return on Capital

Period: 1, 2, 3, 4, 5

Costs in millions ($m): 200.0, 250.0, 300.0, 350.0
Graph retrieved on 13 July 2017 from https://kellyandjenny.wordpress.com/2012/01/15/natural-monopoly/
What Used to be Immutable Truths

• Supply and demand must balance instantaneously as stockpiling is not economically feasible

• Central co-ordination is required to keep the grid stable – frequency control/electrical inertia

• AC wins due to ease of transforming between voltages to reduce losses, and DC breaking being difficult

• Natural barrier to entry
  – Can’t compete with the cost effectiveness achieved from scale economies
  – Capital intensive in nature

• Consumer behaviour has tended to be economically inelastic, so does not respond to peak pricing
The New Paradigm

The economics of scale are falling away

• Optimization for capacity, or sizing of generation sources
• Optimization of operations
• Pro forma cash analysis with assumptions
• Demand management, especially in emerging economies
Alternate Paradigms / Fractionation / Productisation

- DC in the home, savings from not having to do multiple transformations
- Niche local electricity solution for specific applications such as pumps
- Stand alone rural microgrids
- Federation of microgrids with decentralised control
• How committed is the government committed to a centralised dispatch market?

• Break up the network businesses into microgrids and auction access rights to provide infrastructure and energy supply service
  – completely dismantle existing market structure

• Parallels to teleco break ups, in the 1990s, but does electricity lend itself to ‘productisation’ like mobile devices?? Probably not, but watch this space.
Evaluating Market Opportunities

• Technical Feasibility
  – Matching/optimising generation mix, storage & loads
  – Grid and end user integration
  – Siting

• Economic Feasibility
  – Identifying Costs and Revenues
  – Does project exceed current cost of energy for end users?

• Financing
  – Capital Stack and investors’ hurdle rate
  – Ownership / Management structure
  – Repayment structure

Retrieved from *Brian Farnen*, General Counsel and Chief Legal Officer Connecticut Green Bank
Consideration of Longer Term Liabilities

• Battery warranties – Buyer Beware
• Consumer expectations of High 9s Reliability
  – Particularly relevant for stand alone systems
• End of Life
  – Enduring obligations to supply???
  – Replacement CAPEX. What about possible AUGEX??
  – Cost to dispose of batteries
  – Environmental risks from battery chemistry?
  – PV long term performance degradation
  – Regulation of microgrids likely to develop in the future, what overhead in cost will that bring??
• **Mercedes-Benz Energy Storage Home**: 80% of nominal capacity after 8,000 cycles.

• **SimpliPhi PHI3.4 Smart-Tech Battery**: 80% of nominal storage capacity after 10,000 cycles.

• **Enphase AC Battery**: 95% of nominal storage capacity after 7,300 cycles.

• **LG Chem RESU**: 80% nominal storage capacity after 2,625 cycles.

• **GCL E-KwBe**: 80% of nominal storage capacity after 2,000 cycles

• **Tesla Powerwall 1**: 60% of nominal storage capacity after 2,368 cycles