VALUING THE IMPACT ON NETWORK RELIABILITY OF RESIDENTIAL BATTERY STORAGE

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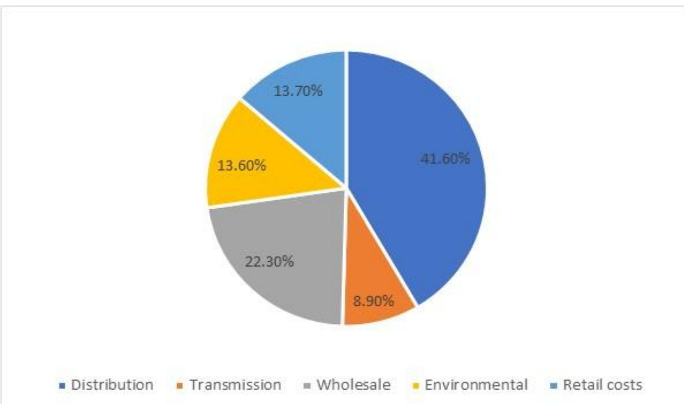
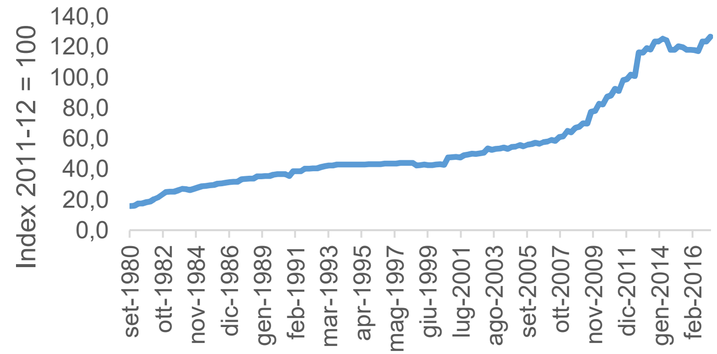
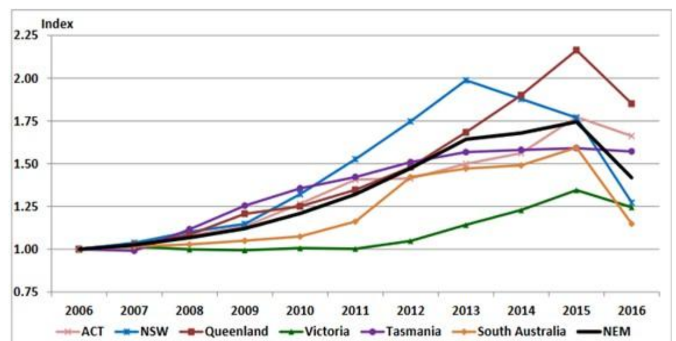
Background – NEM a cautionary tale



Queensland Competition Authority Electricity Pricing Inquiry - Final Report, 2016

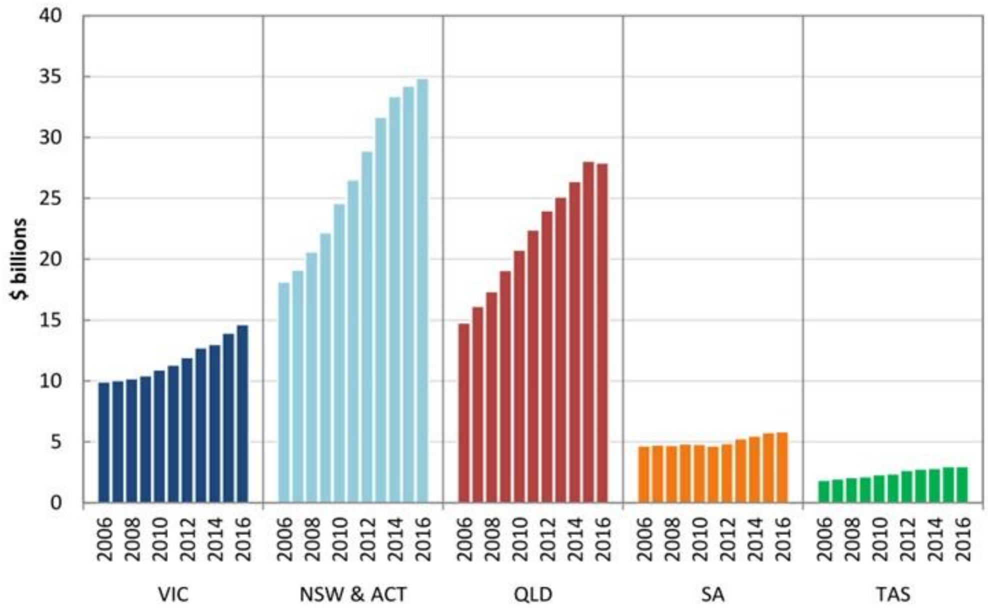


Electricity prices Australia 1980-2015 source: Australian Bureau of Statistics 6401.5 2017



Index of revenue changes from 2006 to 2016 by state in real terms (index 2016) Source: AER, 2017

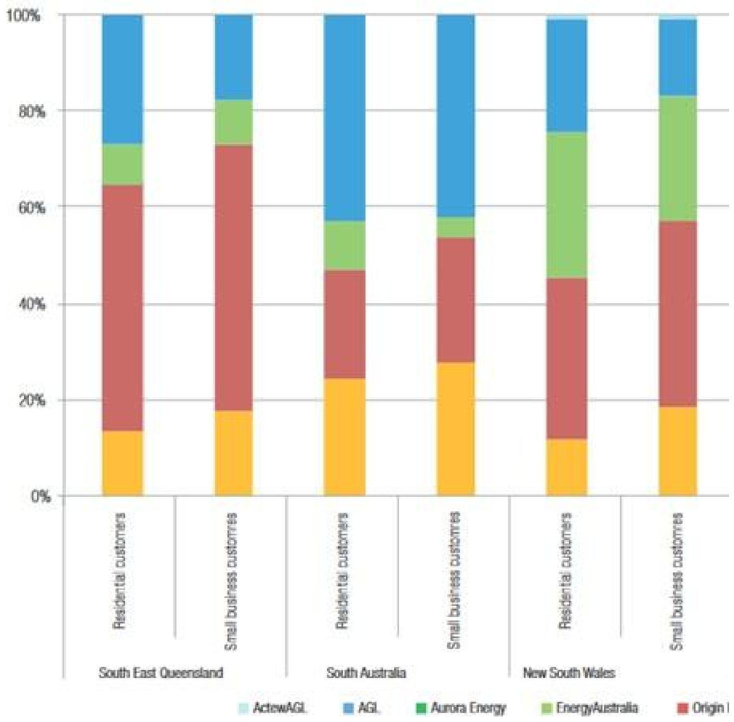
Asset bases



Regulatory Asset Base from 2006 to 2016 by NEM region, real values in 2015-16. Source: ACCC, 2017

- At a time of flat or declining demand
- Guaranteed rate of return on assets

Market concentration



"In retrospect, the creation of three very large retailers was not the best starting point for a competitive market" ACCC, 2017

…let alone generation

Source: Annual Report on Compliance & Performance of the Retail Energy Market 2016-17 p14

Rise of Distributed Generation

- Australia has one of highest rates of PV adoption 1.8m households
- Some urban areas over 40% penetration
- Network Operator response has been to limit further uptake
- Based on a narrow view of costs v benefits

Network responses

- Barriers to further distributed gen
  - Network operator culture
  - Political landscapes influence network operators
  - Network revenue implications
  - Technical challenges

    Simpson, G. Network operators and the transition to decentralised electricity: A Australian socio-technical case study, Energy Policy 2017.

- Qld example: Ergon tariff 46 July 2014 daily supply charge from 1162% ($42/day to $488/day) for commercial customers

Reliability

- Commonly used as a planning metric
- Basis of incentive schemes for DNSPs
- Applied at network type level
- Lack of granularity in LV network

Aim

- To develop a model to determine local reliability impacts of PV + Batteries
- Through changes in area load profiles and economic outcomes

Significance

- Reliability and affordability primary drivers of network spending
- Household investment decisions can result in positive outcomes for network operators
- Economic efficiency in alignment of rewards for actions that benefit and costs for that do not

Methodology

- Techno-economic simulation model of households
- Monte Carlo modelling of weather, demand and pricing
- Economic analysis across a range of penetration scenarios measured against baseline of retail tariffs

Value measures

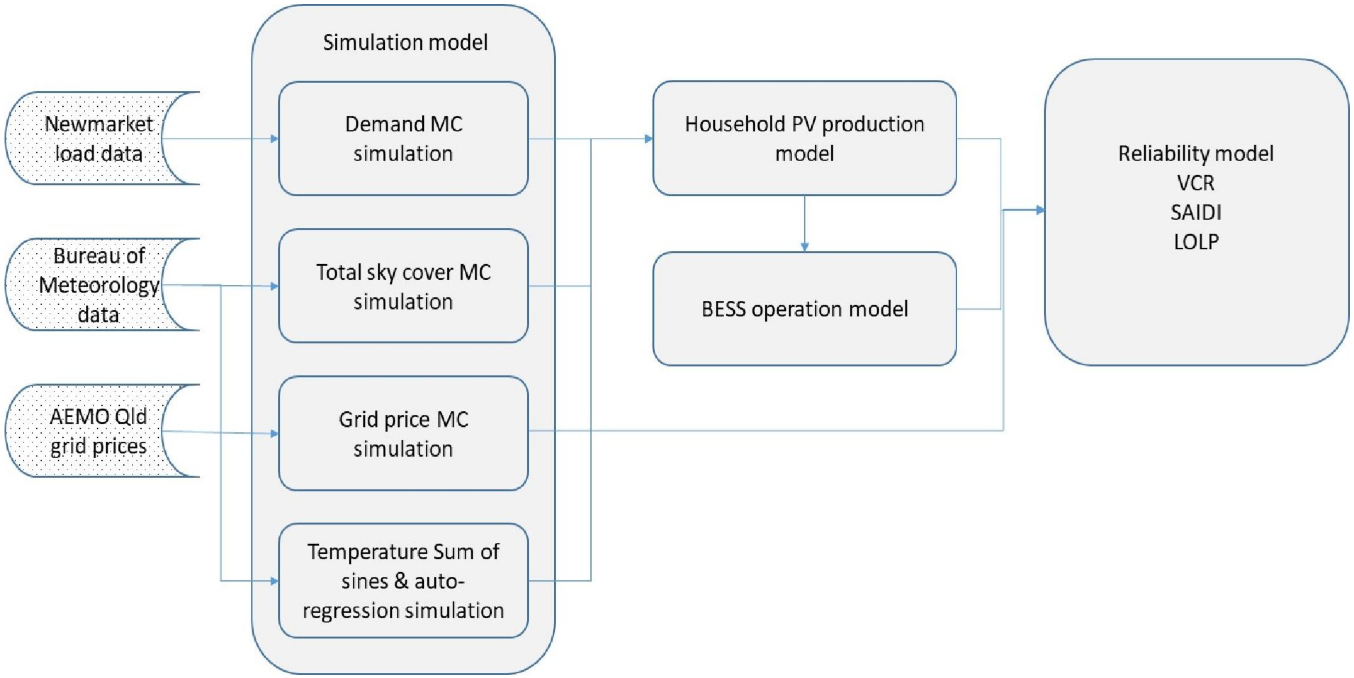
- SAIDI - System Average Interruption Duration Index

  $$SAIDI = \frac{Total\ of\ unplanned\ outage\ minutes}{Number\ of\ distribution\ customers}$$

- VCR – Value of Customer Reliability – extensive survey based valuation of customer classes willingness to pay for reliable supply of electricity
- LOLP – Loss of Load Probability – probability that demand will exceed supply in any given period

  $$LOLP = \sum_j P(SOCend_j < 0)$$

Model components

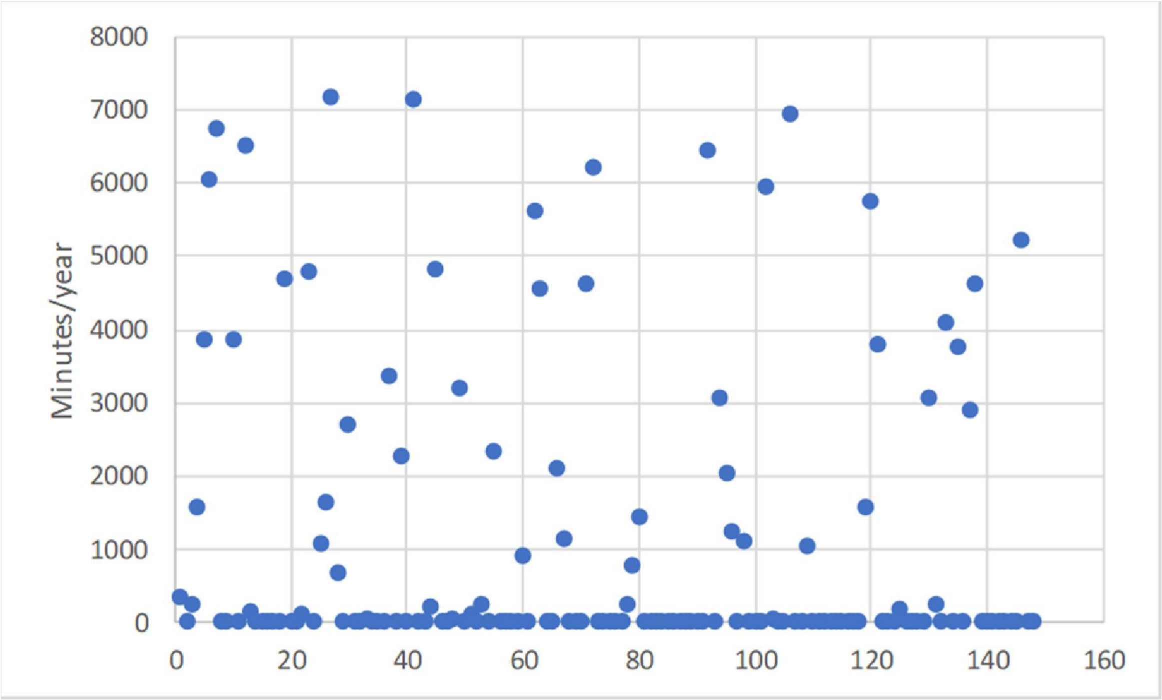


Energy profile changes

Annual Aggregates	Baseline	10%	25%	50%
PV installed kW	-	70.0	185.0	375.0
BESS installed kWh	-	189.0	499.5	1,012.5
Max Demand kW	387.9	355.9	304.9	229.4
PV generation MWh	-	109.9	290.5	588.9
Peak period energy MWh	613.4	518.6	364.6	110.5
OffPeak period energy MWh	210.7	195.4	168.7	124.1
Peak Energy %	74%	73%	68%	47%
Total Energy Served MWh	824.1	714.1	533.3	234.6
Total Energy Served %		13%	35%	72%

- Standardised kit per house of 5kW PV and Tesla Powerwall 13.5kWh

Minutes exposed to outage by household



- 58% households have reduced their minutes exposed to an outage to zero/yr across all scenarios

Reliability - SAIDI postcode area 4051

	0%	10%	25%	50%
House	562,044	505,839	421,533	281,022
Unit	379,475	379,475	379,475	379,475
Business	61,314	61,314	61,314	61,314
Total minutes	1,002,832	946,628	862,321	721,810
SAIDI_local	76.21	71.94	65.54	54.86
% reduction		5.6%	14.0%	28.0%

- Deeper dive into area reliability using area SAIDI measures
- From Energex substation data
- STPIS implications (network reliability incentive schemes)

Results

- The value of increased reliability per household $AUD 223 per year
- SAIDI metrics would be improved by 14% if the current 24.9% of households were to incorporate battery storage.

Financial results - Reliability

	10%	25%	50%
Capex	$ 245,000	$ 647,500	$ 1,312,500
PV+BESS NPV savings	$ 2,218	$ 31,163	$ 132,048
Value of energy not served(wholesale $)	$ 6,738	$ 17,809	$ 36,183
% of Baseline wholesale energy cost	13.7%	36.1%	73.3%
Value of energy not served (Retail $)	$ 30,364	$ 54,781	$ 110,642
% of Baseline retail energy cost	14.1%	25.5%	51.4%
LOLP delta	0.0966	0.2518	0.5071
VCR of reliability improvement	$ 222,437	$ 580,037	$ 1,168,154

- LOLP – reduced by half

Why is this important?

- Reliability is primary driver of network spending
- Household investments can result in free-rider benefits for network operators and or other households
- Can result in perverse outcomes e.g. STIPIS incentive scheme in Australia allows DNSPs to claim higher revenues for reliability improvements.

Conclusions

- Reliability improvements can be a significant contributor to the cost benefit analysis of PV and storage incorporation
- Rarely considered vs costs of existing PV subsidy
- Rewards should be aligned with beneficial actions

Grazie mille