Optimisation of behind the meter DER generation assets within network constraints: A roadmap to successful DER program (Project-69)

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About AGL Energy
Who we are

Australia’s largest energy generator and leading energy retailer

- Proudly Australian, with 185 years’ experience of leading the energy sector
- Leading vertically integrated retailer:
  - Australia's largest electricity generator
  - Leading multi-product energy retailer supplying more than 4.3 million customer services
- Operator of the largest portfolio of renewable generation and storage assets of any ASX-listed company
- Employs nearly 4,000 people across Australia, in major cities and regional communities

AGL is leading Australia's energy transition

Connecting our customers to a sustainable future

4.3 million services provided nationally - helping our customers decarbonise the way they live, work and move

+

Transitioning our energy portfolio

Ambition to add up to 12 GW of new generation and firming by end of 2035, requiring a total investment of up to $20 billion

>

Leading the energy transition for all Australians

We will enable this transformation by ensuring a strong foundation:

ESG at the forefront

ESG at the forefront of what we do; playing a pioneering role in sustainability beyond carbon

Future focused, high performing culture

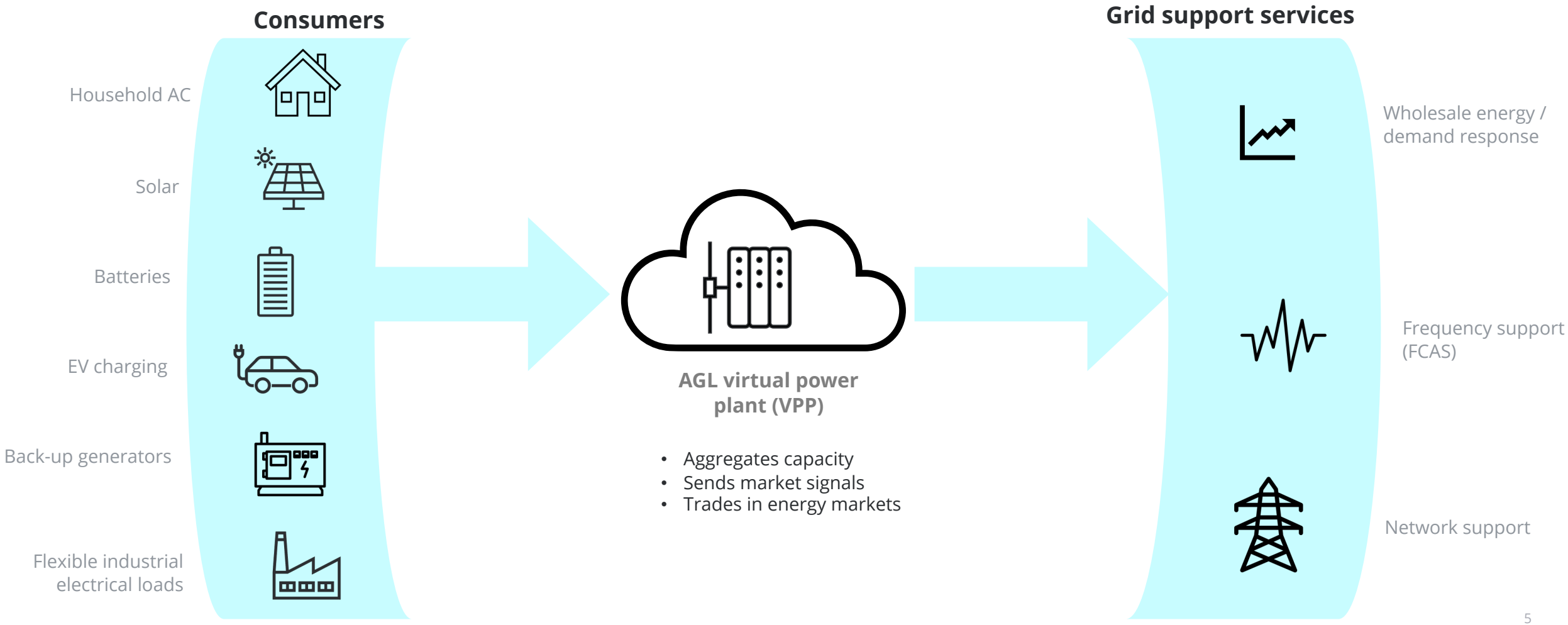
Develop and embed a future focused, purpose-driven organisation with our people as the driving force

Technology at the core

Unlocking growth through technology, digitisation and AI - enhancing customer experience as well as trading, operational and risk management capabilities

AGL's virtual power plant empowers consumers to capture additional value from their energy assets

AGL has 316 MW and growing of consumer energy assets in its virtual power plant



Demand response

Overview

AGL rewards businesses for **temporarily reducing electricity consumption** during high price events or when system stability is at risk.

Participants are generally called on to reduce demand for **several hours only a few times** a year.

AGL's DR C&I portfolio has seen significant growth of **435% since 2020** and contains some of the largest energy users in the grid

Key benefits

Participants **earn revenue** either as a fixed annual availability payment, or on a per event basis

Increase the **utilisation of existing assets** without the need for capex investment

Support the electricity grid during periods of very high demand to avoid load shedding

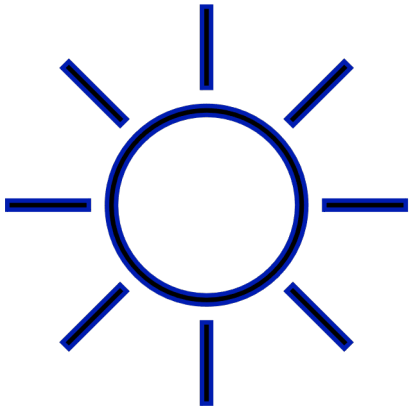
Enable a **higher penetration of renewables**, using flexible demand side solutions to help firm solar and wind supply

Improve the **reliability of back up generators** by increasing the run hours and activating them in real conditions

agl Join the change

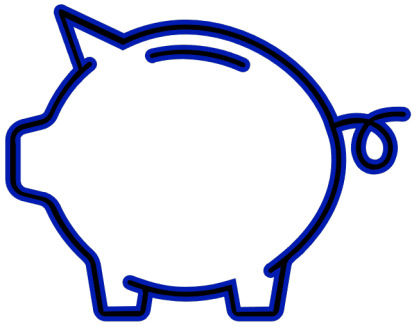
Batteries can help businesses decarbonise, increase resilience and decrease energy costs

Increase renewables uptake



Businesses can store solar energy generated onsite for later use and reduce Scope 2 emissions

Lower electricity bills



Businesses can reduce their electricity bills by reducing grid electricity consumption and network demand charges

Earn more from energy markets

AGL can earn more revenue for commercial batteries from energy markets through its virtual power plant

AGL's experience and capabilities help to make battery energy storage work for businesses across Australia

Leading solutions provider

#1 for commercial solar in Australia
AGL has the highest market share in commercial solar (SunWiz, 2023)

Full turnkey EPC capabilities
Design and engineering, procurement, project management and construction for grid-connected solar PV, standalone power systems and batteries

Dedicated asset management
Full suite of quality monitoring and maintenance services. AGL monitors over 1000 business sites across Australia

Significant battery experience

Commercial-scale battery experience
AGL has designed and installed a range of battery types for businesses including in water, electricity distribution, health, logistics and retail

Grid battery operations
AGL is currently operating 130MW GW of grid scale batteries, has 300 MW under construction and another 1.2 GW in the development pipeline

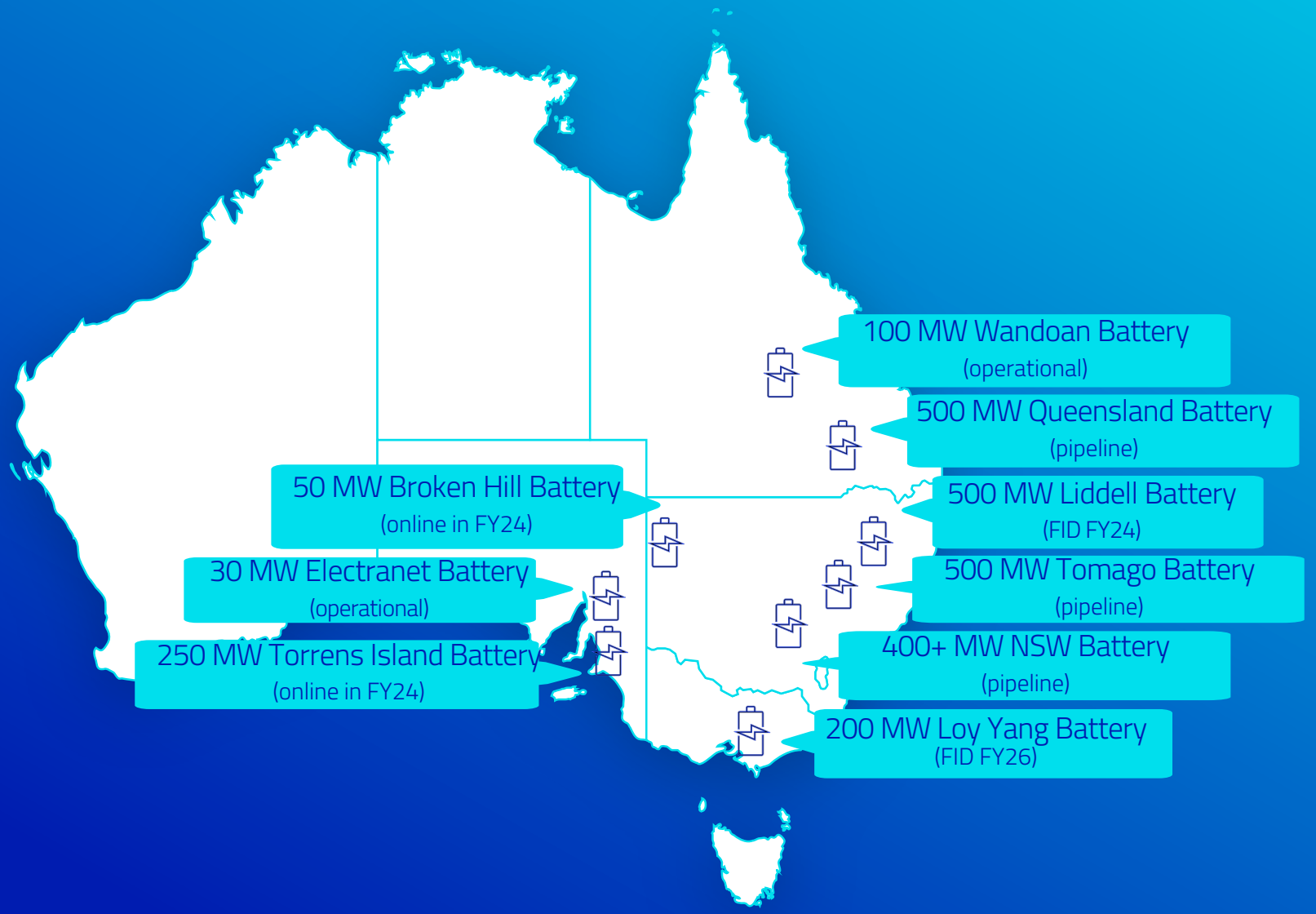
Leading residential battery VPP
AGL launched the first battery virtual power plan in Australia in 2016. It's now greatly expanded with thousands of household batteries

We create value for our customers

#1 for generation and trading portfolio
AGL has Australia's largest generation and trading portfolio.

AGL's virtual power plant
New batteries for commercial sites can join AGL's portfolio of 300MW+ of assets

To enable the energy transition, AGL has 430 MW grid batteries operational/under construction and 2.1 GW in the pipeline



AGL is powering Essential Energy's network battery

- AGL constructed and commissioned a 1MW / 2MWh battery for Essential Energy
- The battery can store enough energy to power 1600 households in Port Macquarie for two hours

Customer benefits

- Increases reliability of the local poles and wires network
- Network services of voltage support, frequency stabilisation and reduced network demand
- Increase network capacity to help residents and businesses install and export more solar

AGL capabilities

- Full EPC solution
- Design of a new battery control system
- Participation in AGL's 316 MW virtual power plant

AGL's Virtual Power Plant earns revenue for concreting company's Tesla Megapack

- Concreting company Elvin Group has a large (2.6 MW, 5 MWh) Tesla Megapack battery in Canberra
- AGL enables the battery's access to energy markets

Customer benefits

- AGL earns wholesale and frequency control ancillary services (FCAS) revenue for the Elvin Group's
- The battery supports the stability and security of the grid
- Elvin Group is trialling an innovative battery network tariff

AGL capabilities

- Demand response service provider to provide FCAS services to AEMO
- Ingestion of high-resolution real-time data from the battery into AGL's VPP with automated bidding into 5 minute markets
- Revenue co-optimisation across markets

Project Overview

WP-1: Machine learning for C&I customers' baseline improvement

- Identify the correlation between the C&I customer demand and weather parameters
- Apply machine learning techniques to improve the C&I customer baselines/ demand prediction

WP-2: Unlocking the potential of participation of backup generators in demand response

- Identify the main factors contributing to back-up generator export limitations
- Identify the strategies to improve back-up generator export limits
- Feasibility study of biodiesel for backup generators

WP-3: Identify tariffs that can incentivise the uptake of batteries

- Developing a battery optimization tool for a C&I customer
- Analysing battery behaviour at site level and its network impact
- Recommendations for the network tariff structure to increase uptake of batteries

Roadmap for successful implementation of demand response for C&I customers

Overview of WP-1 & WP-2

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Roadmap for successful implementation of demand response for C&I customers

WP-1 & WP-2 Recommendations

- Machine Learning Techniques for Baseline Calculations.
- Dynamic Export Limits for Backup Generators.
- Flexible Operating Modes for Backup Generators.
- Consistent Inter-tripping and Synchronisation Standards.
- Biodiesel for Backup Generators.

Overview of WP-3

WP-1: Machine learning for C&I customers' baseline improvement

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Roadmap for successful implementation of demand response for C&I customers

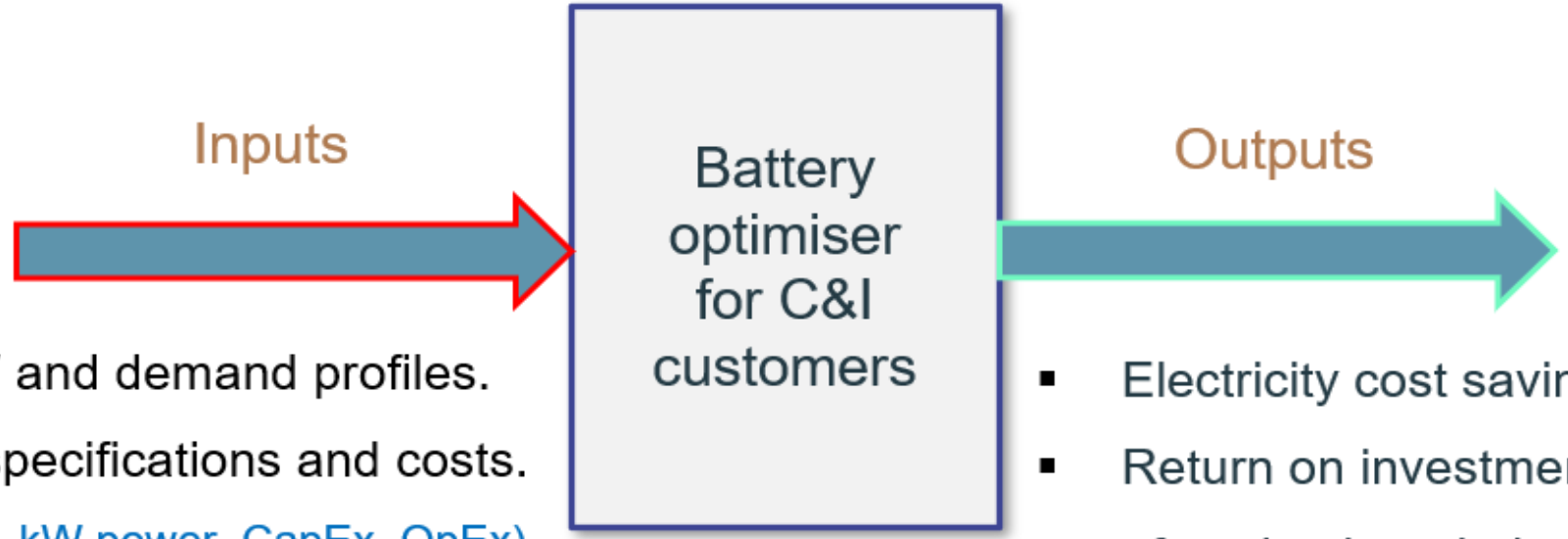
WP-3 Findings

Identify tariffs that can incentivise the uptake of batteries

WP-3 Scope

- Review of existing network tariff structures for C&I customers.
- Develop a battery optimisation tool for a C&I customer based on the load profile, battery size, tariff, and onsite solar generation.
- Assessment of the impact of tariffs on uptake of batteries.
- Analyse battery behaviour at site level and its network impact.

Developed Optimisation Tool Overview



- Solar PV and demand profiles.
- Battery specifications and costs.

(kWh capacity, kW power, CapEx, OpEx)

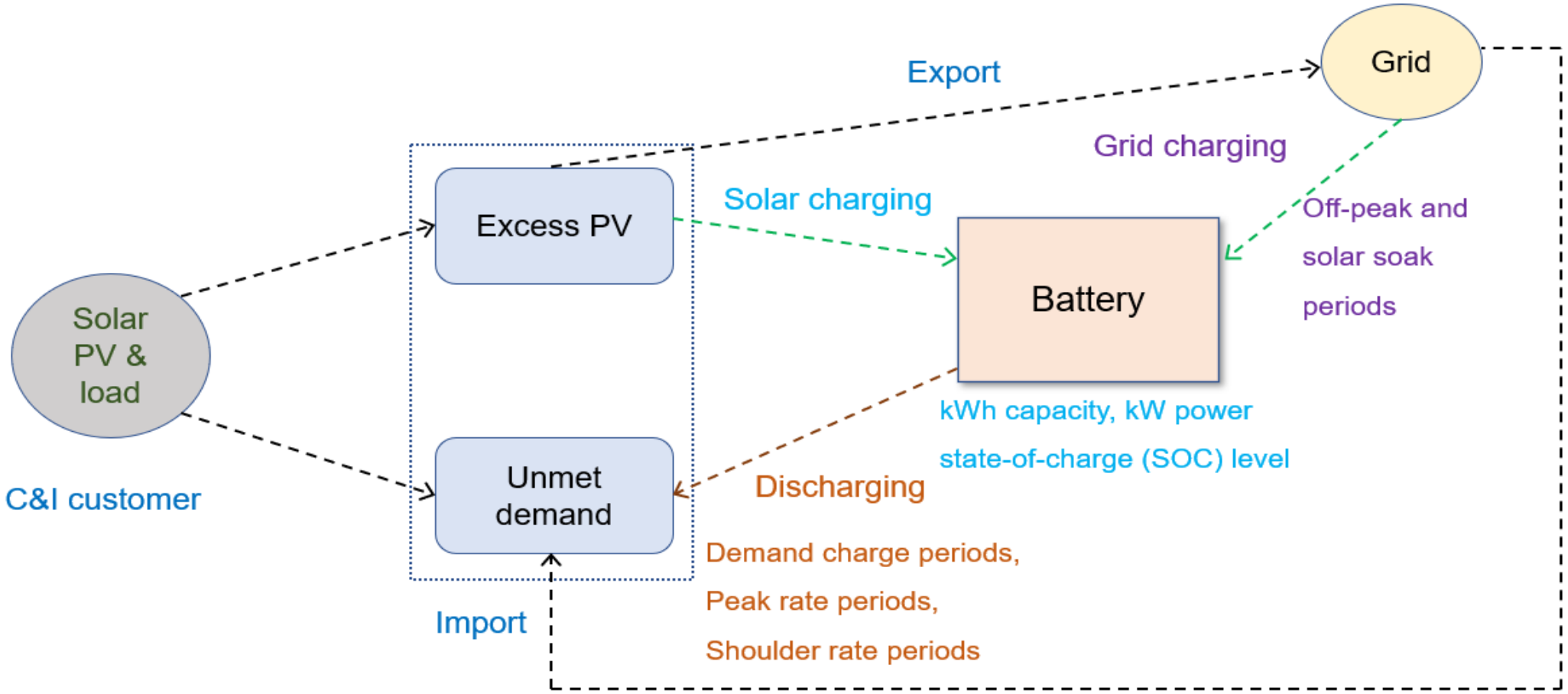
- Tariff structure (without and with battery trials.

(Peak, off-peak, and shoulder times and rates,

demand charge, capacity charge, supply charge).

- Electricity cost saving analysis.
- Return on investment in terms of payback periods.

Battery Optimiser Overview

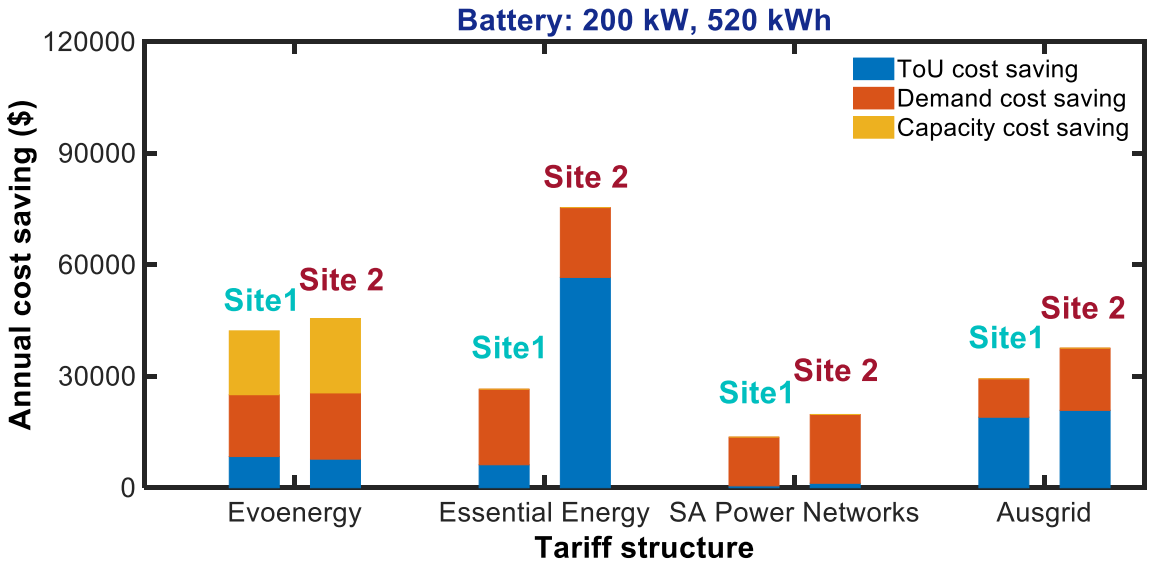


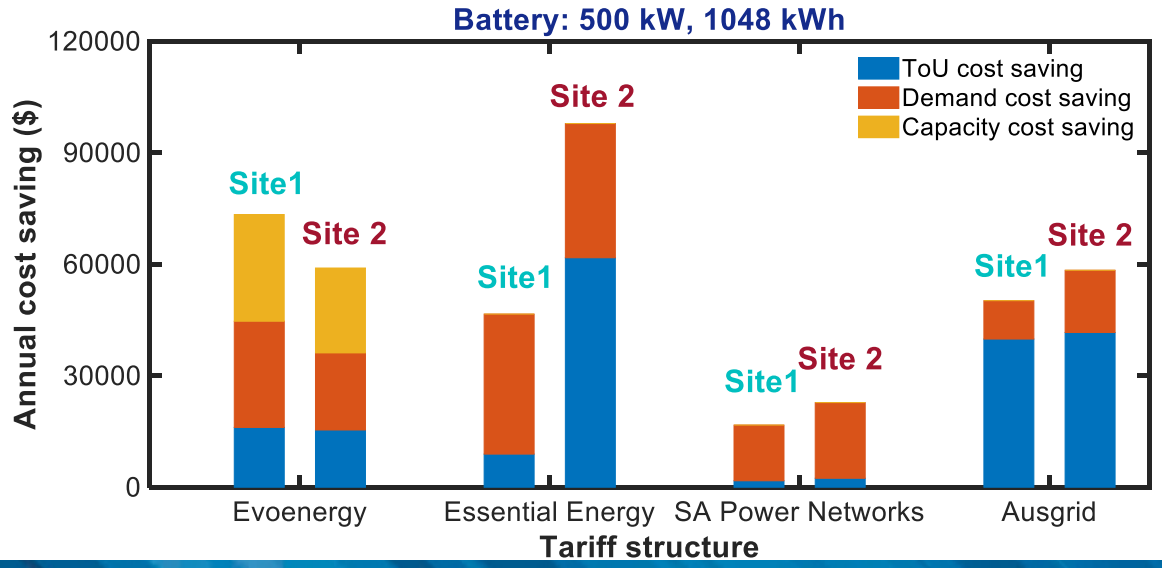
Analysis of Different Tariff Structures

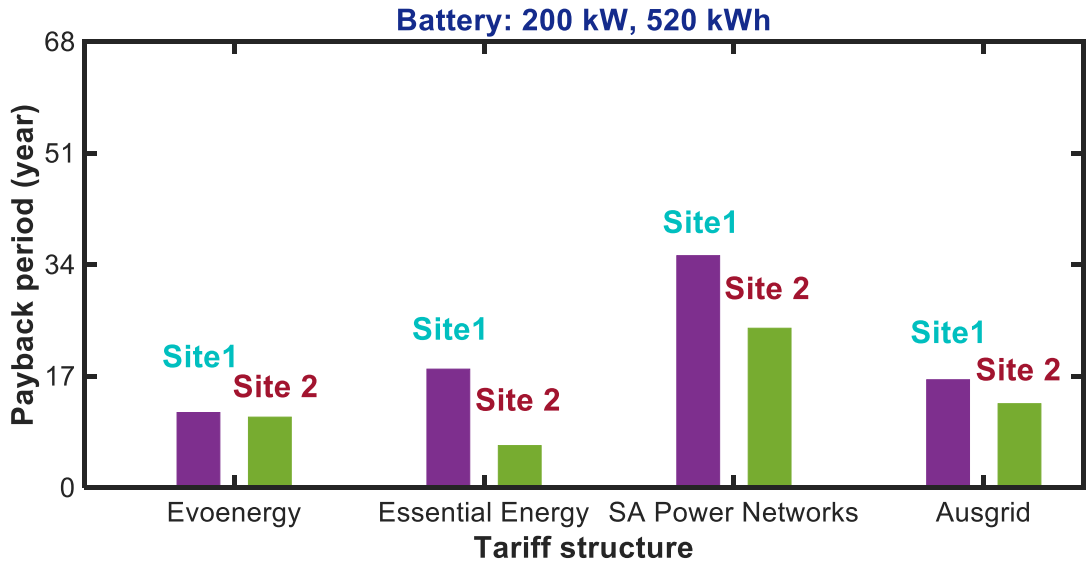
Studied C&I Sites

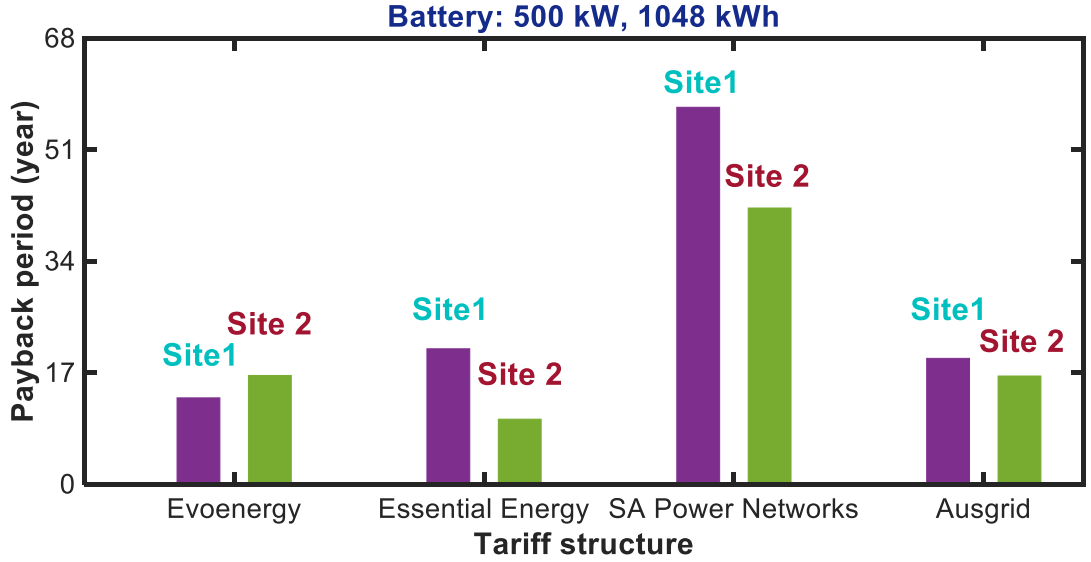
- **Site 1 (Cold Storage Warehouse, 1.5 MW PV, considerable high load)**
- **Site 2 (Manufacturing, 3 MW PV, high load)**
- Site 3 (Shopping Centre, 745 kW PV, low load)
- Site 4 (Supermarket, 400 kW PV, considerable load)

Case Study 1 (Base Case)

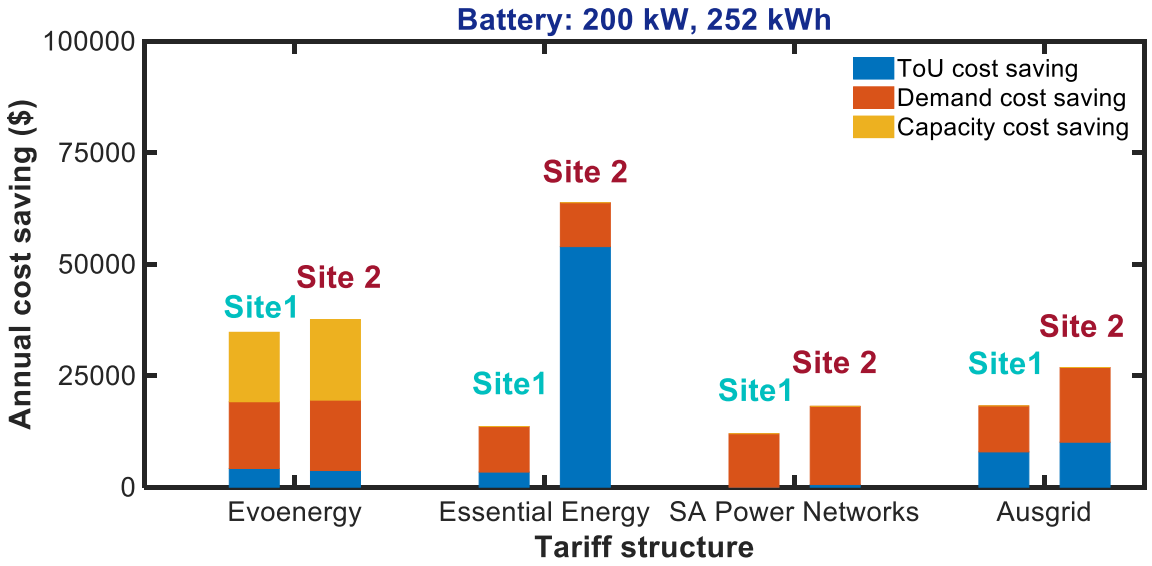


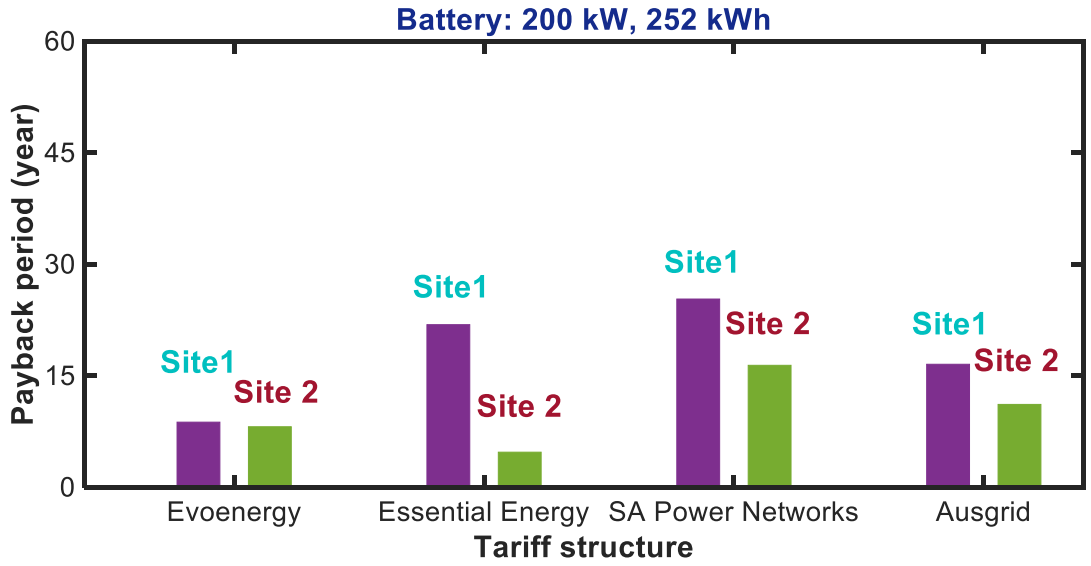


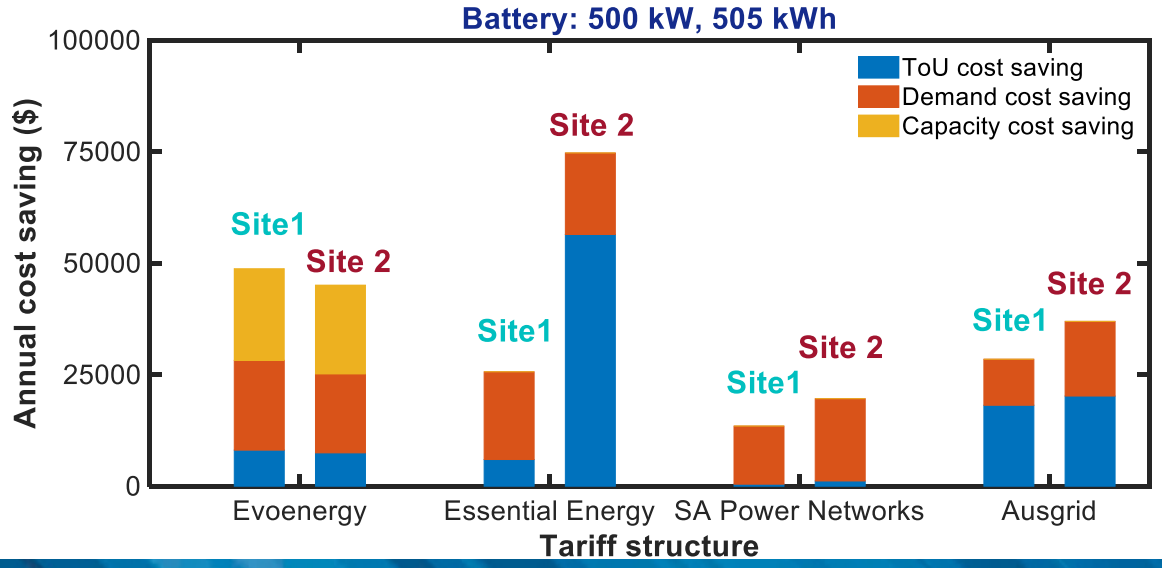


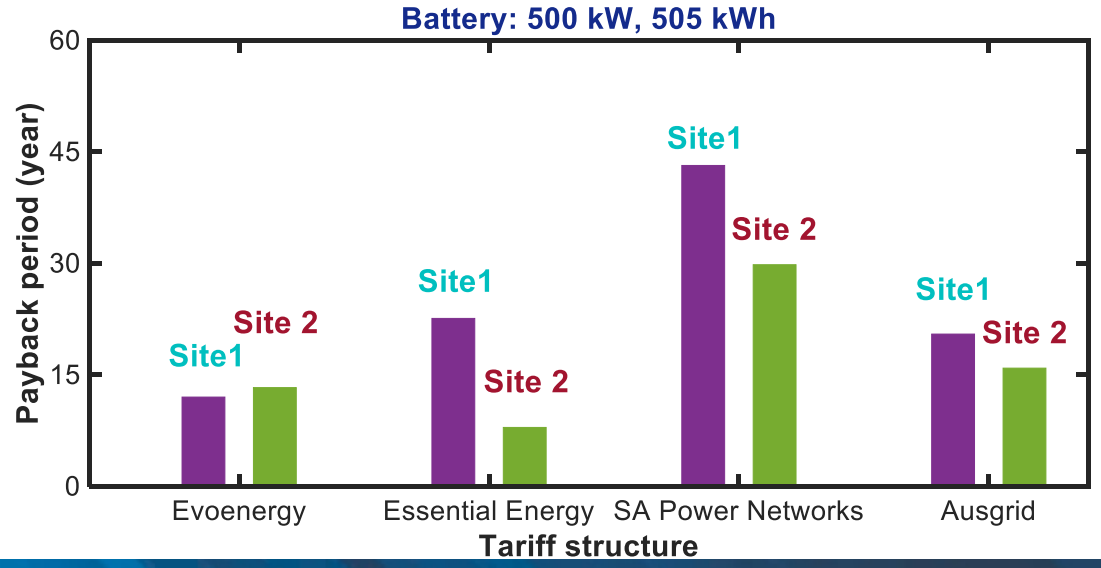


Case Study 2 (Decreased Battery Capacity)

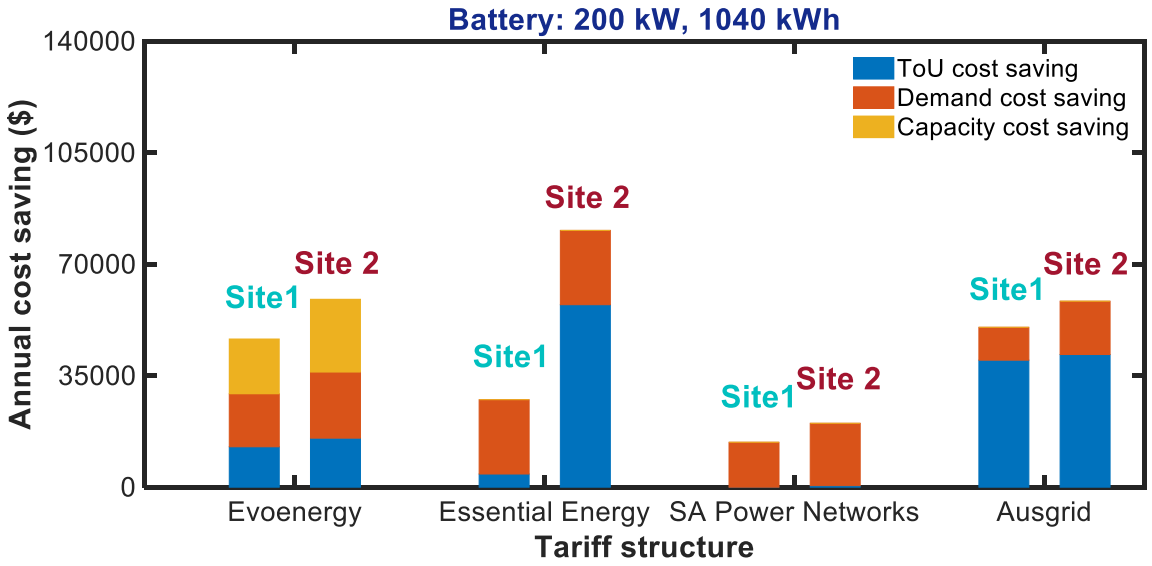


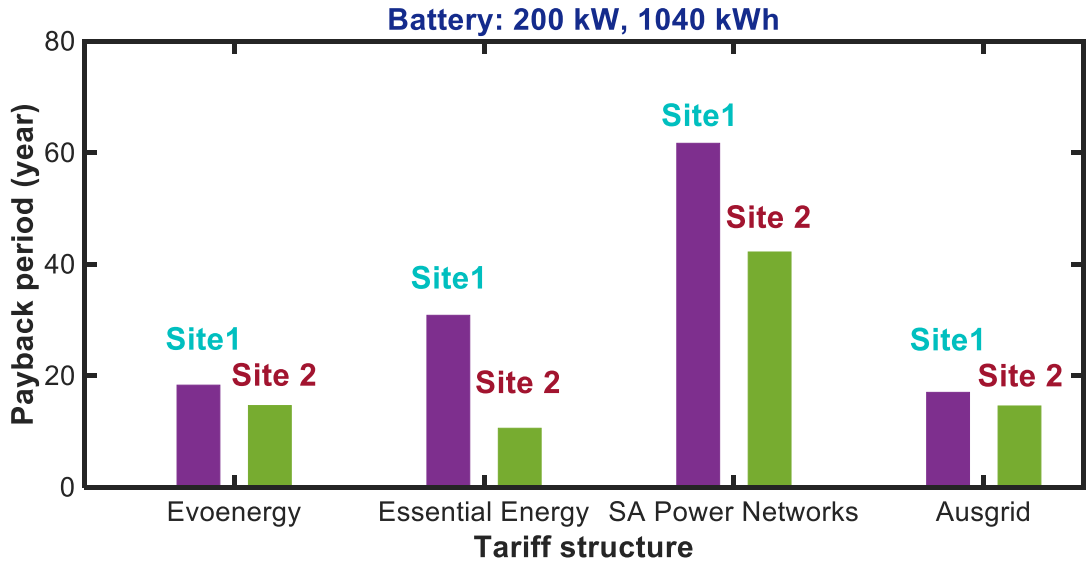


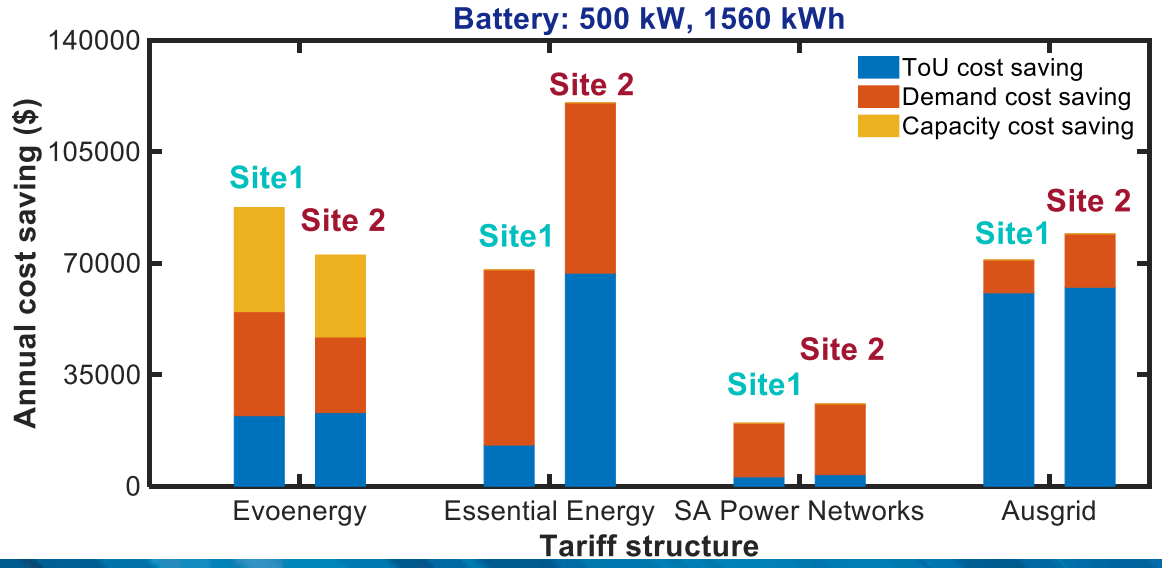


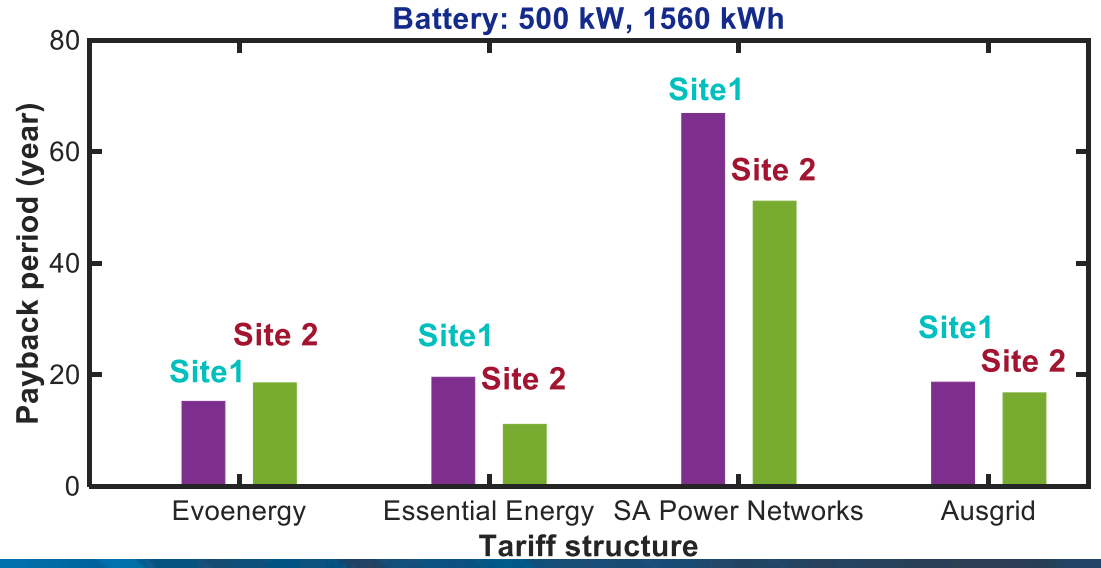


Case Study 3 (Increased Battery Capacity)







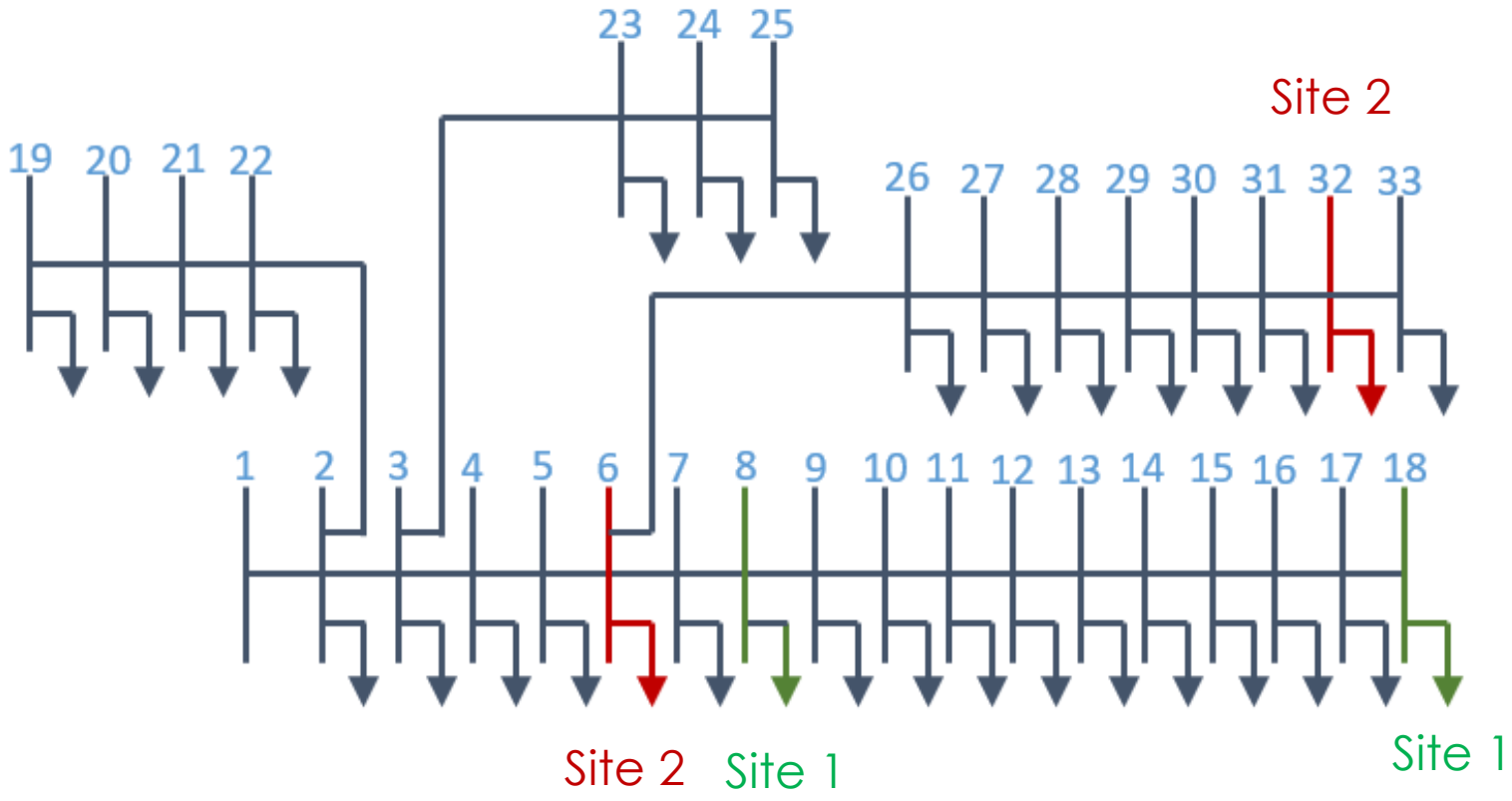


Summary

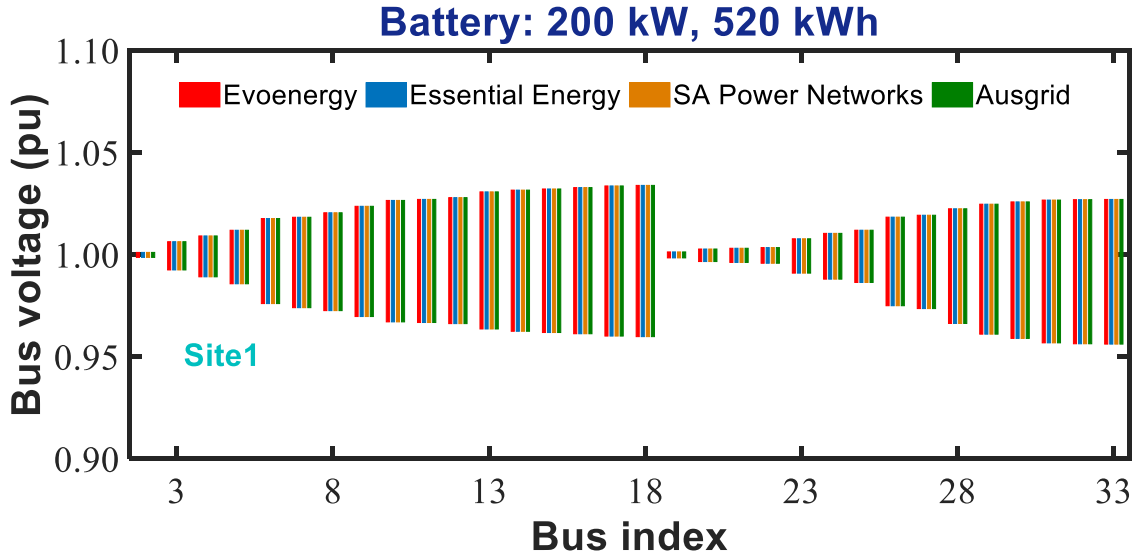
- Cost saving depends on various factors, including battery size, load and solar PV profiles, and the tariff structure.
- Payback period also depends on various factors, including battery size, battery cost, load and solar PV profiles, and tariff structure.
- Payback period in the trial tariffs are lower than that of standard ones.

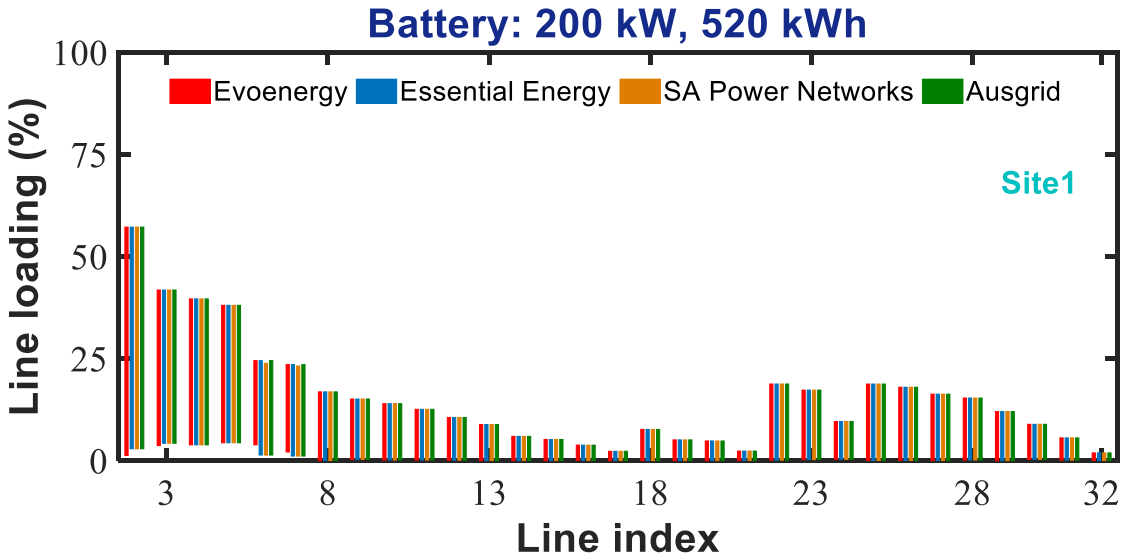
Network Impact Studies

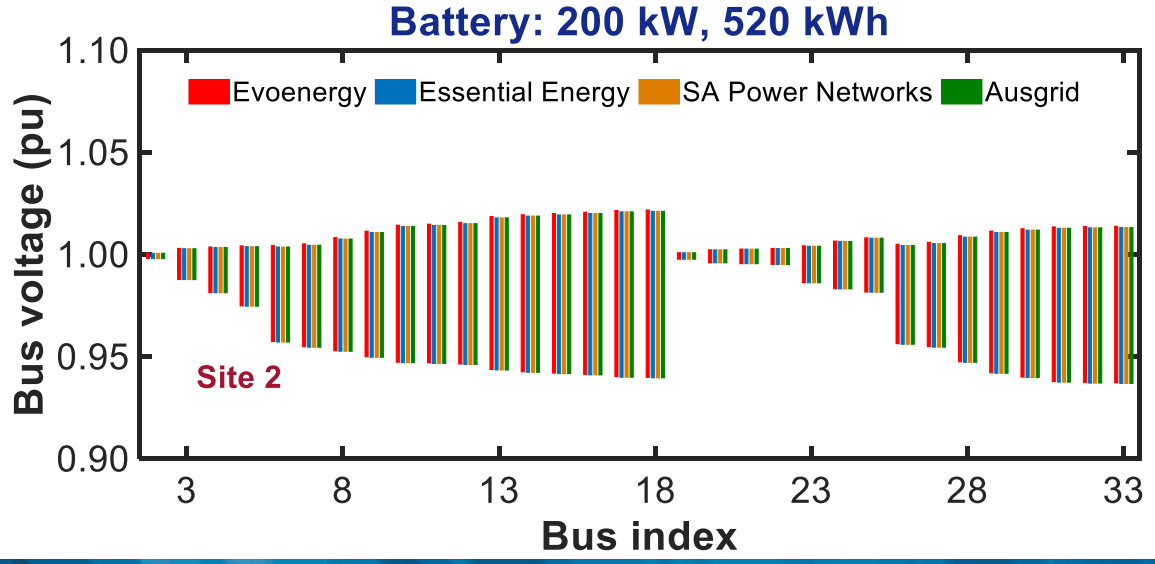
Representative Power Distribution Network

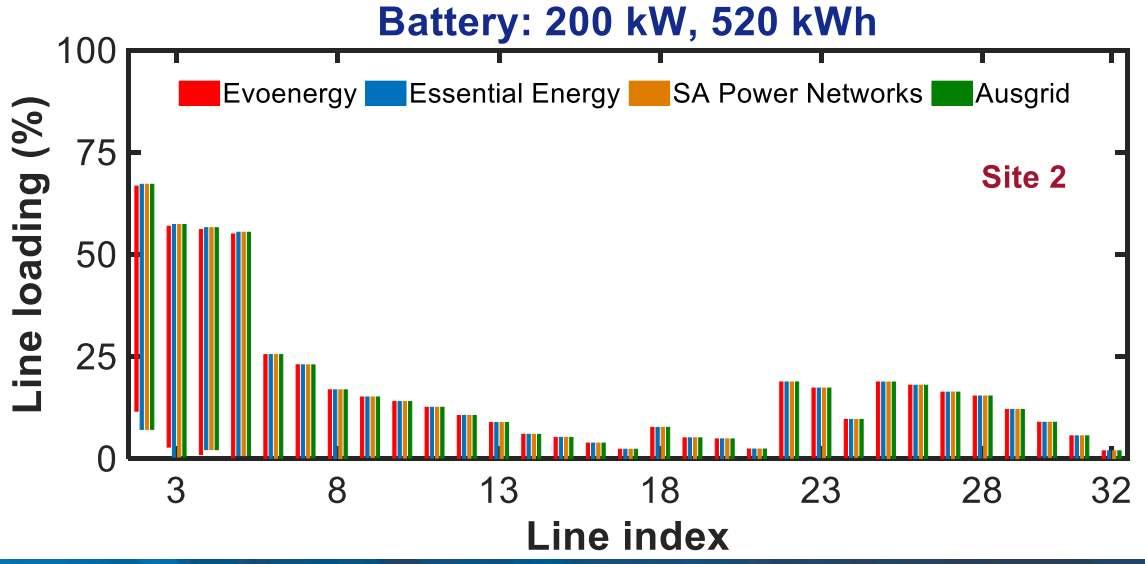


Case Study 1 (Located at the Middle of the Feeder)

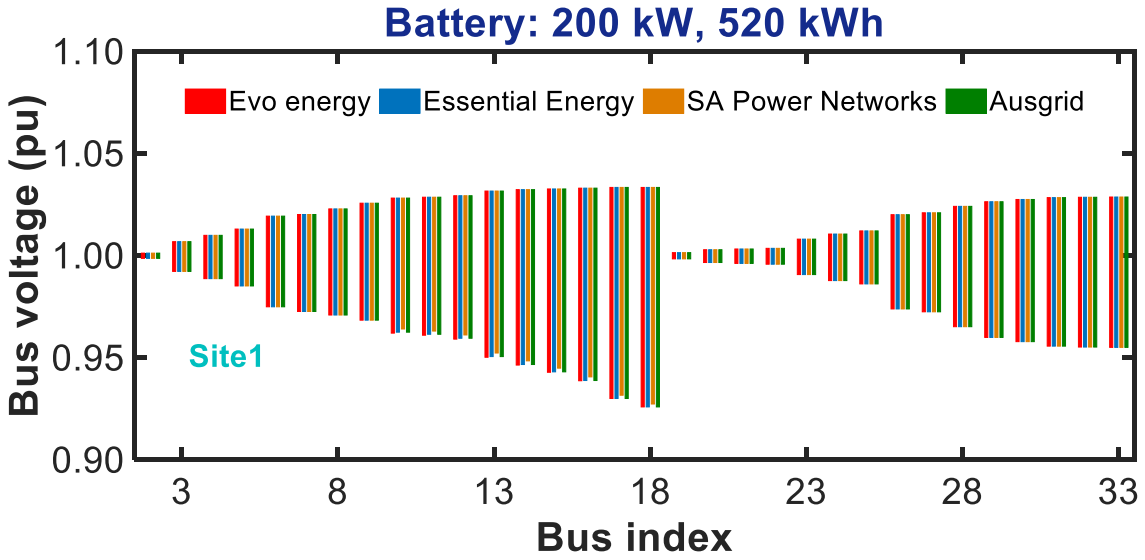


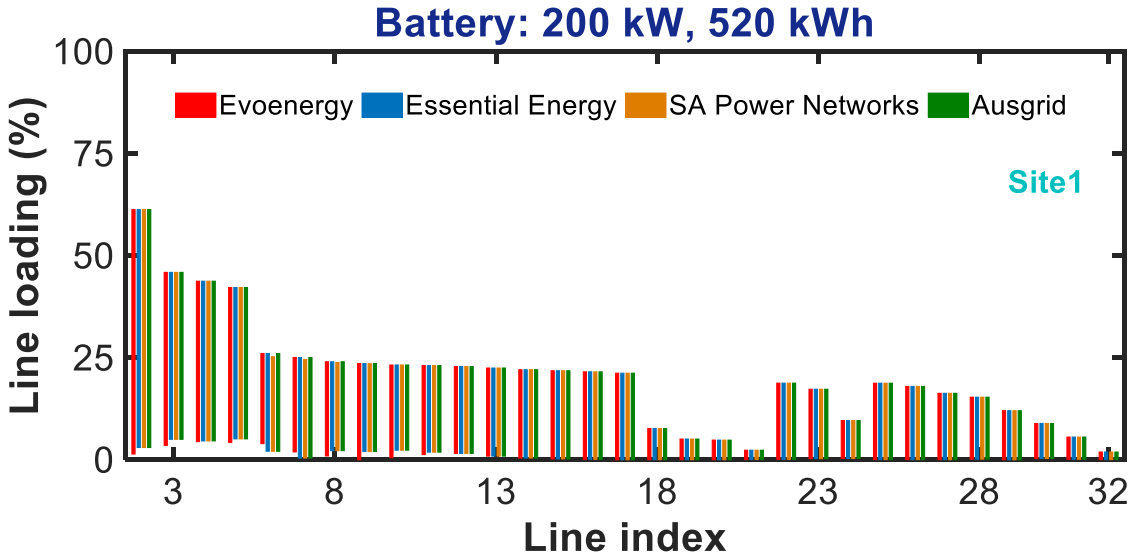


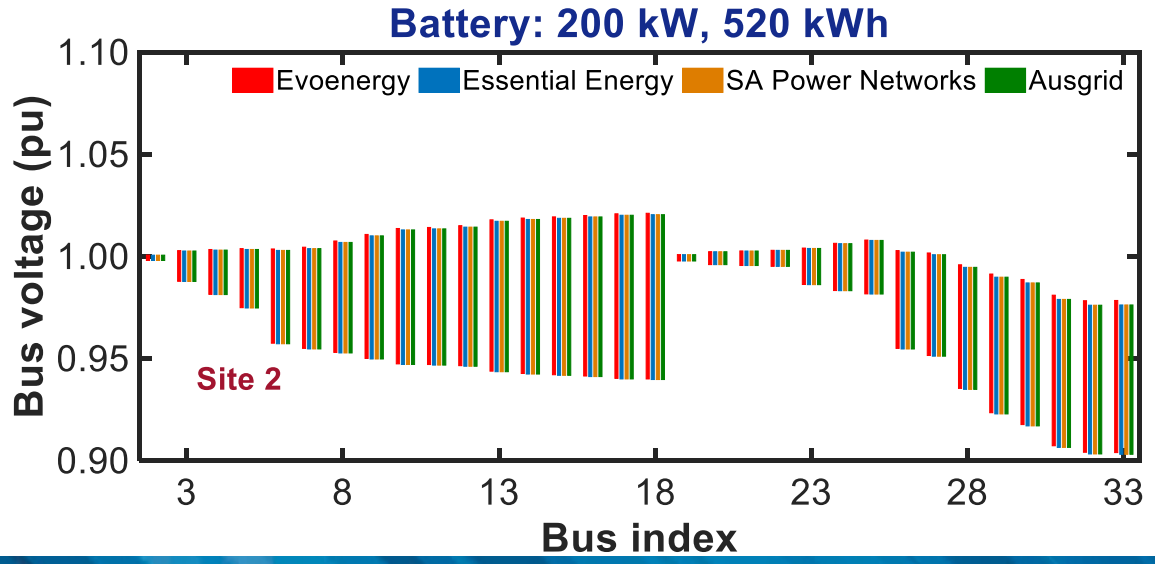


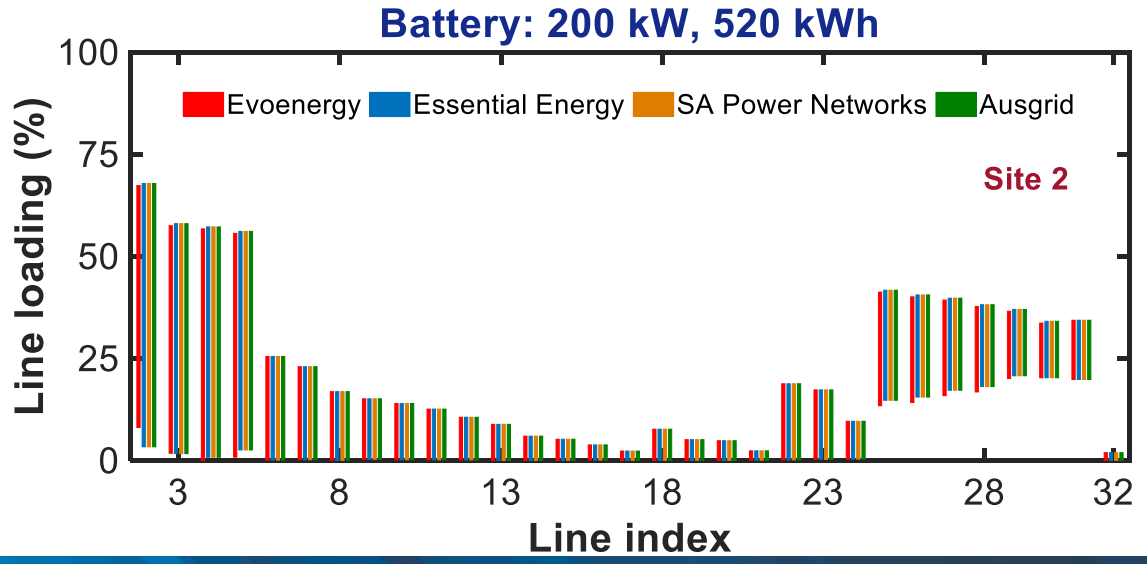


Case Study 2 (Located at the End of the Feeder)









Summary

- Voltage magnitudes and line loading do not vary significantly under the considered tariff structures and batteries.
- The battery can have more impact on voltage and line loading if the C&I customer is connected at the end of the feeder.
- Both voltage magnitudes and line loading are within the limits in the studied cases.

WP-3 Recommendations

1. Tariffs for Batteries –

- Studied tariff trials, i.e., Evo Energy, Essential Energy, SA Power Networks, and Ausgrid, provide higher saving for C&I customers in comparison to standard tariffs.

- Tariff reforms such as introducing a gap between peak and off-peak prices as well as solar soak periods could help customers with achieving more savings, which would ultimately promote higher uptake of batteries.

WP-3 Recommendations

2. Reduced Battery Price –

- The payback period for C&I customers could be long due to the high battery price. Therefore, in order to achieve the target payback period, potential grants could incentivise the uptake of batteries.

- While it is anticipated that batteries will provide various market and network services, the reduction in prices will help to make C&I batteries financially viable.

WP-3 Recommendations

3. Ensuring Network Integrity –

- Deployment of a large number of behind-the-meter batteries by C&I customers can potentially result in violation of network constraints. Therefore, it is recommended to explore the adoption of concepts such as the dynamic operating envelope (DOE).

Optimisation of behind the meter DER generation assets within network constraints: A roadmap to successful DER program (Project-69)

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