Electric Avenue – paving the way for neighbourhood batteries

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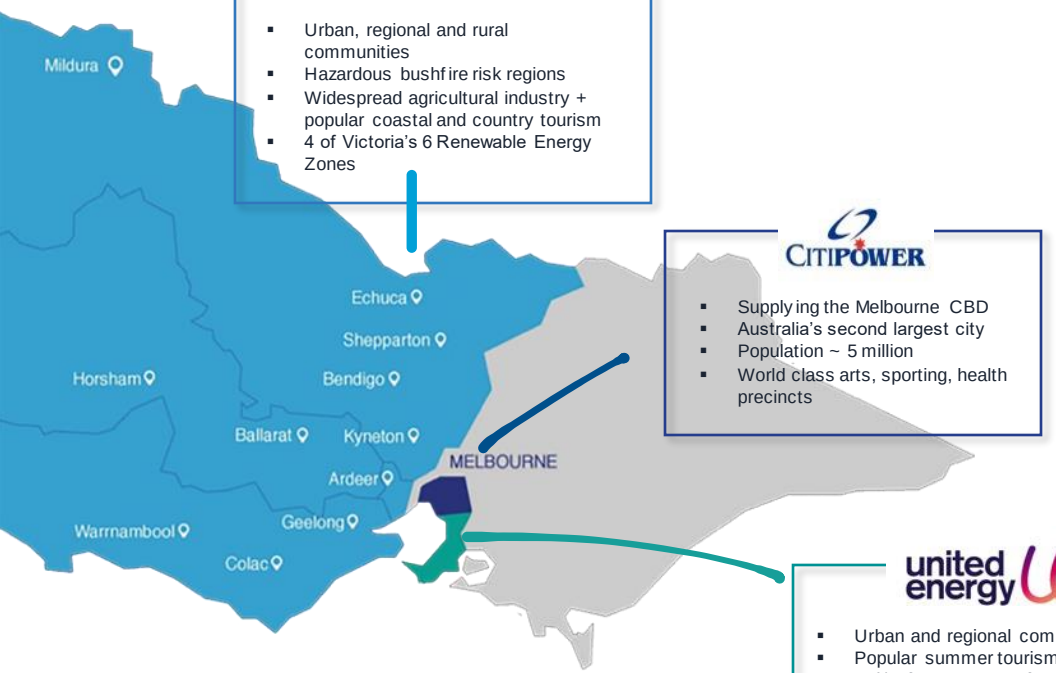
3 networks delivering reliable, safe, & affordable power



- Urban, regional and rural communities
- Hazardous bushfire risk regions
- Widespread agricultural industry + popular coastal and country tourism
- 4 of Victoria's 6 Renewable Energy Zones

- Supplying the Melbourne CBD
- Australia's second largest city
- Population ~ 5 million
- World class arts, sporting, health precincts

- Urban and regional communities
- Popular summer tourism industry
- 27% of state's manufacturing sector
- Successful wine and agriculture regions

	CitiPower	united energy	Powercor
Network area	**157 km²**	**1,472 km²**	**145,651 km²**
Customers	348,000	710,000	902,000
Renewable generation connected	0.1 GW	0.6 GW	2.4 GW
Residential solar customers (% of customers with solar)	18,000 (6%)	108,000 (17%)	190,000 (25%)
Electric vehicles (% of customers, Jul 23)	8,962 (2.6%)	10,957 (1.5%)	4,841 (0.5%)

We are supporting the energy transition

Enabling greater rooftop solar connections
The fastest way of increasing renewable capacity and the lowest impact on communities.

Connecting large scale renewables to our network
Uses available infrastructure and easements and can be delivered faster than transmission.

Installing more energy storage capacity
To enable renewable generation and ensure it is used.

Preparing for greater electrification of transport
We are enabling our networks for the gas and transport electrification uptake

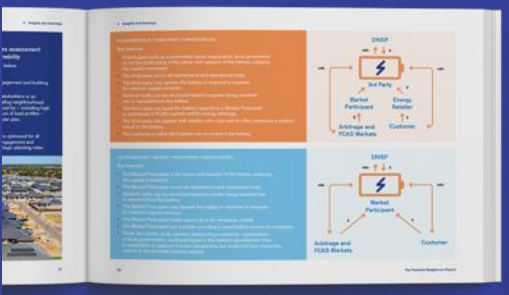
Our role in enabling more storage capacity

Electric Avenue program, 2021- current

- Up to 40 x 30kW pole top batteries rolling out in United Energy supporting up to 5,000 customers
- Two ground mounted batteries - 284kWh in CitiPower and 360kWh in Powercor - servicing up to 250 customers each, with two new battery projects in planning stages
- Innovative control systems enabling batteries to participate in the wholesale market via a market participant (energy retailer)
- Opportunity for energy retailers to deliver customer-focused offer

Defined benefits

- Improved network reliability
- Increased solar hosting
- Keep local solar local
- NEM arbitrage
- Local emissions reduction
- Mitigate peak demand
- Defer network augmentation



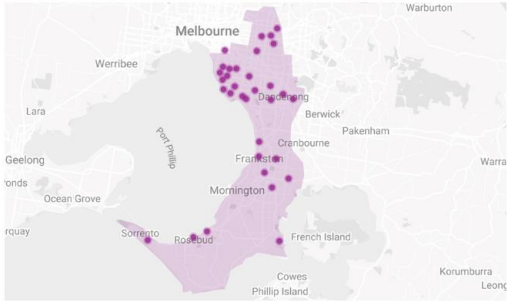
Landmark Feasibility Study in 2021

- Defined role for neighbourhood batteries in collaboration with 12 community partners
- Identified benefit streams, 3 alternative ownership structures, community perceptions, regulatory barriers and financial models
- Focus on site selection, critical for community acceptance of the battery as a public asset

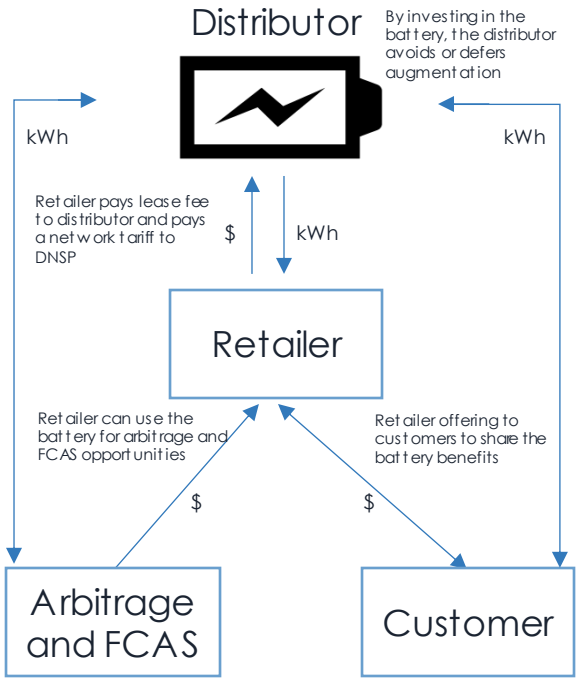
Distributed storage | Benefits for customers and the network

Overview	• Batteries on the network, can help sustain power reliability for customers, support those with rooftop solar to get the most out of their investment and enable all customers to support a cleaner energy future.
Customer benefits	• Provide everyone in the community with access to local renewable energy • Improve the reliability of electricity supplied in the community, particularly during peak demand times when everyone is using power
Network benefits	• When aligned to areas of network constraints, they can defer investment that may otherwise have been needed to manage peak demand • Improve the quality of electricity supplied by our distribution network and help reduce network charges for customers by avoiding traditional network upgrades that might otherwise be required.
Funding	• Sharing across the value chain can allow for least cost deployment of distributed storage • The model we are pursuing allows, retailers access to the battery for market services, while the network can also rely on the battery for peak demand management

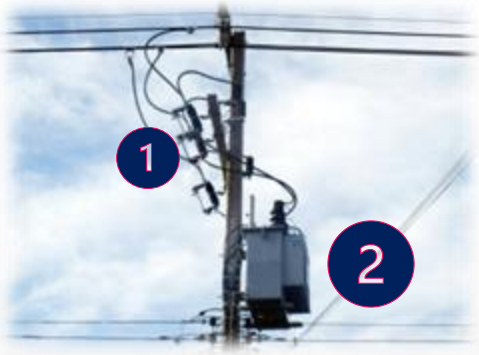
UE BESS prototype and expanded trial locations



Value stack to maximise storage benefits, minimise costs



BESS help absorb solar and manage demand



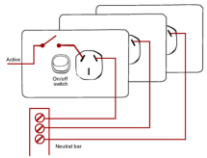
From Pilot to Program

- 3 day install
- 1.2m (Base) x 2.2m (High)
- 2x cabinet wrap around design + bracket (1750kg)
- New “straight” pole
- Dedicated crossarm
- 2x battery strings lithium NMC (650Vdc)

- 4 hour install
- All pole types
- Isolation device located rear of unit for easy access
- Single cabinet + bracket (1850kg)
- Lithium titanate single battery string (800VDC)
- Direct coupled (2x 40kW) 30kW inverter system
- Strengthened footings

DER Scheduling (IEEE2030.5)

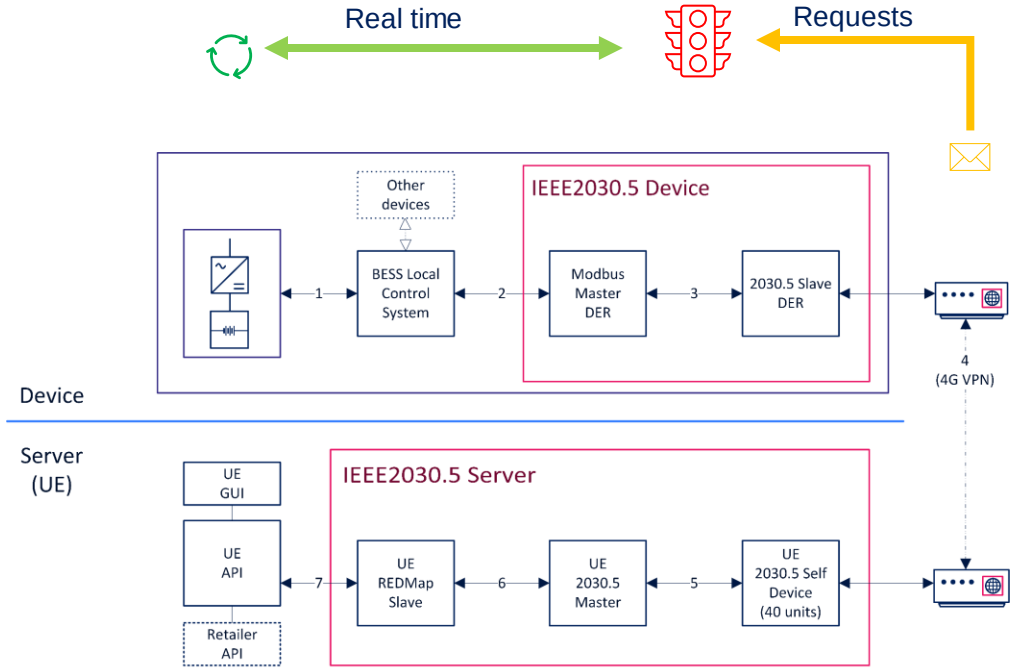
AS4777.2 Inverter
(discrete component)



Local Control System
(Modbus interconnected components)

API Control
UE IEEE2030.5

Common standard many suppliers



- Dynamic load envelopes

The path isn't always smooth

Custom built solution – Pole top BESS

Benefits	Learnings
Safety centric design	Production quality
Virtually silent operation	Defect rectification support
Significant inhouse capability building	

Commercially-off-the-shelf – Tarneit BESS

Benefits	Learnings
Cost efficient	Compliance
Strong production capabilities	
Comparatively simple to implement	

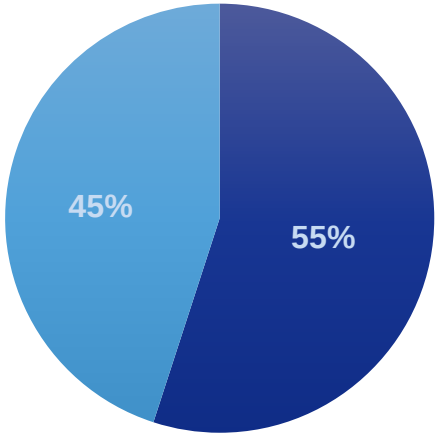
Battery location

Battery siting and location is a critical issue for battery projects, even in new developments builds as suitable land is rarely available. Batteries need to be located within a suitable exclusion zone for noise and fire risk requirements, dependant on the battery chemistry and size.

Tarneit neighbourhood battery, located on council land

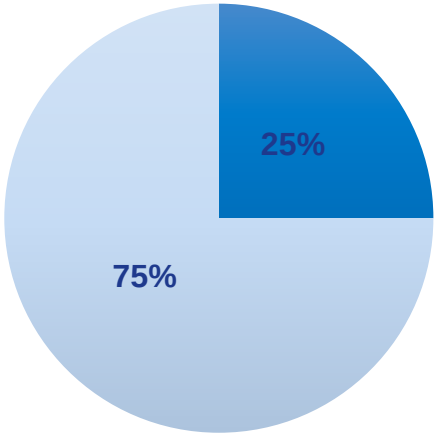
Funding & costs – Early battery project

Funding sources



- External funding
- Powercor in-kind contribution and Retailer lease

Cost



- Battery supply
- Design, Installation, Community Engagement and IT control System

- Based on current price of batteries, external support is required for feasibility
- Initial setup cost includes development of specification documents and IT infrastructure

Initial investments leading to competitive delivered costs

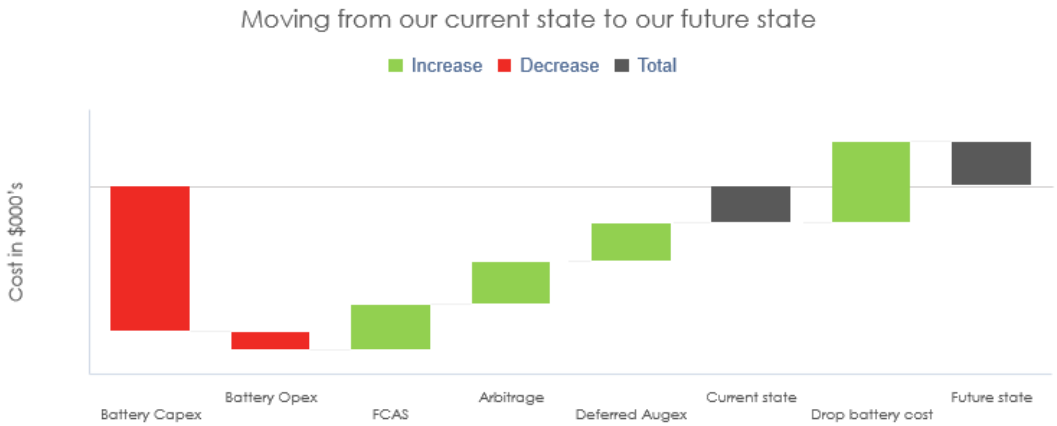
Initial investments in IT and control systems led to a high cost per kWh for early projects, with subsequent projects showing improvements of ~40%

Battery capex will be a higher proportion of overall costs for future projects, due to the decrease IT/supporting costs, which are amortised across initial projects

Total project costs include community engagement, commissioning of local artwork, Land Use Activity Agreements

Increasing competition and future estimates for delivered battery projects shows the pathway to <$1k/kWh

Modelling shows the path to commercial success will rely on cost reductions and improved battery revenues



Influences on future viability:

1. By 2030, battery costs are expected to decline by up to 50%, *CSIRO GenCost 2022-23*

1. Economic viability requires a combination of the following:
   a) Reduced up-front capital costs
   b) FCAS and arbitrage markets;
   c) Network augmentation deferrals and other network benefits;
   d) Battery specific tariff arrangements

Thank you
Questions