ENERGETICS

Tetris Energy

Report for the Department of Environment, Land, Water and Planning

31 August 2022 |126898

Agenda

1.0	Executive summary
2.0	Introduction
3.0	Participant loads
4.0	Overview of BESS business models
5.0	Financial assessment
6.0	Decision making framework
7.0	Discussion of preferred models
8.0	Appendix

1.0 Executive summary

Purpose of this report

This report provides the Department of Environment Land, Water and Planning (DELWP) with the results of an assessment of various commercial models for a community battery associated with the Port Fairy Battery Energy Storage System (BESS). This project is a grant recipient under the Victorian Government's Neighbourhood Battery Initiative (NBI) in the "Project Development" category.

The Port Fairy Smart Energy Precinct is a collaboration between Tetris Energy (Tetris), several members of the Port Fairy Smart Energy Precinct (PFSEP) and the Rivers Run Estate housing development to investigate how a Commercial & Industrial (C&I) community battery may help achieve a range of objectives, including increased renewable energy uptake, reliability and virtual storage. Specifically, this project seeks to identify commercially rational models by considering the possible revenue streams and underpinning contracting strategies.

Steps undertaken

- Project kick-off
- Agree on draft straw models
- Financial modelling
- Workshop *25 July*
- Agree on preferred commercial models
- Develop report for DELWP
- Report to DELWP *19 August*

Recommendations and key findings

Following consultation with relevant stakeholders, five commercial straw models were proposed that aligned with the needs and objectives of the Port Fairy participants. These straw models were then assessed to illustrate the potential business case for a community battery and determine the most viable business commercialisation pathway for a community BESS amongst the group of potential participants in the PFSEP that will meet their intended objectives.

The results from the financial modelling undertaken indicate that while there are evident financial benefits to the PFSEP participants that manifest through a reduction in their energy and network charges, these savings are currently unable to overcome the capital costs for the installation of a BESS.

This report identifies additional potential value streams that could serve to supplement the value shortfall and bridge this gap. In addition, this report looks beyond the financial outcomes of a BESS and articulates the potential for additional co-benefits that the straw models could bring about. In doing so, a potential commercialisation pathway is proposed while highlighting the challenges that will need to be overcome.

2.0 Introduction

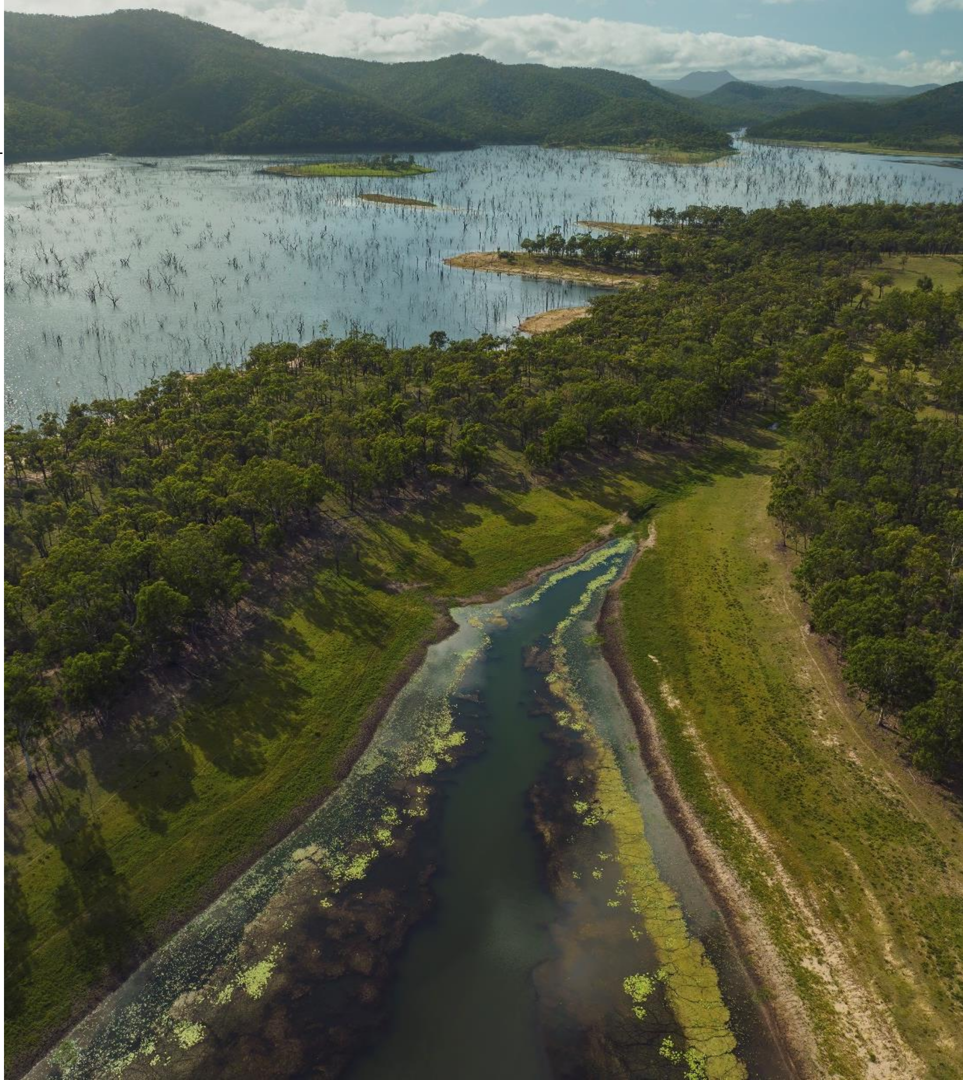
Purpose of the project

Determine if a community BESS is commercially viable amongst the group of potential participants in the Port Fairy Smart Energy Precinct (PFSEP), taking account of the size and shape of participants load, energy cost and behind-the-meter generation capacity.

Explore potential commercialisation pathways for the commercial model deemed most optimal for the PFSEP.

Report objectives

- Define commercial principles to guide the PFSEP's assessment of models
- Evaluate the commercial viability of straw models, which includes consideration of:
  - results of financial assessment undertaken by Energetics
  - risk appetite of PFSEP participants
  - energy generation capabilities of PFSEP participants
- Determine the most viable business commercialisation pathway for a community BESS amongst the group of potential participants in the PFSEP



3.0 Overview of the participants

Summary of individual electrical loads of Port Fairy participants

The Port Fairy Smart Energy Precinct constitutes three C&I customers and the Rivers Run Estate development, comprising of 94 residential homes. Due to inherent differences in the operational profile of participants, there is considerable variation in their individual consumption profiles. Moyne Health has a typical commercial load profile with peak consumption in the middle of the day while a residential load has been assumed for the Rivers Run Estate. On the other hand, meter data for Southern Ocean indicate a relatively flat profile which is attributable to a stable load across the day. Finally, BAM Stone illustrates a peak load in the mid mornings between the hours of 7-9am.

In addition, while all sites are known to have access to rooftop PV, there remains diversity in the underlying load shapes, with excess solar generation in the middle of the day for the Rivers Run Estate and BAM Stone. On the other hand, consumption for Moyne Health and Southern Ocean exceeds rooftop PV generation.

The individual profiles pre and net of solar for each participant are subsequently illustrated in this section while also detailing the underlying assumptions that were used to derive the estimated load.

PFESP is a collaboration between local business in the Port Fairy community

Moyne Health Services	Moyne Health Services is a public health care service, supporting needs of people living in Port Fairy, Koroit and surrounding Moyne Shire communities. Moyne Health Services has provided care for the community for more than 160 years.
BAM Stone	Over four decades and three generations, BAM Stone continues to source the same sustainable basalt supply and has grown to become the largest stone processing facility in the southern hemisphere, distributing Victorian bluestone products in a variety of finishes around the world.
Southern Ocean Mariculture (SOM)	SOM started as a business in February 1996 and commenced building one of the first abalone farms in Australia in April 1996. The business was started by a group of local Port Fairy abalone divers.
Rivers Run Estate	MM Hearn Constructions is the proponent of the innovative Rivers Run Estate development. The 94-lot subdivision is seeking to implement cutting-edge sustainable house design, incorporating market leading energy efficiency solutions. The team specialises in designing and building Homes, Aged Care, Health and Education facilities, Hospitality, Retail and Public spaces and Commercial buildings.

Map of Port Fairy

Summary of participants average daily consumption profile

[redacted]

Commercial in confidence

Average daily profile of participants (net solar)*

Commercial in confidence

Participant load assumptions (C&I)

Commercial in confidence

Participant load assumptions (Rivers Run Estate)

- Residential load derived from Warrnambool substation (closest network substation with a representative residential load)
- Warrnambool substation load shape (net of local rooftop PV) adjusted with rooftop PV data from the Clean Energy Regulator (CER) to derive a profile of underlying demand

[redacted]

Commercial in confidence

[Powercor substation data]
[Clean Energy Regulator]

Summary of potential BESS use case based on participant load

Participant	Type	Description of load	Potential BESS use case
Rivers Run Estate	Embedded network	Commercial in confidence	Load shifting can be implemented using a BESS to soak up excess rooftop PV in the middle of the day and discharge when embedded network is importing from the grid
Moyne Health	C&I load		Could benefit from BESS charging off cheap PV in the middle of the day and discharging during intervals of peak pricing
BAM Stone			BESS could be used to charge off excess rooftop PV and discharge during non-solar hours to achieve 100% renewable energy.
Southern Ocean			Could benefit from BESS charging off cheap PV in the middle of the day and discharging during intervals of peak pricing

4.0 Overview of BESS business models

In this section, five commercial straw models are developed to cater for the two customers groups*.

Whilst the models are presented separately, we note that these are not mutually exclusive and may be combined in future to meet collective's objectives.

In the following slides we outline

- Key building blocks
- Product delivery streams
- BESS revenue streams
- Detailed description of models and their components

** Residential and commercial groups were separately considered to ensure modularity in the models proposed, thereby allowing for models to proceed should any individual party choose not to participate in the project.*

Building blocks and considered value streams

Beyond pure financial input variables, other key design parameters influence the accessible value streams and the risks that the PFSEP and its individual customers may be exposed to include:

Building blocks of commercial models

Asset

Ownership
Location
Operation

Energy source

BESS charging source (e.g. rooftop PPA, renewable PPA)

Delivery channel

Electricity retailer, BESS aggregator or Network service provider

Value streams accessible by BESS

- Forward markets
- Spot markets
- Network tariff
- Network services
- Reliability and Emergency Reserve Trader (RERT)
- Frequency Control Ancillary Services (FCAS)

The delivery channel is operated by different 'market participant classes' that under regulations can access different BESS value streams

Value streams →

Who can access the opportunity? ↓

	Forward markets	Spot markets	Network tariff	Network services **	RERT	Contingency FCAS***
Registered retailer*	✓	✓	With value sharing agreement	✓	Yes if a RERT panel participant	✓
Registered aggregator	Requires an AFSL and spot exposed asset	If working with a spot exposed asset	With value sharing agreement	✓	Yes if a RERT panel participant	✓
Network Service Provider****	✗	✗	N/A	Will engage with market for services	Yes for regulated assets only	✗
Customer	Requires a third party	If spot exposed	✓ On whose site the BESS is located	✓	Yes if a RERT panel participant	✓

* *Under special circumstances such as embedded networks, an exemption to a retail licence can be used, however the exemption will still need to be granted.*

** *The market will also value a service differently, depending on whether a network area is, amongst other considerations, constrained, remote or close to major load centres.*

** *Please note under the Market Ancillary Services Specification (MASS), regulation FCAS is not an attainable revenue opportunity for DER.*

*** *Much of the network value stack is currently theoretical (beyond pilots and trials) and will be difficult to include economically until the relevant DNSP has some kind of DER marketplace or alternative solution for passing on value.*

Brief description of value streams

Use case	Description of revenue opportunity	Opportunity
Load shifting, energy exports and energy arbitrage (retail commodity cost)	Commercial terms of the electricity Retail Services Agreement (RSA) are the dominant factor influencing the ability to extract value from microgrid price responsiveness. The scale of the revenue opportunity for load shifting or arbitrage is principally determined by: • available volume of energy that can be shifted from one period to another multiplied by the price difference • the ability to move energy between periods more frequently (for example number of cycles per day) • any energy losses or other costs incurred in energy storage and conversion	Many of the new commercial models offered by retailers in the National Electricity Market (NEM) create incentives for the consumer to manage consumption during periods of high market prices. Reduced variability in load can also be rewarded with lower risk premiums incorporated into Retail Agreement prices. Commercial arrangements that fully expose the end user to spot-market prices provide the greatest opportunity to exploit variability in market prices. In doing so many of the risks normally managed by the retailer are transferred to the costumer which may create market exposures in excess of the risk tolerance of the consumer.
Site peak demand management (network tariffs)	This service – also referred to as “peak lopping” - is transacted through Network Service Providers (NSP) via network charge pass through in retail electricity supply contracts. Networks typically recover costs based on: • the maximum demand an end user load places on the network (i.e. demand charges); and • the energy usage by the end user. Reducing the peak demand an end user places on the network or shifting the time of peak demand to a period of lower network utilisation, can deliver network charge cost reductions to end users. The load coordination capabilities and controllable distributed energy resources in microgrids (e.g. adjusting temperature set-points on Heating, Ventilation and Air-conditioning (HVAC) plant, shifting non-critical loads outside of the periods of peak demand, using energy storage (both thermal and electrical) to manage the timing and magnitude of peak demand) is able to better unlock this revenue stream.	Some network tariffs include strong incentives for users to manage loads during periods of high network utilisation, for example during extreme temperature days in summer. An example of this is the AusNet Critical Peak Demand tariff which rewards end users for reducing demand on 5 high demand days during summer nominated by AusNet.

Brief description of value streams

Use case	Description of revenue opportunity	Opportunity
Contingency Frequency Control Ancillary Services (FCAS)	FCAS are used by the market operator (AEMO) to maintain the frequency on the electrical system by both lowering system frequency (Lower services) and increasing system frequency (Raise services). The growing proportion of electricity supplied from generation utilising variable renewable energy resources such as wind and solar is driving increased demand for FCAS services to ensure power system security. Furthermore, retirements of aging coal and gas fired thermal generation plant – the historical suppliers of FCAS – diminishes the resources available to provide FCAS. In response the FCAS market value in some states have demonstrated notable increases in recent years, with FCAS revenue constituting a large share of the revenue base for both grid scale and behind the meter Battery Energy Storage Systems (BESS).	In the NEM, AEMO uses FCAS to manage frequency deviations under system normal conditions (regulation services) and in response to disturbances (contingency services) such as the sudden reduction in the output of a large generator. FCAS is used to both lower system frequency (Lower services) and increase system frequency (Raise services). FCAS dispatch is via a market mechanism that is fully co-optimised with the energy market with a regulatory framework that facilitates commercial arrangements with operators of microgrids, either by direct market participation or via third-party aggregators.
Network support services (i.e. demand management program that responds to network signals)	By nature, this service is very location specific, based on deficiencies in a network and a Distribution NSP's specific program and PFSEP participant's capability to reduce demand on the network at the location at the time of a constraint. Distribution Network Service Providers (DNSPs) and Transmission NSPs are encouraged by the Australian Energy Regulator (AER) to find lower-cost alternatives to upgrading electricity networks. Significant upgrades or replacement of aging network infrastructure in AER regulated jurisdictions are subject to a Regulatory Investment Test (RIT). As part of the RIT non-network infrastructure options such as consumer demand response, battery storage, or embedded generation are generally examined. This process can lead to Network Service Providers making network support payments to defer or delay network asset capital expenditure. The financial benefit that can be realised is dependent on the specific NSP's demand management program.	A separate assessment is required to confirm if there is an opportunity in the PFSEP area. However, a review of network opportunity data (specifically Available Distribution Capacity and Annual Deferral Value – see slide 58) developed by Energy Networks Australia does not indicate that there are deficiencies in the network at present.

Brief description of value streams

Use case	Description of revenue opportunity	Opportunity
Emerging services	The growing proportion of electricity supplied from generation utilising variable renewable energy resources such as wind and solar, and connected via electronic power conversion systems (inverters) has led to concerns over the ability to maintain a secure and reliable power system designed around traditional synchronous (electro-mechanical) generation systems. To address the changing generation mix, the introduction of new market services such as the provision of Fast Frequency Response, synthetic inertia, reliability services (such as strategic reserves) is under review by market designers and rule makers	The Energy Security Board is currently consulting on a post 2025 re-design of the NEM. The design process is seeking to integrate transformative technologies and increase engagement of consumers in the market (two-sided market) leading to the prospect of improved revenue opportunities for microgrids.

Rivers Run Estate embedded network commercial straw models

<table>
<tr><th></th><th>Model 1: BTM BESS within embedded network</th><th>Model 2: Market facing BESS</th></tr>
<tr><td>Description</td><td>A BESS is installed onsite (behind the gate meter – BTM) with the sole objective to lower costs for embedded network customers. These costs are managed through coordination of embedded network rooftop PV consumption and export, generation / load shifting to optimise retailer TOU tariffs and management of DNSP demand charges.</td><td>A BESS is installed behind a child meter within the embedded network allowing the battery to be market facing. Therefore it would have a wholesale market contract and would participate in the full spectrum of wholesale markets i.e. energy and ancillary services.</td></tr>
<tr><td>Energy source(s)</td><td>Exported rooftop PV within Embedded Network</td><td>Exported rooftop PV generation purchased from the Embedded Network and energy bought off wholesale market during low price periods</td></tr>
<tr><td>Storage and generation asset ownership</td><td colspan="2">Rooftop PV assets are owned by home owners while the BESS is owned by either the embedded network operator or Tetris Energy. Alternatively, proportional ownership of the BESS can be linked to the purchase of land title within the estate</td></tr>
<tr><td>Location of storage and generation asset</td><td colspan="2">BESS and rooftop PV located within embedded network</td></tr>
<tr><td>Control of storage asset</td><td colspan="2">1. Tetris Energy, or
2. Embedded network operator, or
3. Embedded network retailer</td></tr>
<tr><td>Physical Considerations for MM Hearn</td><td colspan="2">Establishing an embedded network requires considerations from a developers standpoint, these may include,
1. Installation of underground network resulting in significant upfront costs
2. Substations within the embedded network will require allotments within the development i.e. opportunity cost to developer</td></tr>
<tr><td>Commercial considerations for embedded network</td><td>1. The embedded network must be registered with the Essential Services Commission
2. A schedule of TOU rates will need to be developed.</td><td>1. Development of Feed In Tariffs (FIT) for embedded network exported rooftop PV production
2. Allocation of revenue to community members</td></tr>
<tr><td>BESS revenue sharing mechanisms</td><td>Captured through reduction in total energy spend for customers</td><td>Monthly payment / "dividend" to owners as a portion of ownership dependent on monthly profit i.e. revenue minus costs</td></tr>
</table>

Note that in practice the battery could be partitioned with a part market facing (behind a child meter) and a part dedicated to the behind the meter value stack.

C&I buyers group straw models

	Model 3: Spot exposed C&I	Model 4: Virtual Energy Network	Model 5: C&I VPP
Description	This is a retailer-led model allowing participants to access a BTM or community battery though a spot (wholesale) exposed large market retail contract. BESS is used to manage and minimise spot exposure of the combined load for C&I participants and a front-of-meter wind Variable Renewable Energy (VRE) offtake.	Involves the creation of a Virtual Energy Network (VEN), supported by a common retailer. The objective of the VEN is to share excess renewable energy amongst members. The VEN operates on a subscription only basis, it can incorporate in-front of and behind the meter renewable energy generation as well as a BESS.	Under this model, a customer's physical supply of electricity is provided through a standard retail contract, whilst the retailer incorporates and manages the BESS as part of a of a VPP. The BESS is optimised to maximise revenue, primarily through Wholesale market mechanisms
Retail contract type	Spot (wholesale) market exposed retail contract with a common retailer	Remain on standard fixed price retail contract but are limited a common retailer supporting the VEN	Standard retail contract with a common retailer
BESS Ownership	BESS ownership may be pooled by the scheme participants or retained by Tetris Energy	BESS ownership is pooled by the scheme participants or retained by Tetris Energy	BESS is owned by individual scheme participants or retained by Tetris Energy
Energy source	In-front of meter wind VRE offtake sized to annual C&I load	BESS will utilise BTM PV on C&I sites	VRE to be sourced from in-front of meter portfolio, supplemented with charging based on wholesale market pricing
Location of storage and generation assets	Single large BESS located on largest site (Southern Ocean), services and revenue is shared across participants	• Single large BESS located on largest site (Southern Ocean) • BTM PV or Demand Response (DR) assets owned individually	• Each participant has a single BTM BESS participating on an individual basis • BTM PV or DR assets owned individually
Control of storage and generation asset	Retailer assumes operational control of the asset and any BTM PV asset. An AI planning engine optimises forecast spot price, solar generation and consumption to minimise costs over a 24 hour lookahead horizon	Battery is optimised by VEN provider to meet the defined VEN objectives i.e. sharing renewable energy	Retailer would act as the aggregator and would retain operational control of the VPP
BESS revenue sharing mechanisms	Monthly payment to owners dependent on monthly profit i.e. revenue minus costs. The owner of the site where the battery is located may receive incidental locational benefits.	Monthly payment to owners dependent on monthly profit i.e. revenue minus costs	Monthly payment to owners dependent on monthly profit i.e. revenue minus costs.

Overview of value streams accessible by each model

	Description of value proposition
Model 1	BESS is used for load shifting by charging off excess solar in the middle of the day and discharging during non-solar hours to reduce grid imports and decrease both retail and network costs.
Model 2	BESS charges off excess residential solar in the middle of the day to benefit from the avoided network costs. Market facing BESS discharges at the prevailing spot price with revenues/profits from spot arbitrage to be shared with owners (residents).
Model 3	Variable Renewable Energy (VRE) wind offtake for C&I participants to achieve 100% renewable energy. BESS is used to minimise spot exposure of participants by charging when under consuming and discharging when contracted wind generation is less than aggregate load.
Model 4	Virtual Energy Network (VEN) where participants share access to solar generation. Additional Port Fairy load participating to the VEN are able to trade energy with C&I loads that have excess solar generation in the middle of the day, allowing for the avoidance of incurring a higher retail TOU Tariff. BESS is used to load shift for the residual solar generation to peak TOU while also C&I loads to claim 100% renewable energy from Large-scale Generations Certificates (LGCs) created, with excess LGCs sold to the spot market.
Model 5	Virtual Power Plant with BESS situated on individual participants site. BESS charges off excess solar and is used for load shifting to derive to reduce grid imports and decrease both retail and network costs.

5.0 Financial assessment

Results of the financial assessment

To provide an illustration of the use case for a BESS and the potential benefits to the individual participants, this section presents the results of the financial assessment of the five straw models. The straw models were tested against three price scenarios that reflect differing paces of transformation in the electricity grid. Specific examples in this section are presented under a mid-case scenario (i.e. the medium-pace of transformation*).

Results are presented for the embedded network and C&I participants separately, noting that each of the five straw models are not mutually exclusive. One of the key principles guiding the recommended commercialisation pathway relates to the potential for scalability of the commercial model, allowing for more participants within Port Fairy to participate to the scheme, thereby allowing for the associated community benefits to be shared.

Indeed, the potential to accommodate additional participant loads which exhibit greater complementarity in load profiles/shape will likely improve the financial outcome for the models assessed and further cement the business case for a BESS.

* *Note that the three price scenarios represent equally plausible outcomes and should not be viewed as confidence bounds.*

Modelling assumptions

In modelled future electricity prices, Energetics utilises the PLEXOS™ energy market simulation platform. Long range forecasts are prone to underestimating volatility, with long range price forecasts typically smoothing spot market prices as they do not necessarily reflect random extreme events such as simultaneous high temperature and unplanned outages of major generators.

The table in the following slide outlines the assumed modelling parameters while the detailed technical assumptions underpinning the analysis presented in this section are further documented in the appendix.

Modelling parameters

These key parameters that characterise the five models developed and included in the financial modelling are summarised below

	Embedded network (residential)		C&I customers as a part of the PFSEP		
Model name	❶ BESS supports the embedded network	❷Market facing BESS	❸Spot exposed C&I	❹Virtual Energy Network	❺C&I VPP
BESS size*	250kW/500kWh	250kW/500kWh	250kW/500kWh	1MW/2MWh	250kW storage distributed proportionally (100kW BESS on-site for Southern Ocean and BAM Stone, 50kW BESS on-site for Moyne Health).
Retail contract	Standard retail TOU	Standard retail TOU	Spot exposed	Standard retail TOU	Standard retail TOU
Retail premium	Commercial in confidence				
Energy source/size (kW)	94 x 5kW solar systems		Front-of-meter Wind VRE sized to match aggregate C&I load	1MW additional solar on-site for Southern Ocean	N/A
Cost of energy source	N/A	N/A	Commercial in confidence		N/A

** BESS has been sized in this instance to minimise exports to the grid. Note that an optimisation of the BESS sizing was not included in the scope of this analysis.*

Overview of value streams assessed for each model

Value streams considered in financial modelling

<table>
<tr><th></th><th>Forward market</th><th>Spot market</th><th>Network tariff</th><th>Network services</th><th>Contingency FCAS</th></tr>
<tr><td>Model 1</td><td>Retail TOU shifting</td><td></td><td>Network TOU shifting</td><td rowspan="2">Greenfield site allows for potential costs savings from reduction in infrastructure requirements through a BESS</td><td></td></tr>
<tr><td>Model 2</td><td>N/A</td><td>Spot arbitrage through market facing BESS</td><td>Network TOU shifting</td><td rowspan="4">Only available for market facing BESS</td></tr>
<tr><td>Model 3</td><td>N/A</td><td>Spot arbitrage through market facing BESS</td><td rowspan="2">Only for participant whose site BESS is located on</td><td rowspan="3">Potential benefits from deferral of upgrade/maintenance of existing distribution infrastructure</td></tr>
<tr><td>Model 4</td><td>Retail TOU shifting</td><td></td></tr>
<tr><td>Model 5</td><td>N/A</td><td>Spot arbitrage through market facing BESS</td><td>Network TOU shifting</td></tr>
</table>

Shaded grey boxes indicates if value stream has been quantified in the financial assessment

Summary of embedded network models

The results for the Rivers Run Estate are presented from the perspective of the embedded network, with the recommended model dependent upon the risk appetite for the embedded network operator. Overall, Model 1 is associated with greater certainty through retail TOU shifting and better financial outcomes in comparison to Model 2.

However, it should be noted that the attractiveness of spot arbitrage is sensitive to the underlying distribution of spot price forecasts, with volatility likely to be understated in PLEXOS spot forecasts, thereby working against the value potential under Model 2.

In addition, there is scope for further refinement of the BESS operation strategy to incorporate co-optimisation around spot arbitrage and network peak demand management to improve the performance of the battery under Model 2.

Total electricity cost* over 10-year term – Embedded network

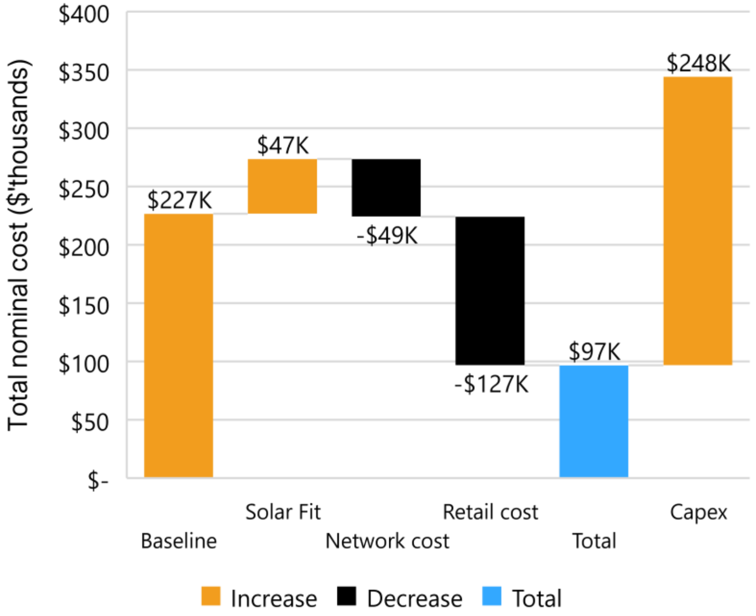
Commercial in confidence

Results demonstrate that the operation of a BESS under each of the assessed commercial models may result in a significant benefit to the embedded network customers through cost savings in the form of reduced electricity costs from TOU shifting as well as a reduction in network charges. This is observed by lower costs over the 10-year modelling horizon against the baseline, which comprises an estimate of the overall electricity costs and network charges that would be incurred by the Embedded Network without a BESS.

However, this benefit is unable to overcome the significant capital outlay for acquiring and installing a BESS along with the associated operation costs as illustrated in the remainder of this section.

> Improved cost outcomes under models 1 and 2 through inclusion of a BESS

Cost breakdown* (Medium case) – Model 1



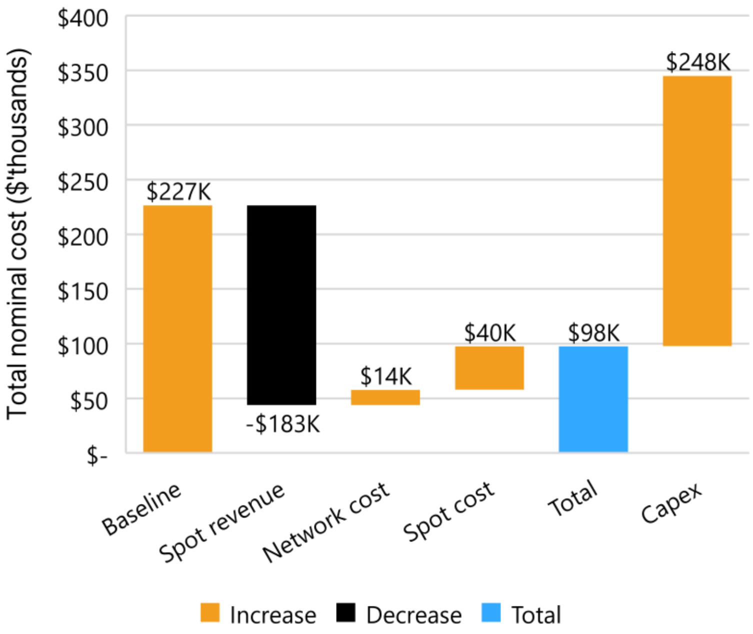
The accompanying chart demonstrates how each of the cost components under Model 1 changes relative to the baseline over the modelled horizon. The storage enabled by the BESS allows for TOU load shifting by charging through excess rooftop solar in the middle of the day, which is then subsequently discharged during peak non-solar hours.

Such a strategy will come at the expense of lower revenues generated through feed-in-tariffs (increase in costs relative to the baseline through a reduction in revenues). On the other hand, the dispatch of the BESS reduces grid imports during peak hours, thereby reducing the overall retail and network costs, with the potential for these savings to be passed on to each customer/resident within the embedded network.

However, the initial capital outlay for the BESS results in insurmountable costs that are unable to be overcome by the associated savings. Consequently, the value shortfall would need to be offset by other value streams (e.g. network deferrals etc.).

** Cost breakdown comprises of electricity costs, network charges and upfront BESS costs. Baseline cost represents total costs without installing a BESS. Total cost (in blue) represents overall costs with a BESS installed before incorporating the capital costs of the battery. Ongoing costs of operating a BESS have not been included.*

Cost breakdown (Medium case) – Model 2



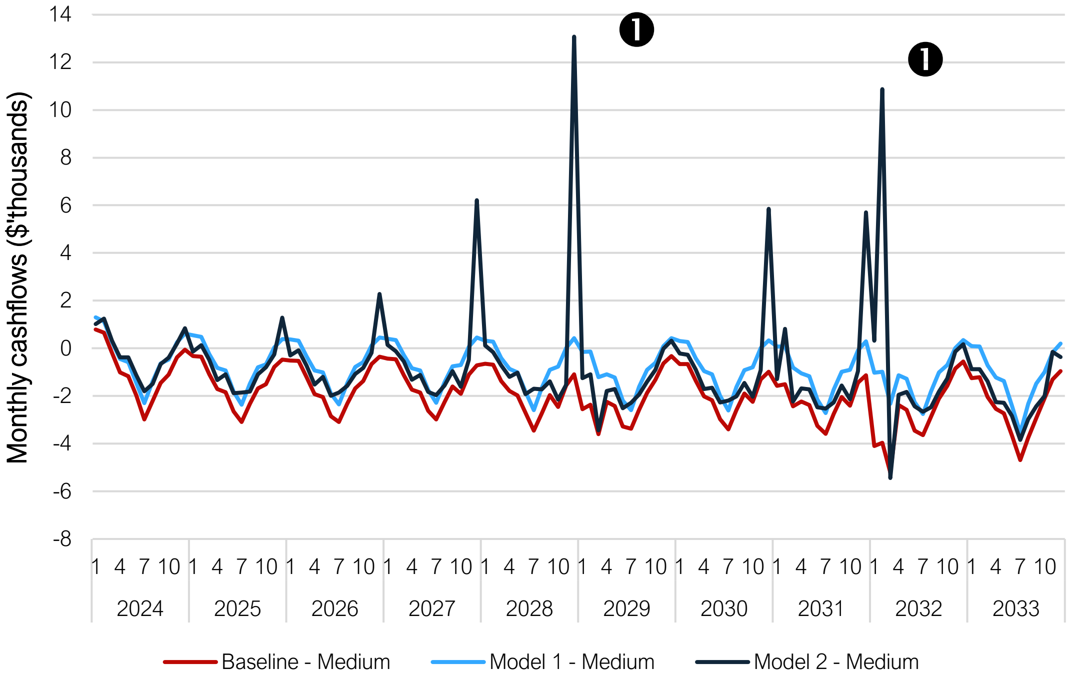
Under Model 2, a market facing BESS is assumed, with the consumption for the battery calculated at the child meter level and settled at the prevailing spot price for charge/discharge. Network tariffs are applied to consumption at the gate meter for the embedded network, while the BESS child meter consumption is subtracted from gate meter to determine retail charges attributable to embedded network.

To the extent that the spot price forecasts utilised in the financial assessment are unable to adequately reflect inherent volatility that is to be expected in the market, the financial attractiveness under Model 2 is also likely to be understated. In addition, value realisation for a market facing BESS is highly dependent upon the performance of its ability to successfully implement spot arbitrage through leveraging volatility in the wholesale market.

Overall, while there is a potential for greater value realisation through spot arbitrage, this also represents a highly uncertain value stream. Nonetheless, a market facing BESS is able to benefit from the potential to tap into alternative value streams to supplement the value shortfall (e.g. contingency FCAS, network augmentation cost deferral, etc.).

** Cost breakdown comprises of electricity costs, network charges and upfront BESS costs. Baseline cost represents total costs without installing a BESS. Total cost represents overall costs with a BESS installed before incorporating the capital costs of the battery. Ongoing costs of operating a BESS have not been included.*

Illustrative (e.g. Monthly costs*) – Medium case



As noted in the previous figures, the financial outcomes under Model 2 are highly sensitive to the distribution of the underlying spot prices. At the same time, this uncertainty is further exacerbated by the reliance on the occurrence of extreme spot price intervals during summer months and the ability of market facing BESS to capture these events.

Indeed, there is a possibility that if high spot price intervals do not eventuate, or if a BESS is unable to accurately discharge during an anticipated high price event, then this would be to the detriment of the financial attractiveness of Model 2.

Legend

❶ Market facing BESS leads to increased variability in cashflows under Model 2.

Before inclusion of BESS CAPEX costs/repayments

Summary of C&I models

Consistent with the financial results presented for the embedded network models, the three C&I models assessed demonstrate that a BESS may bring potential benefits to participants. However, these benefits are once again insufficient to overcome the initial BESS capital outlay and the associated operating expenses.

However, the benefits of a BESS extends beyond absolute cost outcomes and can serve to narrow the range of uncertainty, with the capacity for storage serving as a hedge against fluctuating energy prices by decreasing dependence on grid imports.

In addition, a BESS could support C&I participants in making renewable energy claims, and also provide the potential for greater community benefits across stakeholders in Port Fairy. These aspects of the battery will be illustrated in this section.

Total nominal cost* over 10 year term – C&I loads

Commercial in confidence

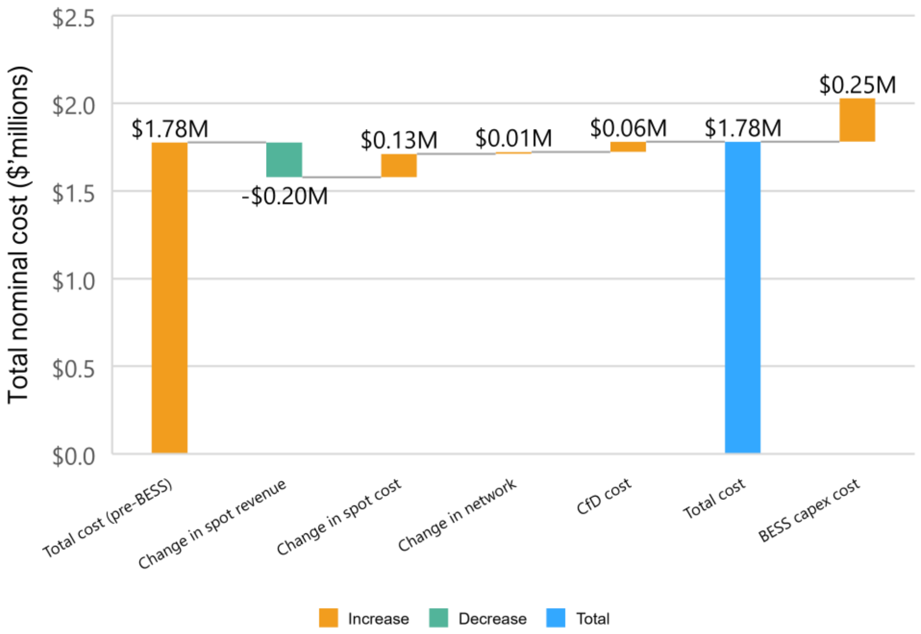
The results demonstrate that the operation of a BESS under each of the three C&I models may result in a benefit through a reduction in overall energy costs and network charges. This is evidenced by lower costs over the 10-year modelling horizon against the baseline, which comprises an estimate of the overall electricity costs and network charges that will be incurred by the Embedded Network without a BESS.

The lower overall cost under Model 3 is attributable to the spot pass-through retail contract, allowing for the avoidance of futures market risk premium and a reduced retail premium. The narrower range of outcomes stem from the hedge that is provided through directly contracting with a renewable energy generation asset.

Likewise, the installation of 1MW additional solar under Model 4, along with the increased BESS capacity of 1MW results in a reduction of grid imports and hence a decreased exposure to underlying commodity prices, resulting in a narrower range of outcomes across different price scenarios.

Meanwhile, there is minimal benefit to the C&I participants under model 5 due to limited excess solar across C&I loads.

Aggregate C&I cost breakdown (Medium case) – Model 3



Under Model 3, a spot pass-through retail contract, where the C&I loads will be exposed to wholesale spot prices, allows for the potential of better overall cost outcomes through the avoidance of higher load-following retail premium.

A financial Power Purchase Agreement (PPA) through a VRE offtake with a wind generator allows for C&I customers to claim 100% renewable energy and serves as a hedge against their spot exposed retail contract.

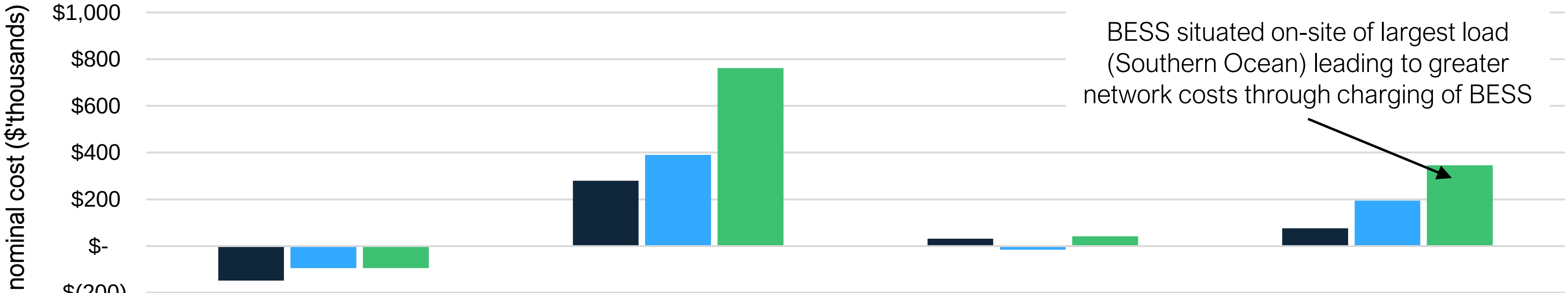
However, being on a spot exposed contract will undoubtedly result in greater volatility in cashflows. In addition, C&I participants could be left spot exposed to the extent that the contracted generation does not correlate with the underlying load.

Therefore, a BESS can be utilised to reduce cost uncertainty and volatility of cashflows under Model 3.

Straw model is compared to its own respective baseline (i.e. without access to a BESS) due to the difference in underlying contracting model for electricity supply (spot exposed vs. standard retail contract)

Model 3 – Breakdown of cashflows by participants (Medium case)

Front-of-meter wind VRE offtake serves to hedge exposure to energy price movements over the longer-term. BESS is utilised to match consumption to wind generation with the objective of mitigating cashflow volatility through monthly settlement of the Financial PPA and the spot exposed retail contract.

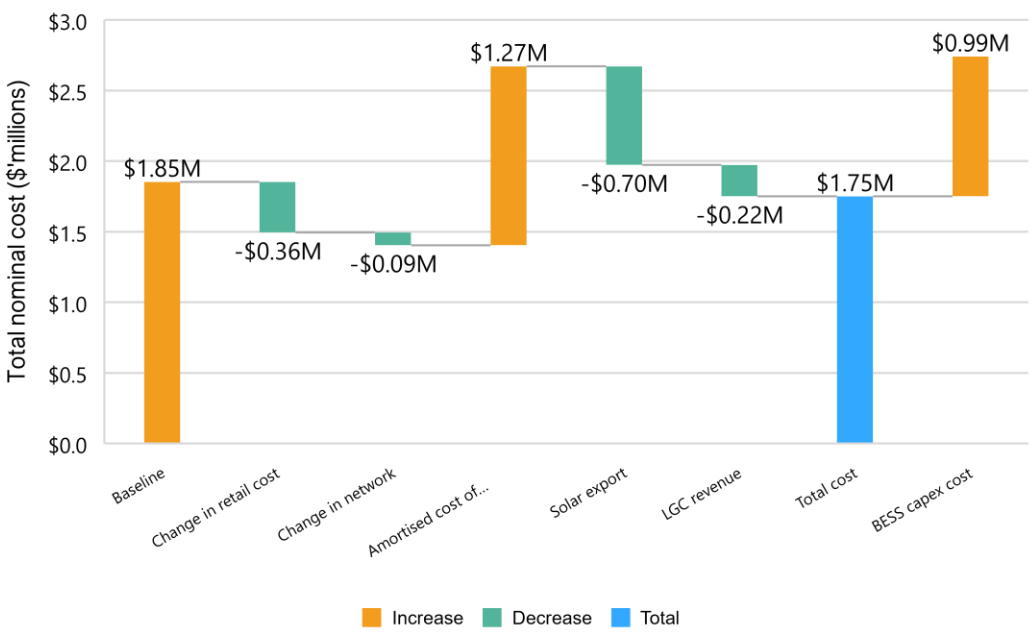


	Spot revenue	Spot cost	CfD settlements*	Network costs
BAM	$(148,081)	$280,270	$31,728	$75,677
MH	$(94,539)	$390,045	$(15,546)	$194,527
SOM	$(94,110)	$762,411	$41,715	$345,650

BAM MH SOM

In-front-of-the-meter Financial PPA (Contract for Difference [CfD]) settlements have been apportioned based of consumption between participants at an interval level basis rather than on the aggregate cashflows. This is the reason for the negative settlement observed for Moyne Health

Aggregate C&I cost breakdown (Medium case) – Model 4



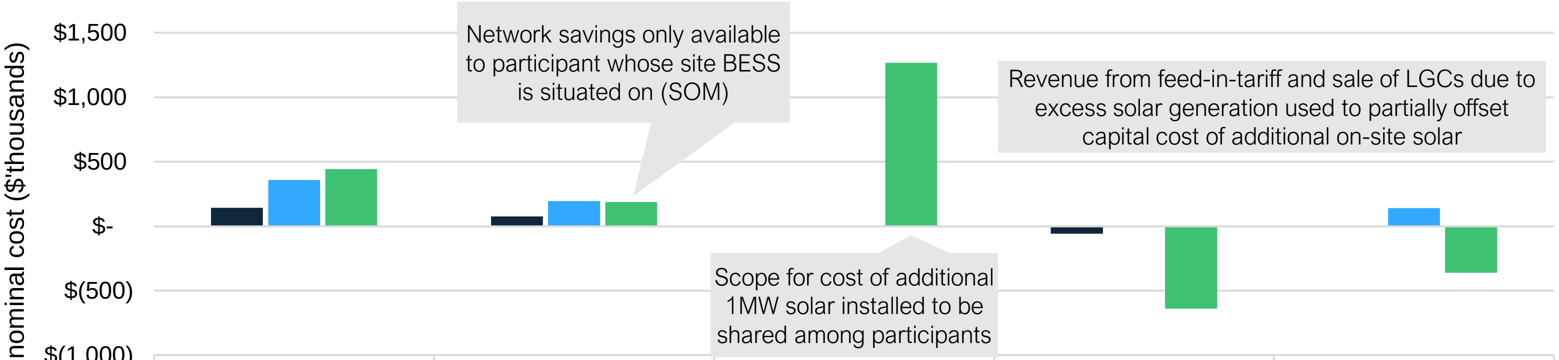
Model 4 incorporates a 1MW/2MWh battery with an additional 1MW of solar to be situated on Southern Ocean's premises. Excess solar generation is traded with additional load in Port Fairy participating under the VEN. C&I load benefits through reduced retail/network costs. Revenue from feed-in-tariff and sale of LGCs from excess solar generation used to partially offset capital cost of additional 1MW on-site solar.

The feasibility of Model 4 requires complementary load profiles amongst VEN participants to enable trading of excess solar generation. Note that the benefit/savings to participants that purchase excess generation are not reflected in the chart as only the costs/benefits to the C&I loads were included in the analysis to ensure comparability across the straw models.

Straw model is compared to its own respective baseline (i.e. without access to a BESS) due to the difference in underlying contracting model for electricity supply (spot exposed vs. standard retail contract)

Model 4 – Breakdown of cashflows by participants (Medium case)

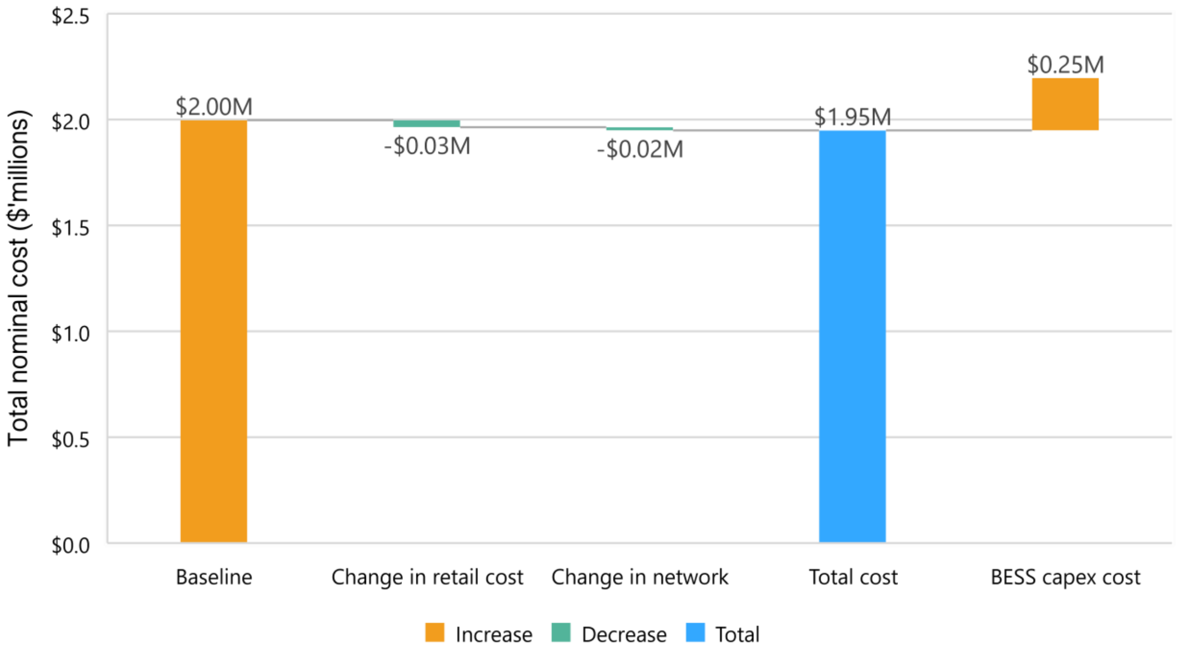
Model 4 will introduce community benefits with greater energy independence to local Port Fairy loads through sharing of renewable energy amongst VEN participants (i.e. less energy purchased at prevailing retail rates).



	Retail cost	Network cost	Amortised cost of BTM solar*	Solar export	LGC revenue
BAM	$143,180	$75,677	$-	$(59,001)	$(1,343)
MH	$359,173	$194,527	$-	$-	$140,185
SOM	$444,663	$187,961	$1,267,313	$(638,985)	$(361,816)

**Estimated based on a Levelised Cost of Energy (LCOE) of $62.90/MWh for a 1MW system*

Aggregate C&I cost breakdown (Medium case) – Model 5



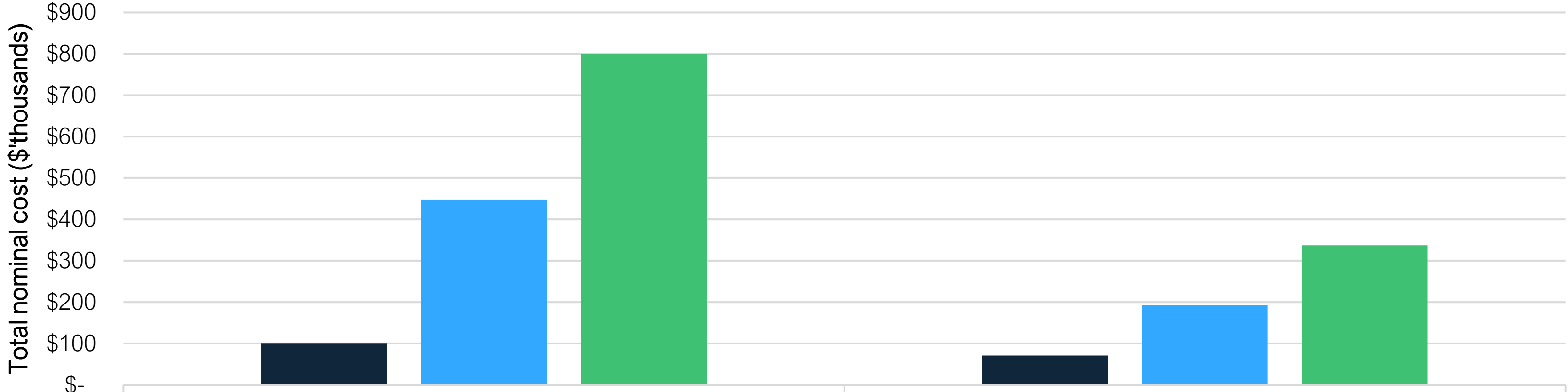
Under Model 5, a BESS serves to reduce retail/network costs through charging off excess solar while discharging during peak intervals. Overall benefits from BESS through a reduction in retail/network costs are unable to offset CAPEX costs, although additional revenue streams that might be potentially accessible under Model 5 (e.g. FCAS, demand response) could be further captured.

Attractiveness of Model 5 will also be dependent upon the load profile of participants, with the limited benefit observed attributable to the lack of existing excess on-site solar output.

Straw model is compared to its own respective baseline (i.e. without access to a BESS) due to the difference in underlying contracting model for electricity supply (spot exposed vs. standard retail contract)

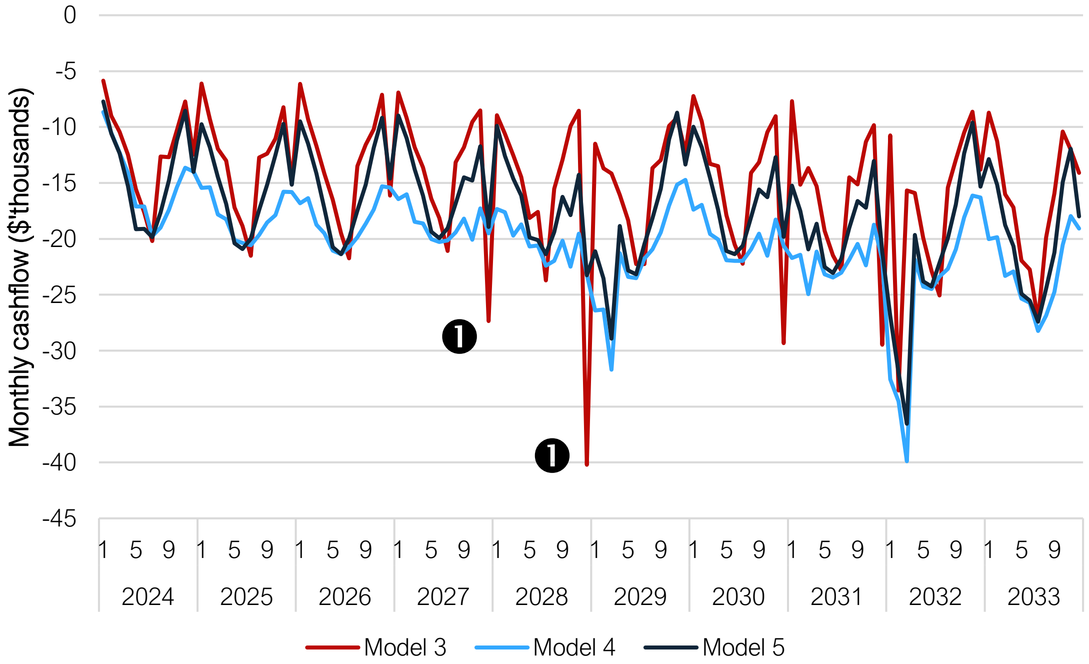
Model 5 – Breakdown of cashflows by participants (Medium case)

Model 5 brings value through the orchestration of DER and will be ideally suited to participants with excess on-site solar to mitigate the increase in network tariffs, while also exhibiting demand response capabilities.



	Retail cost	Network cost
BAM	$100,882	$70,621
MH	$448,024	$192,645
SOM	$800,044	$337,052

Monthly costs (pre-BESS) – Medium case



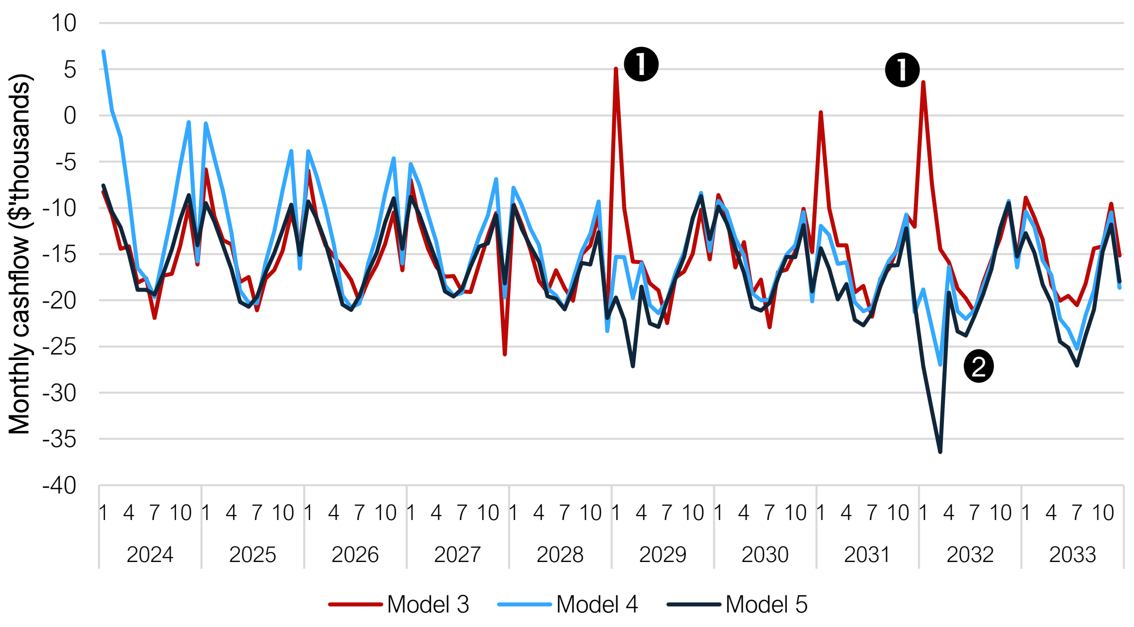
As previously highlighted, while a spot pass-through retail contract allows for the benefit of reduced retail premiums, this exposes the C&I loads to volatile cashflows, particularly during summer months with more frequent occurrence of extreme price events.

Legend

❶ Spot pass-through (Model 3) leads to volatile monthly cashflows

**Before inclusion of BESS CAPEX costs/repayments*

Monthly costs (net of BESS) – Medium case



The installation of a BESS allows for C&I loads to manage exposure to energy price fluctuations, with the benefits most pronounced under a spot exposed contract for Model 3, which capitalises on extreme price events to generate revenue from the BESS.

Legend

❶ Under model 3, BESS is utilised to mitigate volatility and benefit through discharging during high spot price intervals

❷ On-site solar output under model 4 decreases reliance on grid imports and mitigates exposure to commodity / energy price fluctuations over the longer term

*Before inclusion of BESS CAPEX costs/repayments

6.0 Evaluation of straw models

Decision making framework

Having presented the results to the financial assessment of the straw models, this section seeks to establish a common decision making framework for the buyers' group.

Given the contrasting nature of the loads, it is inevitable that some models will be advantageous to varying degrees between the participants, and benefit some more than others. However, the key principle guiding the decision making process would to be maximise the collective benefit of the buyers' group without rendering any participant worse off in the process. It is imperative that this principle should not be overlooked from our experience having previously supported buyers' groups.

In the following slides, we present some of the key commercial principles that have been discussed with the buyers group following several stakeholder engagement workshops, followed by an evaluation of the ability of each model to meet these attributes.

Potential commercial principles

Scalability	Financial attractiveness	High price certainty	Low cash flow variability	Operational simplicity	Community benefits	Capital intensity

Engagement with PFSEP participants have indicated the following principles to be of importance…

- Price certainty
- Financial attractiveness
- Community benefits

Assessment results (quantitative and qualitative)

Commercial principles	Straw model				
	Embedded network (residential)		C&I customers as a part of the PFSEP		
	❶ BESS supports the embedded network	❷ Market facing BESS	❸ Spot exposed C&I	❹ Virtual Energy Network	❺ C&I VPP
Scalability	Not favourable	Favourable	Partially favourable	Favourable	Partially favourable
Financial attractiveness	Partially favourable	Favourable	Partially favourable	Partially favourable	Not favourable
Price certainty	Favourable	Partially favourable	Favourable	Favourable	Partially favourable
Cashflow variability	Favourable	Not favourable	Not favourable	Partially favourable	Partially favourable
Operational simplicity	Partially favourable	Partially favourable	Not favourable	Partially favourable	Favourable
Community benefits	Not favourable	Favourable	Partially favourable	Favourable	Not favourable
Capital intensity	Favourable	Favourable	Partially favourable	Not favourable	Favourable

Favourable   Partially favourable   Not favourable

Evaluation of straw models

	Benefits	Challenges
Model 1	• BTM BESS allows for certainty of capturing a value stream (retail TOU shifting and network tariffs) • Greenfield development allows for potential infrastructure savings by having BESS on-site	• Non-market facing BESS limits the potential to tap into more lucrative value streams (e.g. spot arbitrage, FCAS)
Model 2	• Greenfield development allows for potential infrastructure savings by having BESS on-site • Market facing BESS provides opportunity to tap into more lucrative (albeit uncertain) value streams	• Administratively cumbersome for embedded network operator to equitably distribute benefits across embedded network participants • Require common retailer across participants
Model 3	• Front-of-meter VRE offtake allows for 100% renewable energy claims • Spot pass-through allows for cost savings through reduced market risk/retail premiums • BESS is used to mitigate spot exposure	• Spot market exposure gives rise to potentially volatile cashflows • Participant with BESS on-site liable for increased network charges • Localised network tariffs would be required for such a model to be viable • Current C&I volume might be insufficient to contract with a renewable wind generator and will require additional load
Model 4	• Enables peer-to-peer trading of energy to match loads between participants who are long and short middle of the day rooftop PV • Additional cost savings for participants to VEN that purchase excess renewable energy in the middle of the day • Allows for wider community benefits to be shared across Port Fairy participants	• Potential for establishing a VEN might be limited by local DNSP constraining solar PV export • Capital intensive due to requirement for additional on-site solar and larger battery • Participants that are short of PV will still be liable for network charges for grid imports
Model 5	• Contracting through a retailer/aggregator VPP allows participants to tap into otherwise unattainable value streams (spot arbitrage, FCAS)	• Orchestration of DER most suited to loads with excess PV and DR capabilities • Lack of community benefits (i.e. VPP can be established across unrelated sites)

7.0 Preferred models and recommendation

Preferred models

Having undertaken the financial assessment and presented the qualitative evaluation of the straw models in the previous sections, the necessary considerations to establish a commercialisation pathway for the participants are documented in the subsequent slides.

While each of the straw models assessed have been shown to demonstrate its own associated benefits, it is evident from the analysis that unless additional value streams can be unlocked, these savings/benefits are unable to overcome the cost of installing a BESS over the modelled horizon. Accordingly, this value shortfall (missing money) will need to be supplemented by alternative value streams that have not been incorporated into the financial analysis presented, in order to develop a commercial pathway forward.

Finally, this report outlines the next steps that are required should the participants wish to progress.

Missing money problem

<u>Potential for additional value streams</u>

- FCAS
- Network services
- Network demand charges
- Reliability and Emergency Reserve Trader (RERT)
- Rebates/grants

As highlighted in the previous analysis, there is a value shortfall in establishing a business case for a BESS where, despite the potential benefits to participants, the initial capital outlay surpasses the expected cost savings.

To further supplement this value shortfall, additional value streams that have not been assessed will need to be further considered. The following services represent a potential to further bridge this gap.*

In order to develop a commercialisation pathway for a BESS, the possibility of combining straw models will need to be considered to leverage synergies across participant loads and allow for scalability through additional participants.

*Note that financing options, some which may present tax benefits, have not been explored

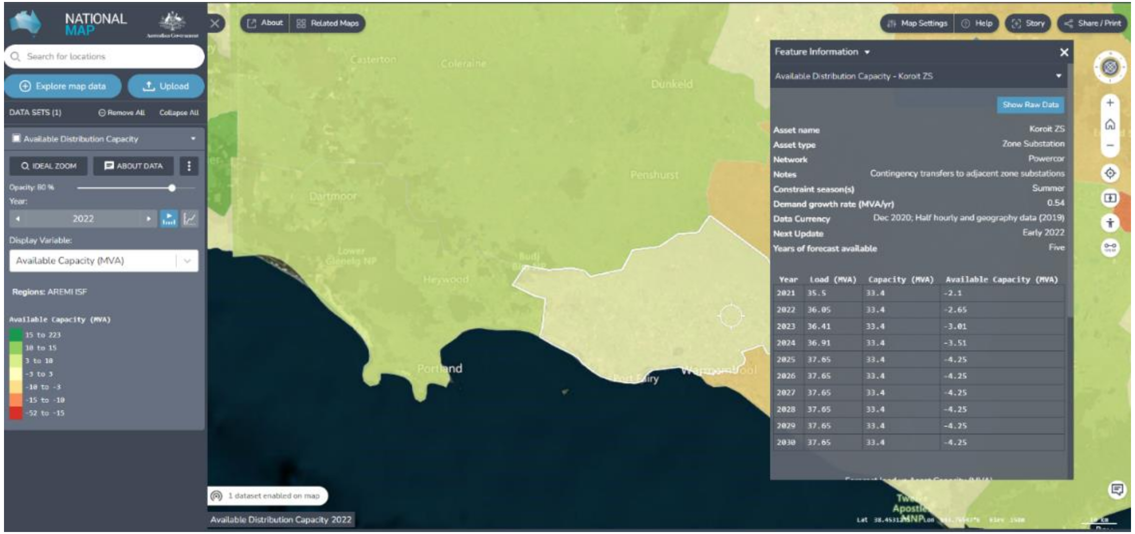
Missing money problem – Estimated shortfall under the medium pace price scenario

	Estimated shortfall*	FCAS**	Network services	Comments
Model 1	$117,660	N/A	Greenfield site development allows for potential infrastructure cost savings	BTM BESS precludes the potential for participation of additional C&I loads
Model 2	$118,387	$175,000		
Model 3	$243,613	$175,000	Potential benefits to delay upgrade to existing distribution infrastructure	Spot facing BESS allows for greater value to be derived, albeit through exposure greater risk/volatility
Model 4	$889,062	$700,000		Would require loads that are participating in the VEN to exhibit complementary load profiles, matching participants that are short on rooftop PV to purchase it off participants have excess in the middle of the day.
Model 5	$296,403	$175,000		Potential for additional revenue streams by participating to demand response under a VPP operated through a retailer/aggregator

**Estimated shortfall is derived based on the difference between the upfront CAPEX costs and the associated savings from the BESS (i.e. Total cost with BESS + BESS CAPEX cost – Baseline cost) under the medium-pace scenario as outlined in the cost breakdown charts for each straw model.*

***Assuming potential FCAS revenue of $8/MW for a 0.25MW over a 10-year modelling term. Potential revenue through provision of contingency FCAS services could serve to narrow the value shortfall.*

Limited scope to benefit from Network Service provision



Available distribution capacity in Port Fairy (Source: Energy Networks Australia)

There is limited benefit for the local distribution network to offer locational network charges, as loads are not in a constrained area of the grid.

However, there is potential for infrastructure cost savings for the embedded network, as part of a greenfield site development.

Further engineering assessment on site for the Rivers Run Estate will need to be undertaken to ascertain the extent of such savings if any.

Which options are most likely to lead to a viable commercialisation pathway?

<table>
<tr><th>For the embedded network</th><th>For the C&I participants</th></tr>
<tr><td>

- Model 1 (BTM) presents an option to demonstrate innovation in commercial models if Network Volumetric and Demand Charge Savings are shared on a pro-rata basis with the body corporate. However, behind-the-meter BESS precludes the potential for combination with additional loads outside the Rivers Run Estate.
- Model 2 would be a similarly innovative model with revenues generated from market-facing BESS to be shared amongst participants in the scheme. Market facing aspect allows for scalability with additional loads.

</td><td>

- Potential benefit for a VPP operator to combine either Models 3 or 4 with Model 2. This would be considered to be innovative, with currently no known combined residential and C&I VPP.
  - In the case of Model 3, the current aggregate C&I load is unlikely to meet the size required to contract for an in-front-of-the-meter wind VRE financial PPA and additional C&I customers will therefore be needed to form a buyers' group. At the same time, the volatility in electricity costs that arise through a spot exposed retail contract under Model 3 might not appeal to the current C&I customers.
  - The establishment of a Virtual Energy Network (Model 4) among Port Fairy participants would allow for wider community co-benefits and would also be viewed as an innovative model with the potential for additional loads (residential or C&I loads) to sign up to the VEN.
- Therefore a combination of Model 4 with Model 2 may be most appropriate.

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Next steps

Should the participants wish to proceed with the recommendation of Models 2 and 4 for the embedded network and C&I loads, respectively, the following steps will be necessary to ascertain the viability of commercial model for the operation of a community battery under a Virtual Energy Network.

As noted in the report, there were concerns over the data quality of the meter data provided for the C&I loads and further scrutiny of the load profiles will be required. Further analysis will also need to be undertaken to ascertain the overall consumption for the embedded network to account for additional load through communal buildings and facilities etc. In addition, the Virtual Energy Network requires additional participants within the Port Fairy locality participating to the scheme and further investigation into the aggregate load profiles of such participants will be required.

Model 4 has also assumed an additional 1MW of solar to be installed on-site for Southern Ocean to be supported by a 1MW/2MWh BESS. Further on-site feasibility studies will need to be undertaken to determine if the proposed model can be implemented.

Finally, negotiations with the local DNSP (Powercor) over the potential for a localised use of system tariff will serve to further enhance the business case for a community battery. At the same time, the expected benefits attributable to a BESS is currently insufficient to overcome the associated capital cost. As such, any government-led schemes that serve to incentivise the uptake/installation of storage capacity would help to further improve the business case for a community battery. For example, the renewable generation market has been supported by the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES) and a similar initiative applied to storage technology could serve to reduce the upfront capital requirements.

8.1 Appendix – Modelling and assumptions

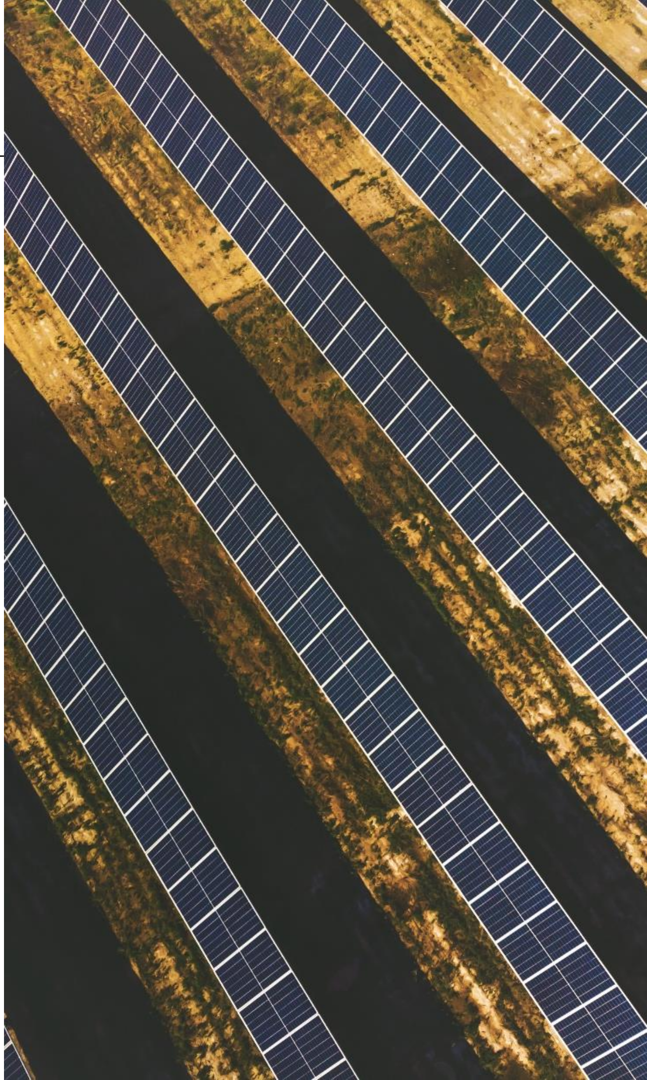
The following slides of this appendix document the detailed modelling assumptions along with the input model parameters utilised to undertake the financial assessment presented in this report.

Modelling parameters

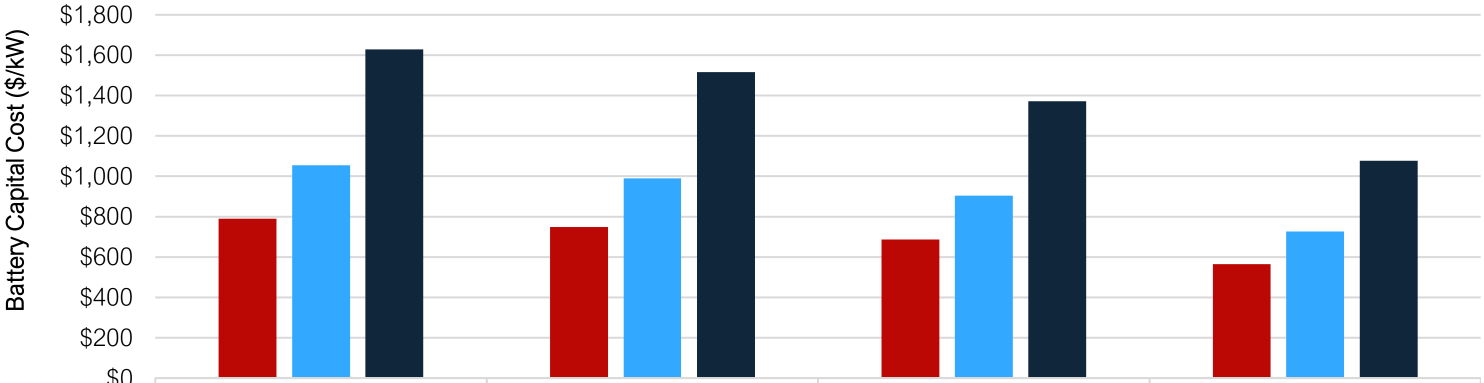
Financial parameter	Assumption
Model term	10 years
Start date	1 January 2024
Discount rate	9%
CPI	2.5%
Futures risk premium	6.09%

Battery specs	Assumption
Size	0.25 MW**
Duration	2 hours
Round-trip efficiency	85%
CAPEX cost ($/KW)	$990

***Optimal BESS sizing would depend on overall load of participants (volume and profile)*



Battery capital cost trajectories – CSIRO GenCost (FY22) Central scenario

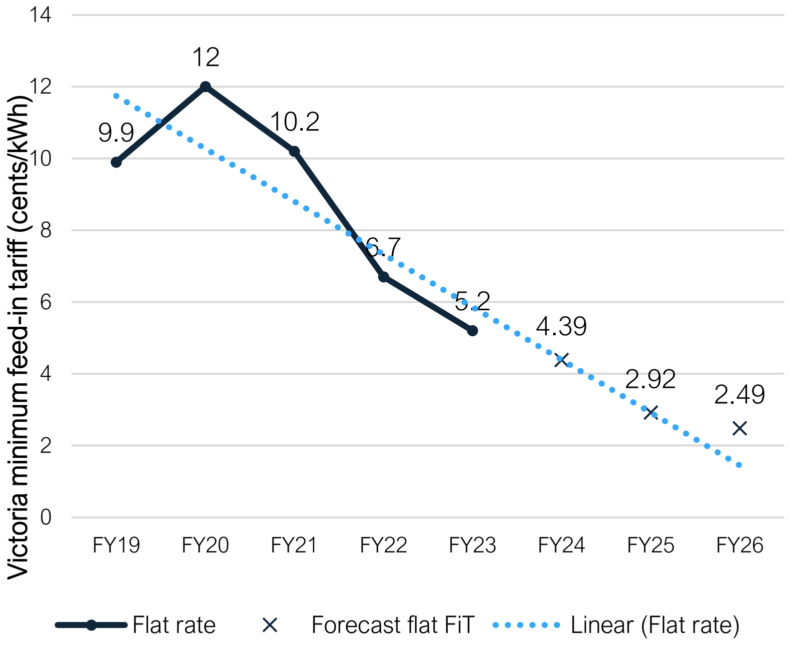


	2022	2024	2030	2040
Battery Storage (1 hr)	790	749	687	565
Battery Storage (2 hr)	1054	990	904	726
Battery Storage (4 hr)	1628	1516	1372	1076

Battery Storage (1 hr) Battery Storage (2 hr) Battery Storage (4 hr)

[CSIRO | GenCost 2021-22 Final report]

Value of exported PV (minimum feed-in tariff)

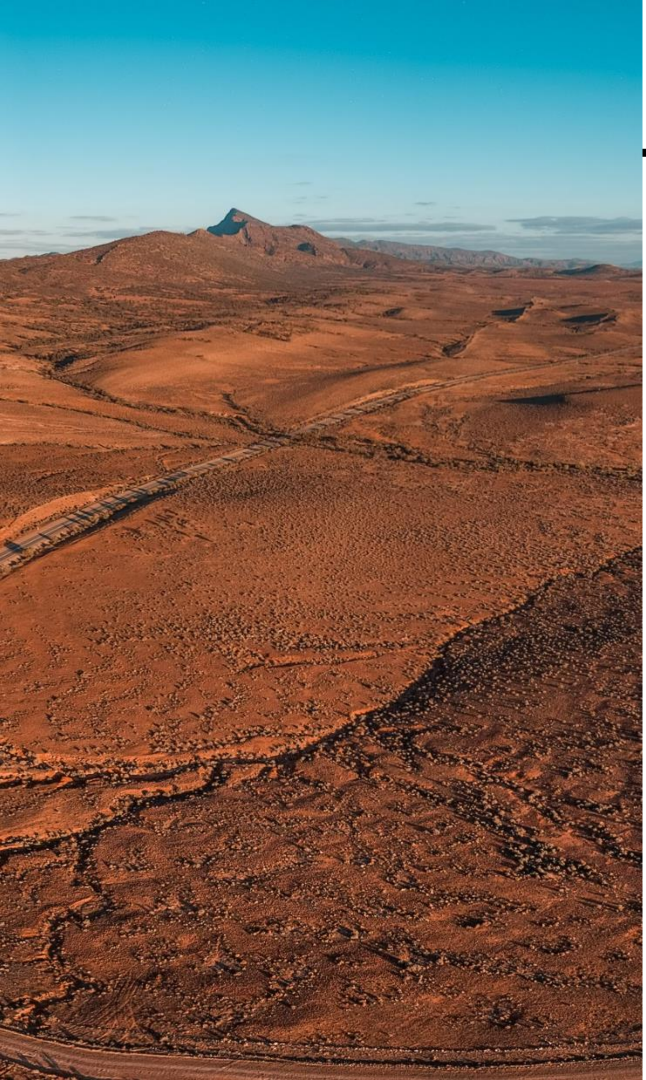


There has been a declining trend in feed-in-tariffs (FiT) with the recent Essential Services Commission minimum feed-in tariff review determining a flat rate of 5.2 cents/kWh for FY23. This comprises of four components:

- wholesale electricity price
- market fees and ancillary service charges
- value of avoided transmission augmentation cost
- value of avoided social cost of carbon.

With the increased penetration of rooftop PV, the value attributed to the first three components is likely to decline. The modelling undertaken has assumed a linear trend in the decline of the FiT, with a floor of 2.49 cents applied to reflect the avoided social cost of carbon beyond 2026.

[Essential Services Commission | Minimum feed-in tariff review 2022-23]



Energetics' long range electricity price forecasting*

Energetics has developed a forecast of electricity prices at a 30-minute interval which has been used to forecast the total retail costs under the contracting strategies modelled.

Model developed using PLEXOS® uses state-of-the-art mathematical optimisation to provide a high-performance, robust simulation system for the National Electricity Market.

The Australian Energy Market Operator (AEMO) is using this same simulation software.

We have changed a number of assumptions to develop three probable price forecast scenarios:

1. **Slow transition** – Under current policy settings and committed generation projects
2. **Medium transition** – Assuming introduction of both committed and advanced renewable projects
3. **Fast transition** – Assuming introduction of committed, advanced and publicly announced renewable projects

*see appendix for technical notes on modelling limitations

Underlying assumptions between Plexos price forecasts

	Slow-pace*	Medium-pace*	Fast-pace*
Demand	AEMO 2022 ISP Progressive scenario		
Renewable projects	Committed generation projects	+ advanced renewable projects	+ some publicly announced renewable projects
Rooftop PV	AEMO 2022 ISP Slow change scenario	AEMO 2022 ISP Progressive scenario	AEMO 2022 ISP Step change scenario
Battery Storage	AEMO 2022 ISP Slow change scenario	AEMO 2022 ISP Progressive scenario	AEMO 2022 ISP Step change scenario
Interconnector upgrades	Energy Connect 2027	Energy Connect 2026	Energy Connect 2025
Pumped storage hydro power	Reduced capacity and delayed implementation. Additional volume in TAS.	NSW Infrastructure Roadmap to target capacity but with delayed commissioning. Additional volume introduced in TAS and SA.	NSW Infrastructure Roadmap to target capacity and date. Additional volume in Tas, SA and QLD.
Coal and gas power stations	Plant close at end of technical life and/or based on announced closure dates. Some plant assumed to operate beyond their technical life due to upgrades.	Power stations retire when no longer economic or when they reach the end of their technical life and/or based on announced closure dates. Mothballing occurs on an economic basis.	Power stations retire when no longer economic and/or based on announced closure dates. Mothballing and some early closures occur on an economic basis or to facilitate more ambitious emissions reduction trajectory.

**Note that the scenarios modelled are illustrative of plausible market outcomes, but the probability of occurrence of each scenario has not been considered.*

Summary of Victorian futures price TOU rates that informed embedded network gate meter and C&I customer tariffs

Commercial in confidence

Technical note on modelling limitations

Data provided by retailers for C&I loads had significant gaps which required interpolation. In addition, the embedded network load was estimated using standardised residential load profiles and would not reflect variation and diversity in consumption patterns that would otherwise be expected within a residential estate.

The modelled range of outcomes for spot exposed pricing models are narrower than what we would expect in practice due to:

- Energetics electricity forecast may not reflect the full extent of transient market power under tight supply conditions, as such the level of ‘tail risk’ included in the model outcomes may be understated
- The slow-pace and fast-pace transformation supply-demand scenarios cannot be viewed as confidence bounds as other more extreme supply-demand imbalance scenarios could unfold over the coming decade
- Long range price forecasts typically smooth spot market prices as they do not necessarily reflect random extreme events such as simultaneous high temperature and unplanned outages of major generators.

In addition, FCAS markets are highly shallow and estimates of potential revenues are highly uncertain.

Detailed modelling assumptions

Model name	Embedded network (residential)		C&I customers as a part of the PFSEP		
	❶ BESS supports the embedded network	❷ Market facing BESS	❸ Spot exposed C&I	❹ Virtual Energy Network	❺ C&I VPP
Size of BESS	250kW/500kWh	250kW/500kWh	250kW/500kWh	1MW/2MWh	250kW/500kWh
Location	Within embedded network		On-site (SOM)	On-site (SOM)	On-site (all participants)
Channel and controlled by?	Embedded network operator (ENO) / retailer	Market participant (assumed ENO)	Retailer	Virtual Energy Network (VEN) operator/Retailer	Retailer/Aggregator
BESS spot exposed?	No	Yes	Yes	No	Yes
Energy source	Residential rooftop solar	Residential rooftop solar and wholesale	VRE offtake and wholesale	Additional Solar PV of 1MW to be shared with Port Fairy participant load	Existing solar PV and wholesale

8.2 Appendix – Additional results

Total nominal cost* over 10-year term – Embedded network

[redacted]

Commercial in confidence

**BESS CAPEX costs included*

Total nominal cost* over 10-year term – C&I models

[redacted]

Commercial in confidence

*BESS CAPEX costs included

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Sydney

Cammeraygal Country

Level 7, 5 Blue St
North Sydney NSW 2060

PO Box 294
North Sydney NSW 2059

Melbourne

Wurundjeri Country

Level 14, 356 Collins St
Melbourne VIC 3000

Brisbane

Meeanjin Country

Level 12, 410 Queen St
Brisbane Qld 4000

Perth

Nyoongar Whadjuk Country

Level 3, 182 St Georges Tce
Perth WA 6000

Adelaide

Kaurna Country

Level 1, 89 Pirie St
Adelaide SA 5000

+61 2 9929 3911 | info@energetics.com.au | www.energetics.com.au

ABN 67 001 204 039 | ACN 001 204 039 | AFSL 329935