Emerging technology observations

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Context

- Emerging technologies including PV, EVs and battery storage are reasonably well understood
- Ignoring the price of emerging technologies we can develop distribution **network** impact scenarios – the impacts are not uncertain
- We outline our early impact scenario observations in this presentation
- We acknowledge that different network and customer demographics **may** lead to different conclusions
- Some uncertainty exists around how the scenarios will be implemented and by who – this uncertainty creates business risks
- The real uncertainty is not around existing emerging technologies but new or significantly evolving technologies – are there 'game-changers' to come and to what extent do we need to respond to these now?

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Some extreme scenarios to test the potential impacts of PV, EVs and storage on the distribution network

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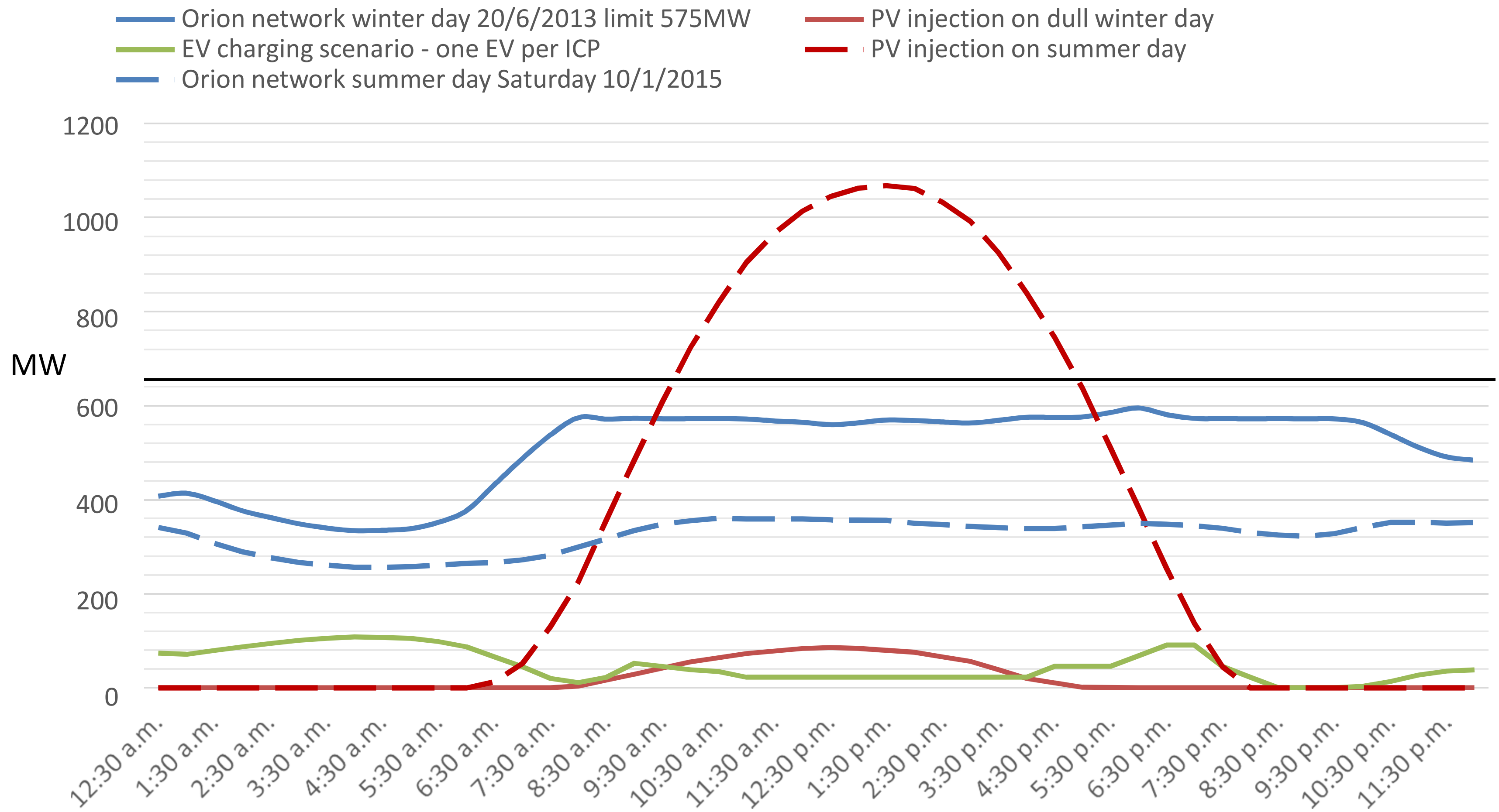
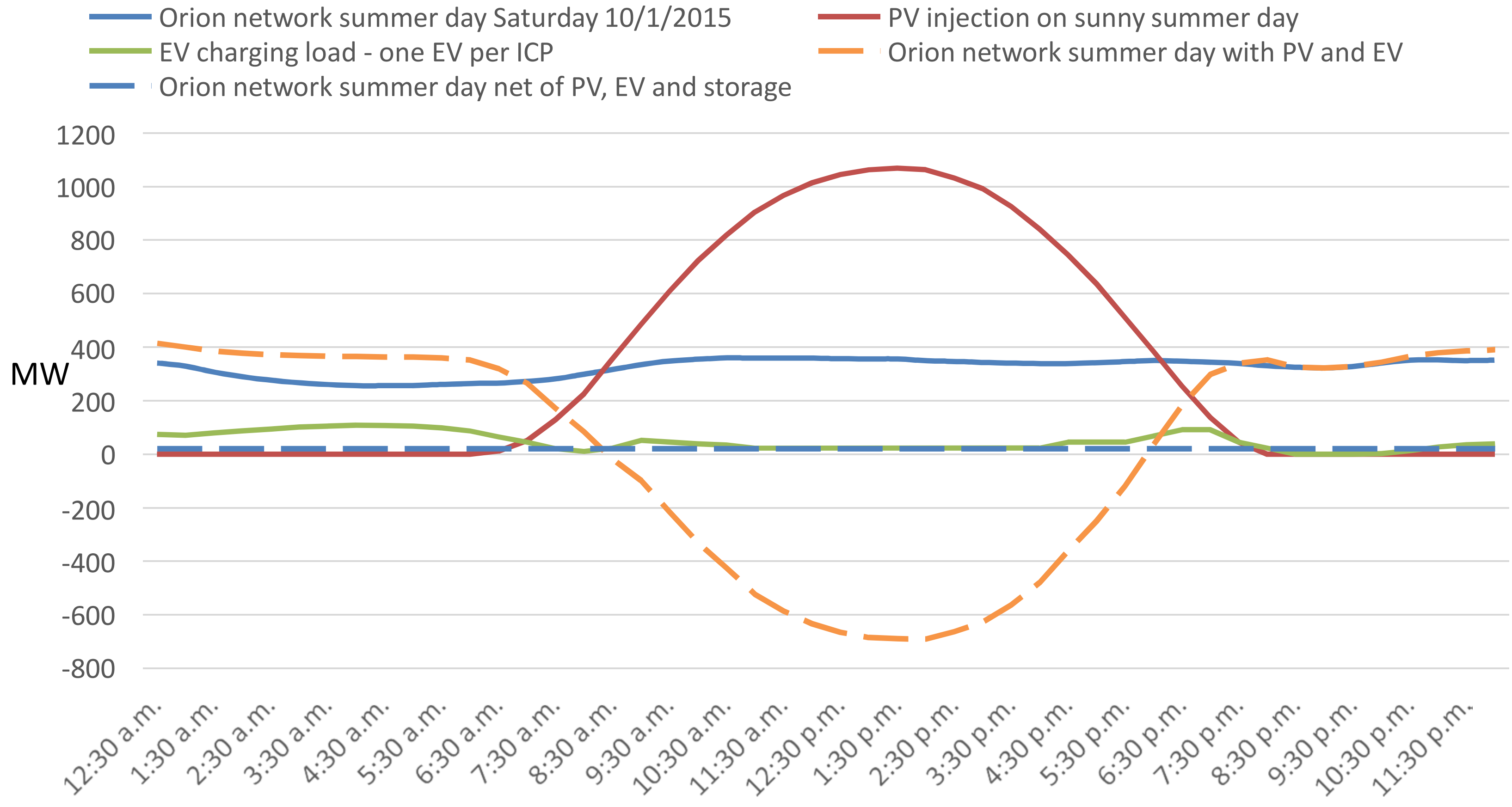
Load, PV and EV profiles



- PV – 6kW per ICP (really extreme with 50% of energy supplied by PV)
- EV – one per ICP, 30km per day (NZ average 40km)
- EV charging 60% overnight, 20% pm peak, 10% am peak and 10% day

Combined impact of EV, PV and battery storage on a sunny summer day



- Storage required equivalent to 45% of ICPs with a Tesla 5kW/7kWh battery
- 8% losses in battery promotes use of hot water storage first
- Summer network demand drops from 360MW to 20MW

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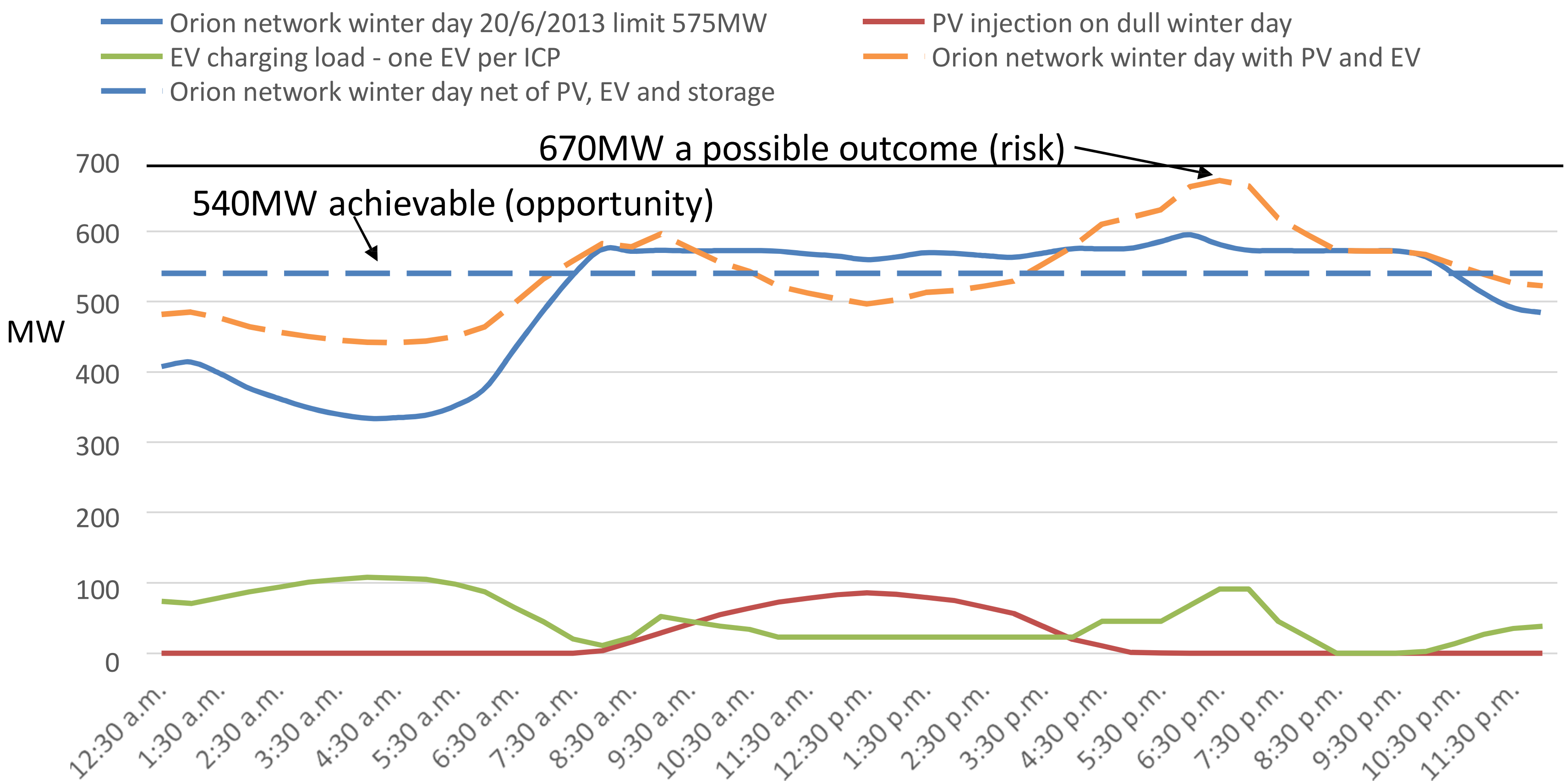
Combined impact of EV, PV and battery storage on a cold winter day



- 15% of ICPs with a Tesla 5kW/7kWh battery to achieve above reduction
- Can expect 3-5 days of this so inter-day energy transfers difficult
- Energy efficiency could drop peak another 10-20%

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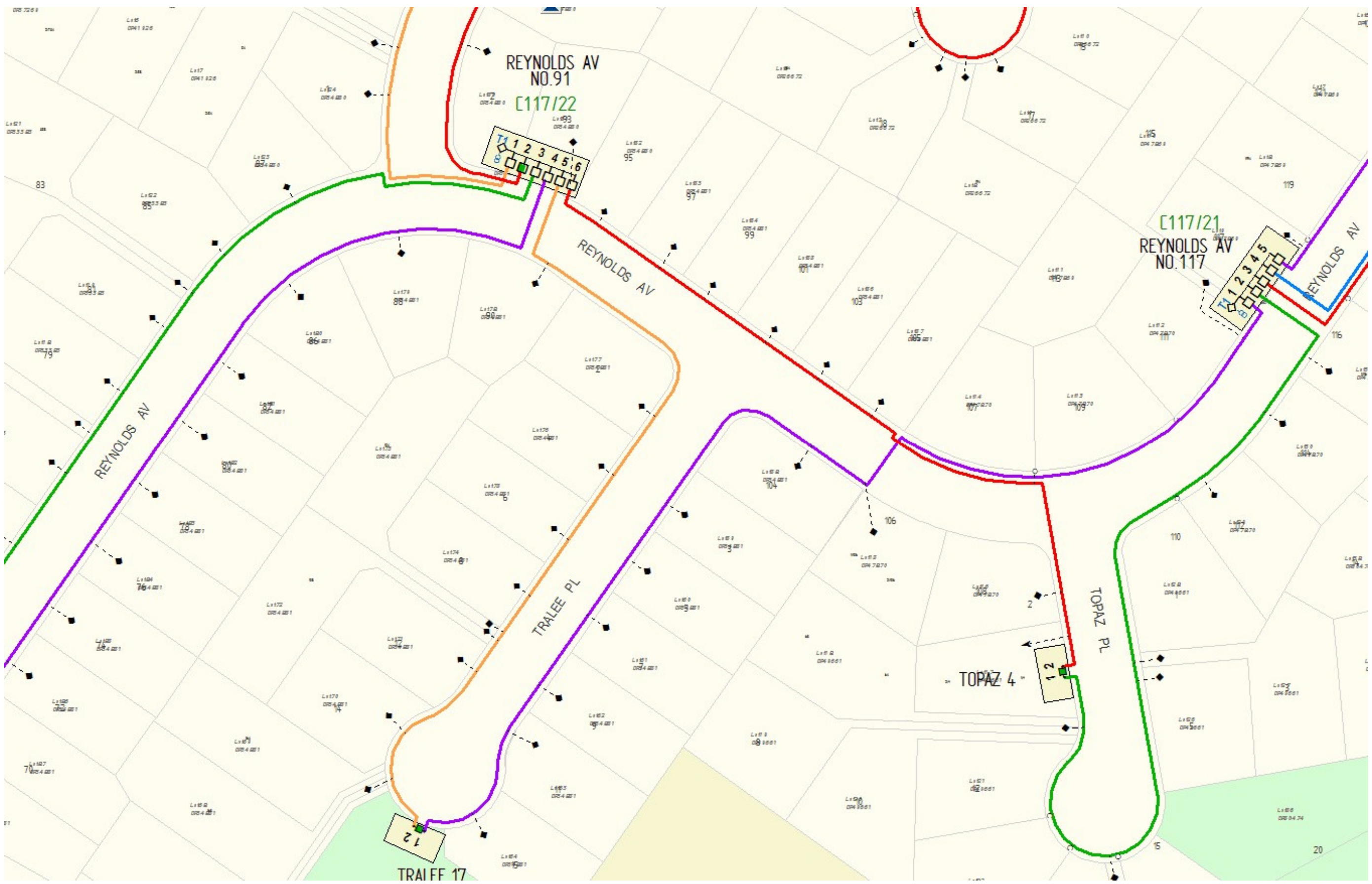
Impact on subtransmission investment

Urban context – rural similar but additional drivers (e.g. irrigation)

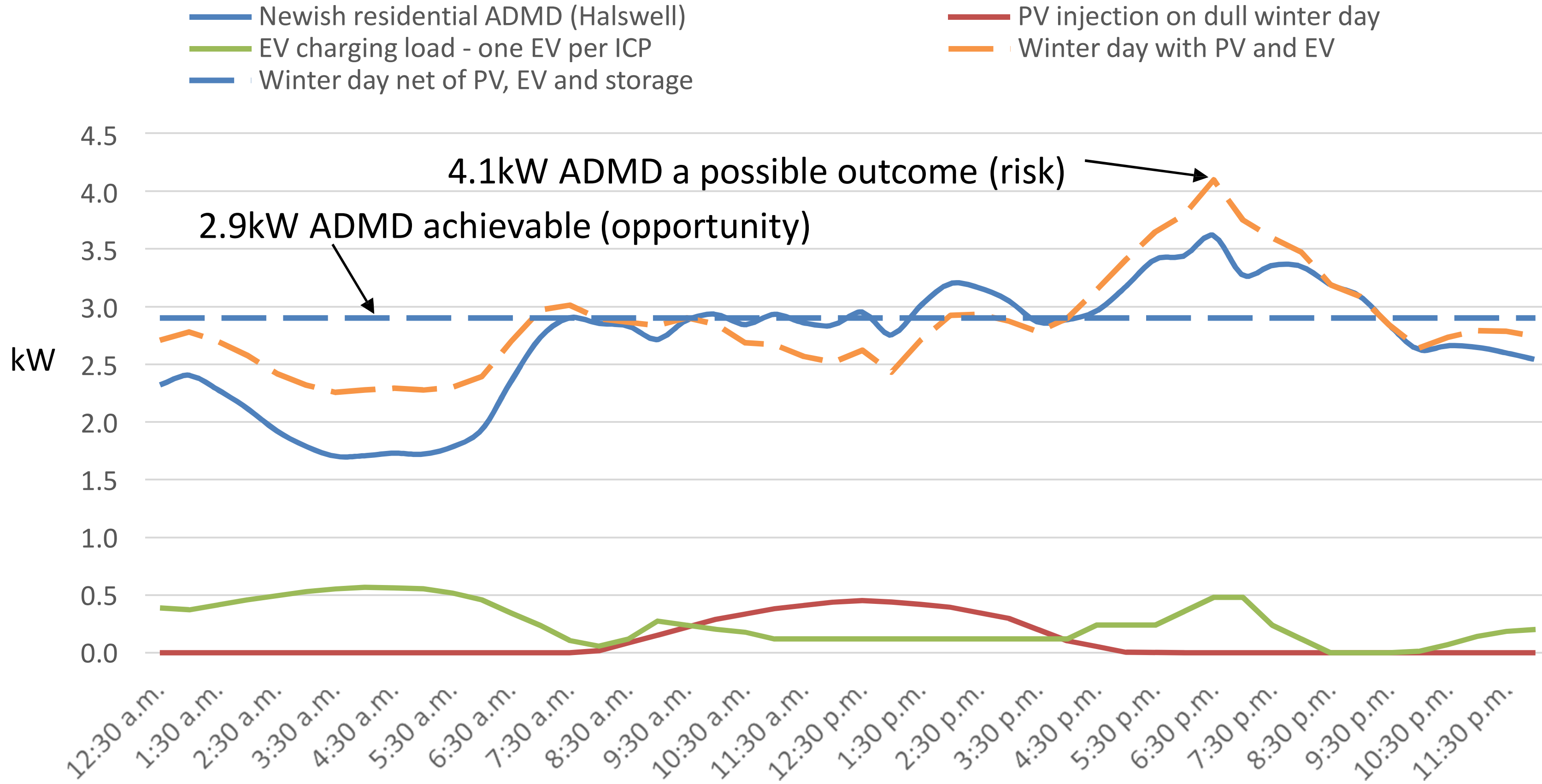
- Existing network well utilised so modest downsizing is not material enough in an underlying population growth environment
- New subtransmission capacity still required in areas of urban sprawl – typical increments of 20-40MW at a time
- A cautious approach to the expansion of our high voltage network is required – similar to current practice

What about the low voltage network?

Around 40% of network value



Low voltage network impact of EV, PV and battery storage on a cold winter day



- 25% of ICPs with a Tesla 5kW/7kWh battery to achieve above reduction
- Can expect 3-5 days of this so inter-day energy transfers difficult
- Energy efficiency could drop peak another 10-20%

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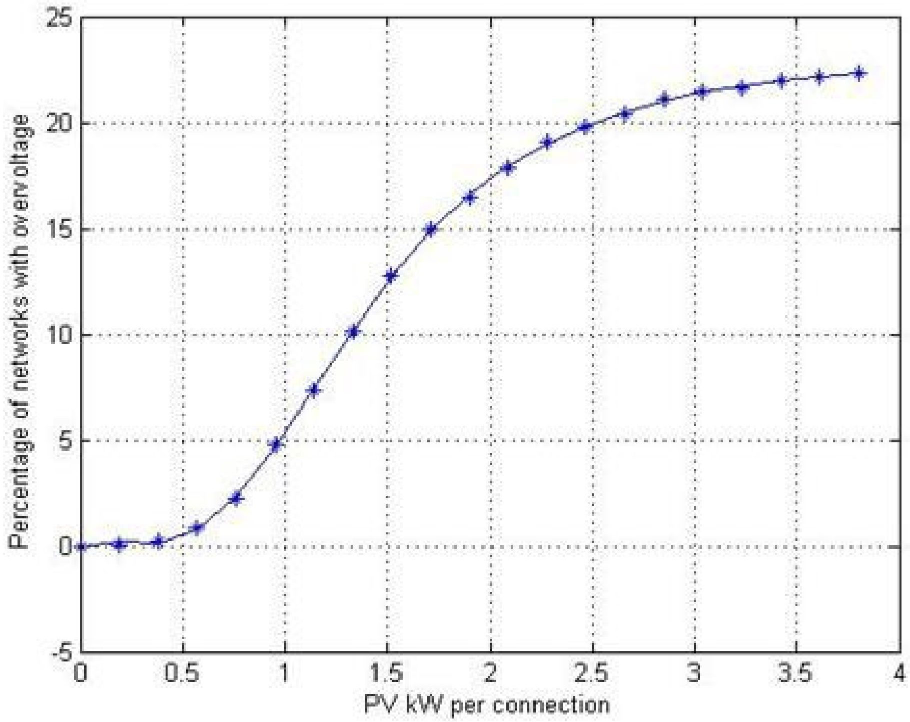
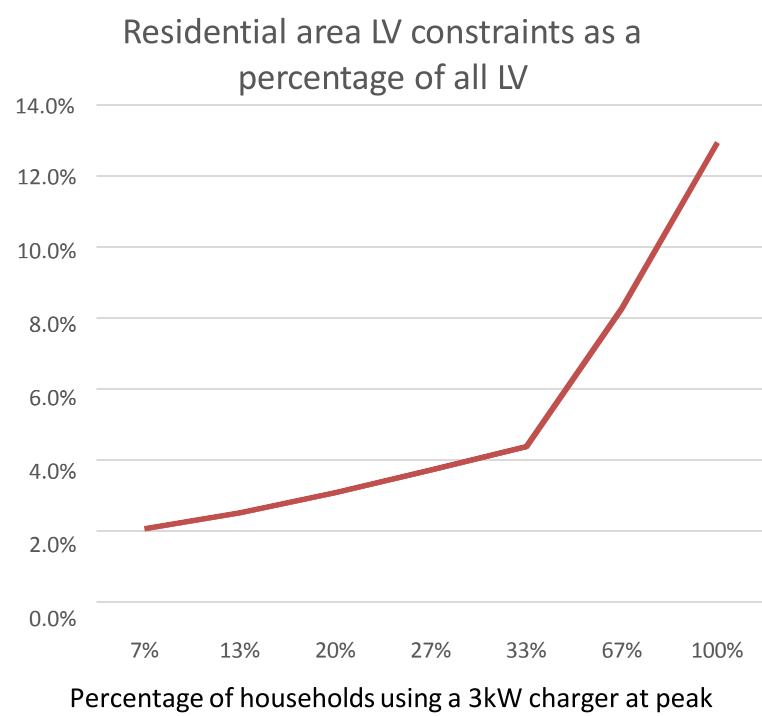
Potential LV network impacts
(without storage or EV charging management)

PV impact on LV



EV impact on LV



Further investment likely – not stranding

Low voltage network investment

Considerations

- Largely a set and forget regime – choices made at the time of subdivision development
- After diversity maximum demand typically 3-3.5kVA per household
- Existing low voltage network design based on 5kVA per household but infill has eroded capacity margin in many areas
- As per current practise, choices about future proofing apply – old practises of providing a small capacity margin facilitate PV and EVs now – an enable or a responder?

Emerging technology impacts

- Whether new technologies achieve efficiency gains or drive reinforcement is largely dependent on successful management of DG and DSM
- Older overhead areas more vulnerable to poor management
- Low voltage network a vital part of micro grids if they should eventuate – unlikely to be stranded?

Observations

- PV provides little benefit to the network in the winter
- EV impact largely dependent on time of charge
- Battery storage could more than mitigate the effect of EV charging at peak but introduces significant losses – 8% plus
- Need to acknowledge further hot water heating efficiencies or fuel switching – 20% household electricity drop possible
- Population growth significantly offsets the effects of emerging technologies on the size of the subtransmission network
- Our LV network needs to remain relevant to customers - enhanced flexibility around how the network is used – added complexity

What are the risks & opportunities?

- Opportunity to support transport sector CO_2 emissions without a corresponding increase in the electricity sector
- Risk that emerging technologies will lead to increased network investment
- Conversely an opportunity to increase the utilisation of the existing network through coordinated management of load, distributed generation and storage – DSM markets and regulation important
- Opportunity for customers to share the role of capacity, security and reliability of supply

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IMs and broader regulation must

- ensure that long term network owner risks **(real or not)** do not result in short term customer service risks - network opex or capex avoidance
- acknowledge the role (or possible role) of distribution networks in facilitating efficient outcomes for emerging technologies – capability and coordination
- Facilitate 'horses for courses' – customer demographics and network geographies may require different solutions
- Recognise that the 'long term interests of consumers' may not be as clear as the past – short term flexibility/optionality in design has value
- Ensure that distribution networks are not disadvantaged when alternatives are available – e.g. expectation of service and pricing restrictions

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Off grid feasibility – Blue Skin Bay (261 ICPs)

(I.G.Mason – EEA Conference proceedings)

Optimising Energy Returned on Energy Invested

- EROEI for PV is 5-9 and wind about 15-80
- EROEI for PV is 5 and wind about 35

Option	Generation capacity as a % of annual requirement	Battery storage requirement (% of annual energy)	Battery storage requirement for annual ICP energy of 4100kWh	Energy return on energy invested (battery life 20 years)
PV with storage	200%	25.2%	1033kWh	less than 0.45
Wind with storage	500%	6.4%	262kWh	1.7

Battery storage makes community scale grid defection unattractive from an Energetics perspective

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