Neighbourhood Battery Initiative Business Case

August 2022

Glossary

Acronym	Meaning
AER	Australian Energy Regulator
BOP	Balance of plant - The supporting components and auxiliary systems of a power plant needed to deliver the energy, other than the generating unit itselfe.g supporting structure, protection and switching equipment, transformers etc.)
CPPAL	CitiPower and Powercor
DAPR	Distribution Annual Planning Report – A report issued by DNSPs to inform National Electricity Market (NEM) regulators, participants and stakeholders about existing and forecast system limitations on our distribution network, and where and when they are expected to arise within the forward planning period
DNSP	Distribution Network Service Provider
FCAS	Frequency Control and Ancillary Services – A process used by the energy market operator to maintain the frequency of the system within the normal operating band of around 50 cycles per second. It provides a fast injection of energy, or fast reduction of energy, to manage supply and demand. There are two markets for Regulation FCAS services which are managed centrally by the market operator. There are six markets for Contingency FCAS services where plants respond to the frequency without a central command or instruction.
MLF	Marginal Loss Factor – Measures the amount of energy generated by a particular generator that is lost during the transmission process
MRSG	Macedon Ranges Sustainability Group
NMI	National Metering Identifier – A unique 10 or 11 digit number used to identify every electricity network connection point in Australia.
NPV	Net present value – A method of calculating a return on investment by calculating the difference between the present value of cash inflows and the present value of cash outflows over a period of time.
STPIS	Service Target Performance Incentive scheme - Provides incentives to network service providers to improve or maintain a high level of service for the benefit of participants in the National Electricity Market and end users of electricity.
VCR	Value of Customer Reliability – The value, estimated in dollars per kilowatt hour (kWh), representing a customers' willingness to pay for reliable electricity supply
VPP	Virtual Power Plant - A network of individual distributed energy resources, such as solar PV and batteries that are located in different places. Although individual assets may not be large enough to access markets. Through aggregation in a VPP, these systems may then be able to participate in trading in the electricity market and providing network services and grid support.

Contents

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Executive summary

Enea Consulting conducted a business case to assess the potential benefits of a neighbourhood battery within the Macedon Ranges

Context and objectives

The Macedon Ranges Sustainability Group (MRSG) was awarded a grant from the Victorian State Government's Neighbourhood Battery Initiative to undertake a feasibility study and develop a project plan for a neighbourhood battery.

To support MRSG with assessing the potential sustainability, community, network, and economic benefits of a neighbourhood battery Enea was engaged to conduct a feasibility business case.

This report aims to provide MRSG with:

- An understanding of the key network sections within the area that would benefit from the battery
- An understanding of the value streams that the battery could unlock in the region
- A quantification of the potential costs and future revenue streams for the battery
- An assessment through a discounted cash flow of the net present value of different neighbourhood battery options (based on sensitivity analysis on the assumptions and technical scenarios)
- Insights into operational and ownership models for future consideration
- Recommendations on the next steps for MRSG.

Disclaimer:
The analysis and recommendations provided in this report are not intended to replace a detailed business case and do not constitute financial advice. They rather act as a guide on the potential achievable benefits and the potential risks associated with the development of a neighbourhood battery project in the Macedon Ranges.

Methodology

Enea has an in-depth understanding of the value that battery energy storage technologies can provide to networks and communities and has extensive experience in building successful storage business cases. For this project, Enea utilised proprietary battery revenue modelling tools and developed a purpose-built discounted cash flow tool to calculate the NPV for various neighbourhood battery scenarios.

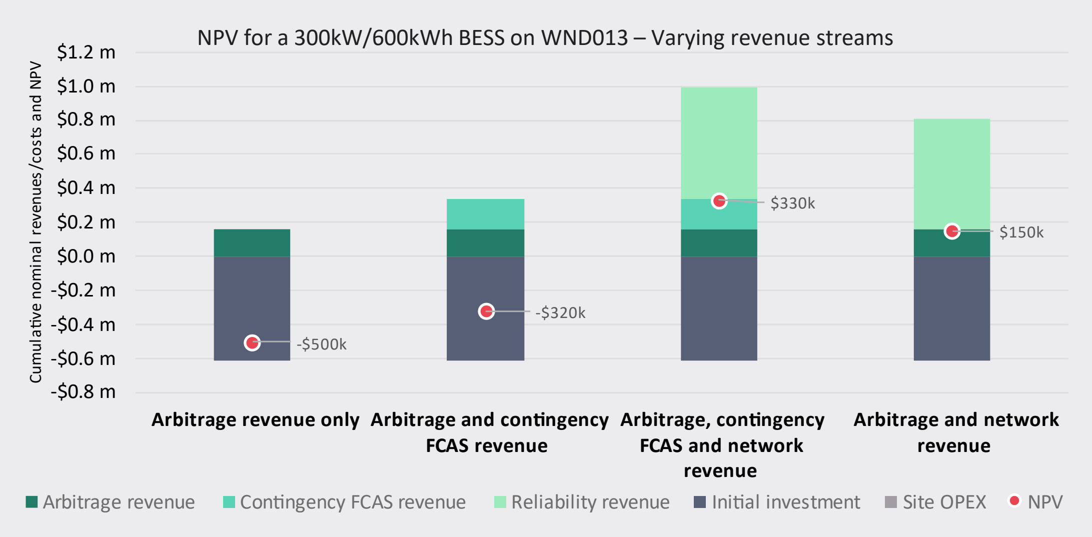
The methodology employed in this business case assessment can be summarised in the following steps:

1. Identify network sections
2. Define value streams
3. Define modelling assumptions
4. Calculate market revenue
5. Analyse network revenue
6. Estimate battery costs
7. Compute discounted cash flow and NPV for different scenarios
8. Highlight ownership and operational models
9. Provide recommendations and next steps

The battery business case will be positive if the battery can target the reliability value

Results and key findings

- Reliability value is the benefit derived from avoiding outages thanks to the operation of the battery in islanding mode. It is the main driver for reaching a positive business case. Achieving this benefit will depend on Powercor's appetite to leverage a neighbourhood battery for reliability purposes.
- If the reliability value is captured and in line with the Value of Customer Reliability (VCR) as defined by the AER, a neighbourhood battery can reach a positive NPV of $150k under the base case scenario.
- Reliability revenues are location-dependent: WND013 is the most promising site.
- If reliability and ancillary services revenue cannot be secured, grant funding of $500k would be required for MRSG to break even.



Recommendations

Enea recommends that MRSG explore with Powercor the opportunity to operate the neighbourhood battery for network reliability purposes. This will maximise the benefit of the proposed battery to the community:

- It enables MRSG to address the community's Top 2 expectations to provide blackout protection and reduce Customer Minutes Off Supply (CMOS)
- It creates the most value for all stakeholders, maximising the battery value add to the system
- It aligns with Victoria's commitment to improving the resilience of the electricity grid

To secure reliability revenues, Enea recommends that MRSG engage with the local network service provider (Powercor):

- To unlock the reliability value stream, the battery will have to be operated by or integrated with Powercor's control room
- Powercor will likely have a more granular view of the reliability benefits and can help identify precise potential sites.

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Context and objectives

Neighbourhood battery business case for MRSG

Context

The Macedon Ranges Sustainability Group (MRSG) has been awarded a grant from the Victorian State Government's Neighbourhood Battery Initiative to undertake a feasibility study and develop a project plan for a neighbourhood battery. The project aims to result in one or more ready-to-run implementation projects.

Enea has an in-depth understanding of the value that battery energy storage technologies can provide to networks and communities and has extensive experience building successful storage business cases.

MRSG aims to engage with residents in the Macedon Ranges to educate, inform and generate interest in adopting these types of batteries. MRSG requires a model for neighbourhood battery adoption that enables the streamlined implementation of these batteries to address community priorities.

Objectives

To support MRSG with assessing the potential sustainability, community, network, and economic benefits of a neighbourhood battery, Enea was engaged to conduct a feasibility business case. This report aims to provide MRSG with:

- An understanding of the key feeders (e.g. network section) within the area that would benefit from the battery
- An understanding of the value streams that the battery could unlock in the region
- A quantification of the potential costs and future revenue streams for the battery
- An assessment through a discounted cash flow of the net present value of different neighbourhood battery options (based on sensitivity analysis of the assumptions & technical scenarios)
- Insights into operational and ownership models
- Recommendations on the next steps for MRSG.

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Methodology and assumptions

Methodology overview

Steps in business case methodology

1. Define feeders (e.g. network section)
2. Define value streams
3. Define modelling assumptions
4. Calculate market revenue
5. Analyse network revenue
6. Estimate battery costs
7. Run discounted cash flow and compute NPV for different scenarios
8. Highlight ownership and operational models
9. Provide recommendations and next steps

Report section

3 – Methodology and assumptions (steps 1–3)

4 – Analysis outputs (steps 4–6)

5 – Business case results (steps 7–9)

Energy arbitrage, frequency reserves and reliability benefits were selected for consideration in the business case

Market services	Energy arbitrage	Trading in the electricity spot market/optimising self consumption
	Generation capacity	Ensuring generation capacity meets maximum demand
Ancillary services	Frequency control	Maintaining system frequency
	Voltage support	Maintaining system voltage
	Black start	Restoring supply following full or partial outage
Network services	Congestion relief	Deferring network investments
	Reliability	Avoiding outage
	Impact on losses	Reduce network technical losses
	Dist. voltage control (DER integration)	Prevent voltage drop (or rise) in specific locations
	Bushfire risk reduction	Avoid asset operation during high bushfire risk events

Reasons for inclusion/exclusion of market (and ancillary) revenues:

- Energy arbitrage: an accessible market for MRSG to access through relationship with an energy retailer.
- Generation capacity: There is currently no market for generation capacity monetisation.
- Frequency control: an accessible market for MRSG to access through relationship with an energy retailer. This will require the retailer to operate the battery in a VPP.
- Voltage support: AEMO works with industry members to regulate voltage levels on the transmission network, no mechanisms exist at the distribution level.
- Black start: The neighbourhood battery is too small to provide black start services.

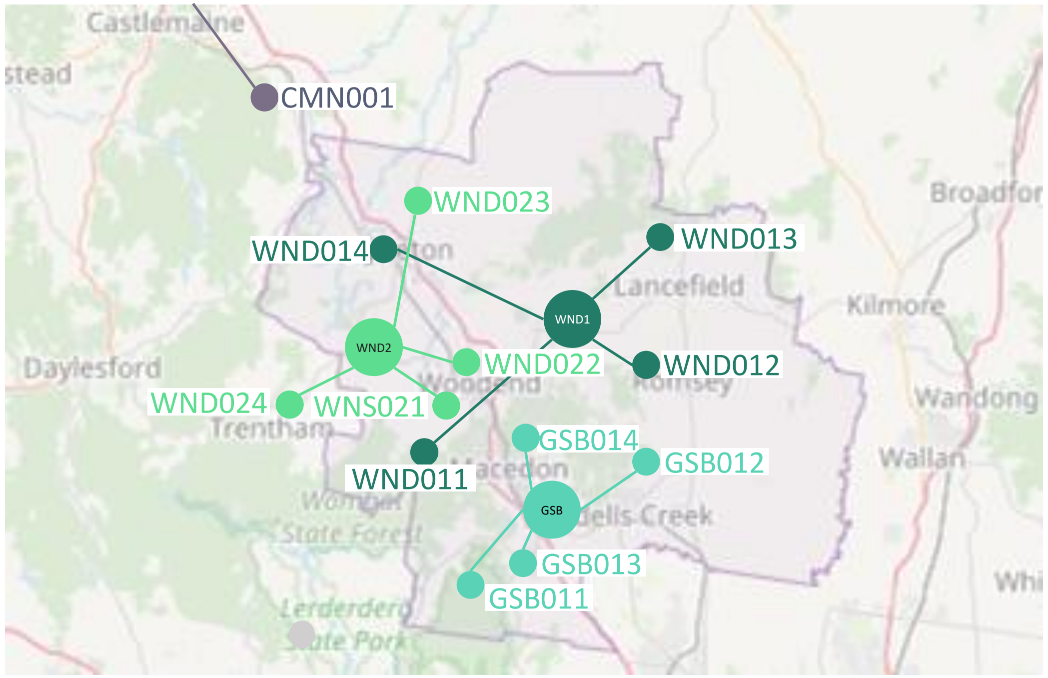
Reasons for inclusion/exclusion of network revenues :

- Congestion relief: based on the 2020 DAPR, it appears that opportunities for AUGEX deferral presently do not exist in the area.
- Reliability: bi-lateral agreement could be established with the DNSP in order to unlock the battery's ability to reduce outages and associated penalties the DNSP would otherwise be subject to.
- Impact on losses: difficult to monetise and potentially negligible compared to other value streams.
- Dist. Voltage control: Enea/MRSG was unable to collect data through C4NET. Based on Enea’s expertise, DER integration support value stream is second order of magnitude compared to congestion relief and reliability benefits for this project.
- Bushfire: Battery size required for off-gridding an entire community supplied by a high-voltage feeder is too important compared to a typical neighbourhood battery size.

Key Not considered for neighbourhood BESS

15 feeders[1] were selected for analysis based on Local Government Area boundaries for Macedon Ranges

Feeders[1] considered relevant for the study



Key: Approximate location of Zone Substation (ZSS) or ZSS bus

Approximate location of Feeder

Approximate boundary of Macedon Ranges Shire

***Note:* (1)** *Feeders refer to physical sections of powerlines within a network. These are segmented and named for ease of reference in planning and maintenance.*

Source: Vic State Govt LGAs (knowyourcouncil.vic.gov.au), Powercor (ZSS reports)

There are three zone substations (ZSS) in or close to the Macedon ranges shire were analysed, these are:

- WND in Woodend (split into ZSS bus WND1 and WND2)
- GSB in Gisbourne
- CMN in Castlemaine

In total 15 feeders were then considered relevant for inclusion in the analysis, these are:

- WND011
- WND012
- WND013
- WND014
- WND021
- WND022
- WND023
- WND024
- CMN001
- GSB011
- GSB012
- GSB013
- GSB014

Note: Feeders WND024 and CMN001 are likely to have a majority of their customers outside of the LGA. They have still been considered for analysis however due to the request of MRSG due to known reliability issues and an approach based on the ‘best outcome’ for the whole area.

Battery dispatch was modelled based on historical data to maximise its overall revenue (value-stack)

Co-optimisation is required as services are not compatible with one another at all times.

- Example: you cannot keep your battery full to maximise reliability value AND discharge it to make money on the energy markets
- It is, therefore, essential to evaluate services « compatibility » to avoid overestimating storage total revenue.

Enea's revenue assessment model relies on several assumptions

- Price taker: the storage device is assumed to be sufficiently small that it doesn't affect wholesale prices. This is a reasonable hypothesis for small-scale batteries (< 5MW)
- Perfect foresight: Future electricity prices are assumed to be known ahead of time, enabling perfect optimisation of storage device operations. Market revenues are then scaled down (70%) to account for imperfect foresight.
- Historical: historical prices (as well as outages and load) are used to represent future conditions. Market modelling could be used to incorporate forward price curves.
- The assumptions leveraged in the model are available on slides 14 and 26.

Revenue assessment model assumptions

Project	**Revenue streams**	Arbitrage, contingency FCAS, reliability
	Dispatch intervals	30-minute
	Perfect foresight	70% achievable
	Revenue scenario	Market prices assessed over the 2015-2020FY period
	Reliability coverage	Interruptions valued using the 2021 VCR values from the AER
	Discount rate	5.78%
	Inflation rate	2.50%
Battery	**Lifetime**	15 years
	Round-trip efficiency	85%
	Power	100kW, 200kW, 300kW, 400kW and 500kW tested
	Duration	1, 2 and 4 hours tested
	Costs	CAPEX/OPEX derived in section 2

Notes:

- The battery is limited to 1 cycle per day, averaged over a year
- 6 Contingency FCAS, 1 Energy markets are co-optimised. Reliability is not co-optimised. Note: Regulation FCAS has not been modelled as it is not accessible for VPP operators.
- Battery is assumed to be dispatched as part of a VPP to reach sufficient size to enable regulation FCAS participation
- From the 1st of July 2021, settlement periods have changed from 30-minutes to 5-minutes. The 5-minute settlement would tend to increase the market revenues generated by a battery as the opportunities to arbitrage among 5-minute intervals are higher than among 30-minute intervals.
- The consideration of STPIS instead of the VCR would tend to put a higher value on interruption events rather than only duration/energy lost
- The end-of-life asset is considered $0. Tax, MLF and network tariffs have been excluded.
- Reactive power benefits that would lower the voltage levels on the low voltage network are not modelled as it would require complex power flow modelling.

Notes: (1) FCAS: Frequency control and ancillary services (2) VCR: Value of customer reliability (3) AER: Australian Energy Regulator (4) STPIS: Service Target Performance Incentive Scheme (5) MLF: Marginal loss factor

4

Key analysis outputs

Market revenues are calculated from Enea's proprietary battery model

Model inputs/outputs:

Enea's proprietary model takes the following inputs:

- BESS power (100 kW tested)
- BESS duration (1, 2 and 4 hours tested)
- Perfect foresight assumption (assumed as 70% for all cases).

The model produces historical revenues for the following value streams:

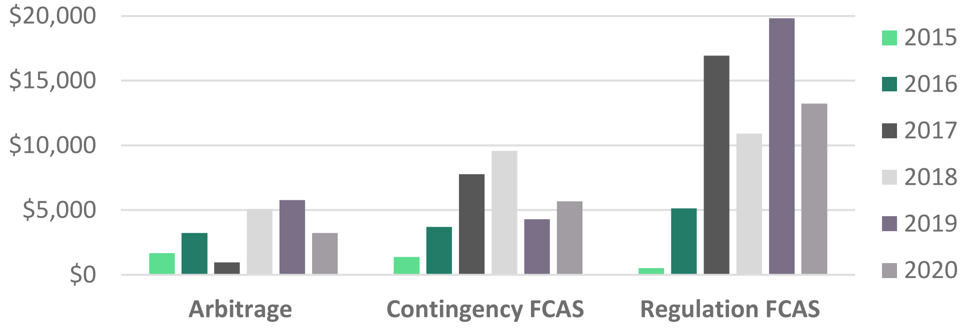
- Energy arbitrage
- Contingency FCAS
- Regulation FCAS.

The model produces results for historical years and this is then extrapolated to produce future revenue forecasts where:

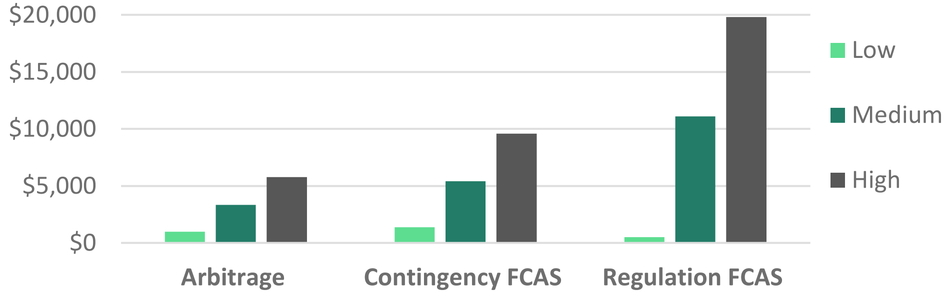
- Low forecast is the minimum value between 2015-2020
- Medium forecast is the average value between 2015-2020
- High forecast is the maximum value between 2015-2020.

Example forecast analysis:

Data exported from model for 100kW 1 hr battery



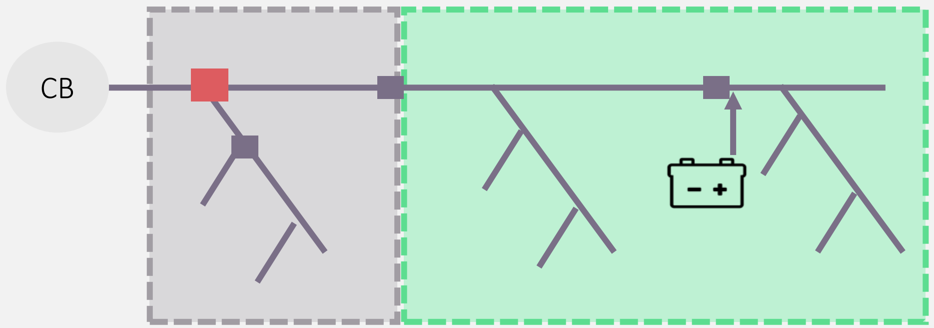
Inputs used in business case for 100kW 1 hr battery years 2022-2037



Values are then multiplied by a factor of 2, 3, 4 or 5 to produce results for batteries with power 200-500kW. The process is then repeated for 2 hours and 4 hours duration.

Storage has the ability to enhance network reliability by providing backup to some areas during outages

Illustration: BESS restoring power to downstream customers[1]



Unplanned outages affect customers along a feeder

Energy storage can restore power to downstream customers

Legend

- CB Circuit Breaker
- Battery
- Fault location in reports
- Remotely controllable device (switches)
- Assumed area of the fault
- Network sections supplied by the battery

Notes: *(1) This would require switches to be turned on to isolate the islanded section of the network. (2) STPIS: Service target performance incentive scheme* considers unplanned outages only. Planned outages not considered in network revenue analysis.

Sources: (3) AER – STPIS scheme, (4) ESC - Victorian Energy Usage Profiles (2019) , (5) AER - VCR

Reliability value corresponds to the benefits of avoiding power outages. It can be quantified through different approaches:

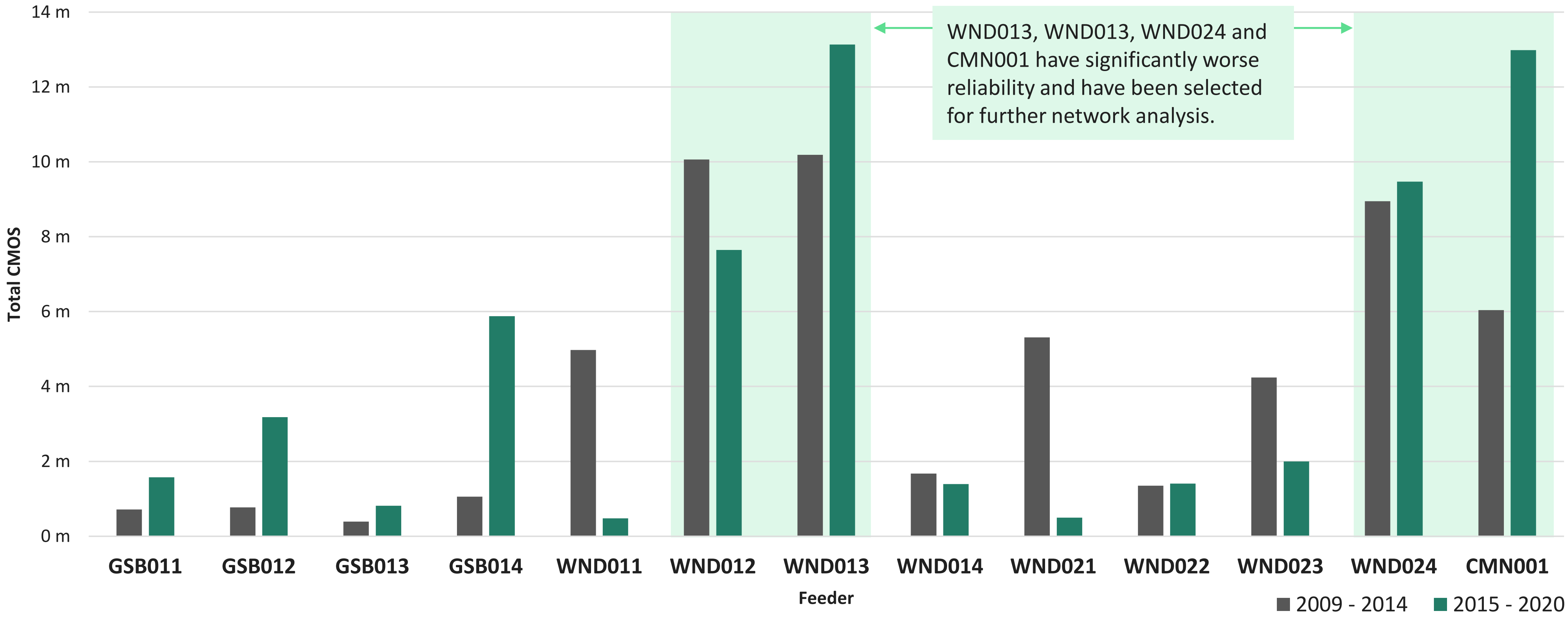
- 1 – By estimating the number of Customer Minutes Off-Supply (CMOS) and valuing it using the Value of Customers Reliability (VCR) as defined by the AER.
- 2 – By assessing the money saved by networks on the STPIS[2] scheme by reducing outages. The Service Target Performance Incentive Scheme (STPIS) provides networks with incentives for maintaining and improving network performance, to the extent that consumers are willing to pay for such improvements[3].

Enea has used publicly available data to estimate the potential reliability savings, leveraging this first approach (CMOS x VCR)

- Networks are required to annually submit Regulatory Information Notices (RIN). This includes detailed asset outage data which enabled Enea to analyse the customer minutes off supply (CMOS) for historic outages.
- By assuming a conservative instantaneous customer power draw of 1kW (based on average daily household electricity consumption in Victoria[4]), Enea was able to calculate the estimate total unserved energy in kWh as a result of each and every outage over the past decade.
- To help networks identify the right level of investment to deliver reliable energy services to customers and inform STPIS incentives the AER releases Value of Customer Reliability (VCR) metrics annually. The VCR seeks to reflect the value different types of customers place on a reliable electricity supply and are expressed in dollars per kilowatt-hour ($/kWh)[5].
- Enea then multiplied the annual unserved energy by the VCR to establish potential reliability revenues for each feeder should a battery have been installed.

Analysis of the total customer minutes off supply (CMOS) highlights four feeders with larger unplanned outages

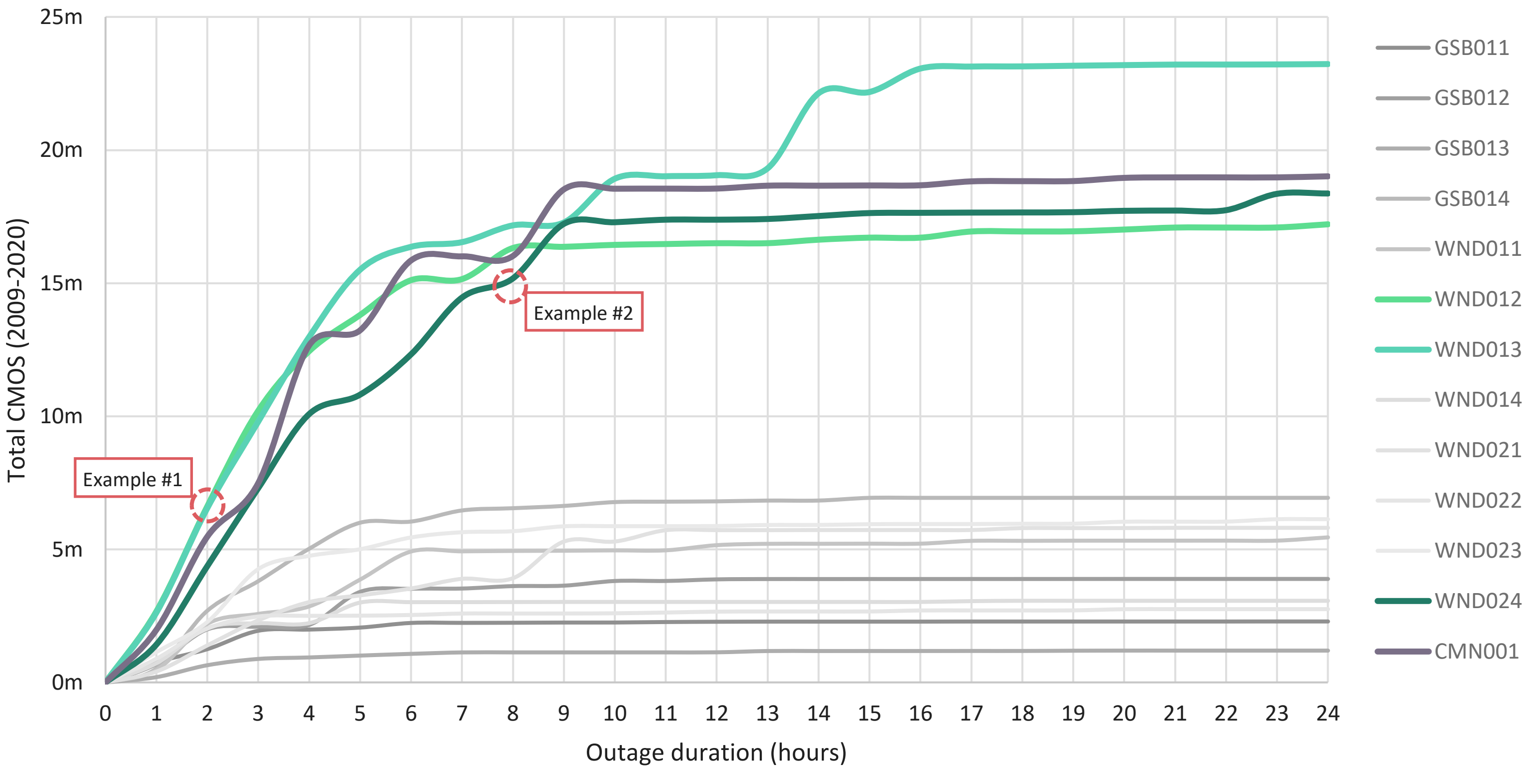
Total CMOS (unplanned, 2009-2020) for feeders in the Macedon Ranges



Source: AER – RIN data

The distribution of outage durations highlights that more than 50% of all outages in the past decade lasted less than 4 hours

Distribution of outage duration in respect to total CMOS (2009-2020)



Graph explainer

Example #1	Indicates that for **WND013**, 6.5m CMOS of the total 23m CMOS or 28% were associated with outages lasting less than 2 hours
Example #2	Indicates that for **WND024**, 15m CMOS of the total 18m CMOS or 83% were associated with outages lasting less than 8 hours

Source: AER – RIN data

Key insights:

- For the total region, greater than 50% of the total minutes off supply since 2009 have lasted less than 4 hours.
- For the total region, less than 10% of total minutes off supply have been from outages lasting greater than 8 hours
- Compared to all other feeders in the Macedon shire, feeders WND012, WND013, WND024 and CMN001 have significantly higher outages in terms of total customer minutes.
- These four feeders also have the greatest contribution for outages that last less than 4 hours which is the likely maximum storage duration capacity for a neighbourhood battery.

Worked example:
Network value analysis for WND013

Sample data to illustrate how reliability value is calculated

A	B	C	D	E	F	G
Date of event	Number of customers impacted	Average duration of outage (mins)	Total unserved energy (kWh)	Theoretical potential energy served by battery		
				100kw x 1hr (100kWh)	100kw x 2hr (200kWh)	100kw x 4hr (400kWh)
14/01/2020	2	364	12.1	12.1	12.1	12.1
15/01/2020	2733	154	7014.7	100	200	400
16/01/2020	2	825	27.5	27.5	27.5	27.5
16/01/2020	2	476	15.8	15.8	15.8	15.8
20/01/2020	41	399	272.6	100	200	272.6
22/01/2020	75	510	637.5	100	200	400
26/01/2020	2	705	23.5	23.5	23.5	23.5
28/01/2020	2	197	6.5	6.5	6.5	6.56

A, B, C = data from Powercor's RIN submission

D = 1*(B*C)/60

Multiply by 1kW load assumption (see page 17)

Convert mins to hrs

E,F,G = If (D < capacity, D, capacity)

"If" statement to assess how much of each outage could have been served by batteries of varying capacity sizes (kWh). 100kW-500kW with 1-4hrs duration tested in actual analysis.

Analysis methodology:

- The theoretical potential energy served by each battery size was calculated for all outages from 2015-2020 (see illustrative data on the left). These were summed into yearly totals and then averaged across the five years.
- The diagram on slide 17 depicts through the green shading that a battery will only likely restore power to a feeder section. This will depend upon the fault's location and the battery's location. It is therefore conservatively assumed that the battery can only address 50% of the outages on the feeder, and the theoretical potential energy is consequently multiplied by a factor of 0.5 to provide a realistic value.
- The realistic potential energy served was multiplied by the VCR to provide a potential annual reliability value
- The VCR for the base case is assumed to be $17.60/kWh based on Macedon Ranges being classified as a regional climate zone 7[1]. The VCR value for other agricultural, commercial and industrial customer types was also tested during the business case scenario sensitivity analysis.

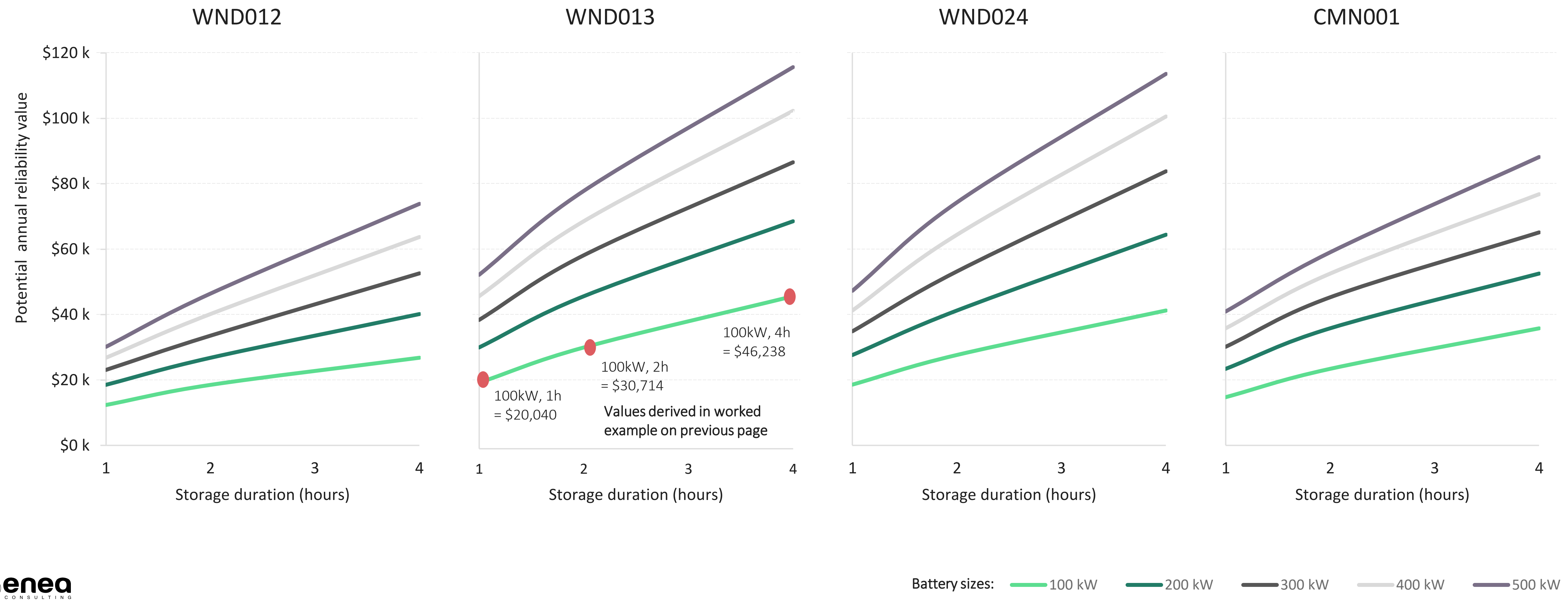
Analysis sample result:

Battery size	Potential energy served by BESS	Potential annual value
100 kW 1h	2,277 kWh	$20,040
100 kW 2h	3,490 kWh	$30,714
100 kW 4h	5,254 kWh	$46,238

Sources: (1) AER – 2021 Annual VCR adjustment

Reliability value increase with larger battery capacities and durations

Potential value for each feeder and battery size



The CAPEX costs were approximated from recently benchmarked projects and industry literature

By undertaking a literature review and consulting previous work by Enea on community and network batteries, five benchmark CAPEX costs were found:

#	Source	Battery size (kW)	Storage capacity (kWh)	Cost ($)
1	Supplier quote	300	546	619,950
2	Supplier quote	68	142	309,930
3	Supplier quote	250	273	446,225
4	KPMG/Ausgrid report	200	250	400,000
5	KPMG/Ausgrid report	400	500	600,000

The price of a battery is known to be a result of its power output, storage duration and a fixed cost component for other balance of plant (BOP). This relationship can be expressed as:

$$\text{Cost (\$)} = Ax + By + C$$

Where: **Cost($)** is the CAPEX cost taken from the benchmark
x is the battery capacity (kW)
y is the storage capacity (kWh)
A, B, C are unknown constants

Although the actual relationship is not truly linear as the approximation suggests, for the size ranges being considered, this is a fair assumption to use.

The five known data points were plugged into the equation and then simultaneously analysed to find A, B and C. An exact answer cannot be found as it does not exist, but the best fit solution can be calculated through an iterative approach.

This involves setting values for A, B and C, comparing the calculated cost to the actual cost and then adjusting A, B and C on the second iteration to minimise the sum of the differences between all calculated and actual costs. Excel's solver function automates this process, and the following was selected:

$$\text{CAPEX} = 335x + 575y + 205{,}500$$

Where: **x** is the battery capacity (kW)
y is the storage capacity (kWh)

This approximation was an almost exact fit for benchmark costs #1 and #2, and only slightly overestimated costs by 1% for #3 and 4% for #4 and #5. Instead of having a proper quote, this approximation will be used, and sensitivity analysis will be carried out for +/- 20%.

Sources: KPMG - Ausgrid neighbourhood battery (2020), Enea - supplier quote from previous engagement (2021)

The OPEX costs are ultimately negligible compared to the CAPEX of the BESS

Due to the relatively small size of neighbourhood batteries compared to utility-scale batteries, and typically less technically competent customer types, componentry is often built with minimal maintenance in mind. Recent industry cost projections[1] quoted suppliers offering between $2,000 and $10,000 per annum for basic annual servicing, depending on the battery size and operational characteristics.

Combining these insights with recent known operational costs for larger grid-connected batteries, Enea has estimated the OPEX costs to be **$5000 per annum**.

Also, lifetime OPEX costs are less than 10%[2] of the CAPEX of the battery, which is negligible for the business case.

Additional notes on battery cost assumptions:

CAPEX costs include a fixed cost, in addition to battery supplier and services quotations this has been assumed to be approximately $100k to cover project development costs and other small balance of plant and construction costs. This fixed cost grows significantly when increasing the size of the battery from community sized to utility sized which can be up to $2m.

Sources: (1) KPMG - Ausgrid neighbourhood battery (2020)

Notes: (2) Based on total project estimated costs on page 24 and OPEX assumption above.

Update on costs

Recent neighbourhood battery projects provide additional information total project costs

#	Source	Battery size (kW)	Storage capacity (kWh)	Cost ($)	
1	Supplier quote	300	546	619,950	Total battery unit cost
2	Supplier quote	68	142	309,930	
3	Supplier quote	250	273	446,225	
4	KPMG/Ausgrid report	200	250	400,000	
5	KPMG/Ausgrid report	400	500	600,000	
6	Yarra Energy Foundation	110	284	1,000,000	Estimated total project cost
7	Tarneit Battery	150	388	1,000,000*	

*Estimated : 800k funding received from VIC gov.

To account for this, Enea recommends to add $500,000 in project budget to cover for project development costs.

Project development activities include:

- Engineering, Procurement and Construction (EPC)
- Connection work
- Legal and consulting

Sources: KPMG - Ausgrid neighbourhood battery (2020), Enea - supplier quote from previous engagement (2021)
Tarneit: https://www.powercor.com.au/media-and-resources/media-centre/media-release-new-battery-to-help-tarneit-share-the-sun
YEF: https://www.abc.net.au/news/2022-06-05/community-battery-in-melbourne-unveiled/101127080

5

Business case results

A purpose built DCF tool was developed to calculate the NPV for various BESS scenarios

An excel tool was developed to calculate the discounted cashflows (DCF) and net present values (NPV) for various scenarios.

The tool utilised the following data:

- Historic market revenue data (see page 16)
- Reliability revenue data (see pages 17-21)
- Value of customer reliability (from AER)
- Battery CAPEX and OPEX data (see page 22-24)

The tool can be customised to change:

- BESS power: 100kW to 500kW
- BESS duration: 1, 2 or 4 hours
- FCAS: none considered, contingency only
- Price forecast: Low (min. of historic prices), medium (avg. of historic prices), high (max. of historic prices)
- VCR: Macedon ranges (climate zone 7), Victorian averages (Residential, agricultural, commercial or industrial)

The tool assumes the following constants:

- WACC: 5.78%
- CPI 2.5%
- Reference year: 2022
- BESS lifetime: 15 years

Business case scenario analysis:

A base case was first conducted for the four feeders of interest in order to select the most economical feeder location, this assumed:

- BESS power: 300kW
- BESS duration: 2 hrs
- Price forecast: Medium (see definition page 16)
- FCAS: Not considered
- VCR: Macedon ranges (climate zone 7)

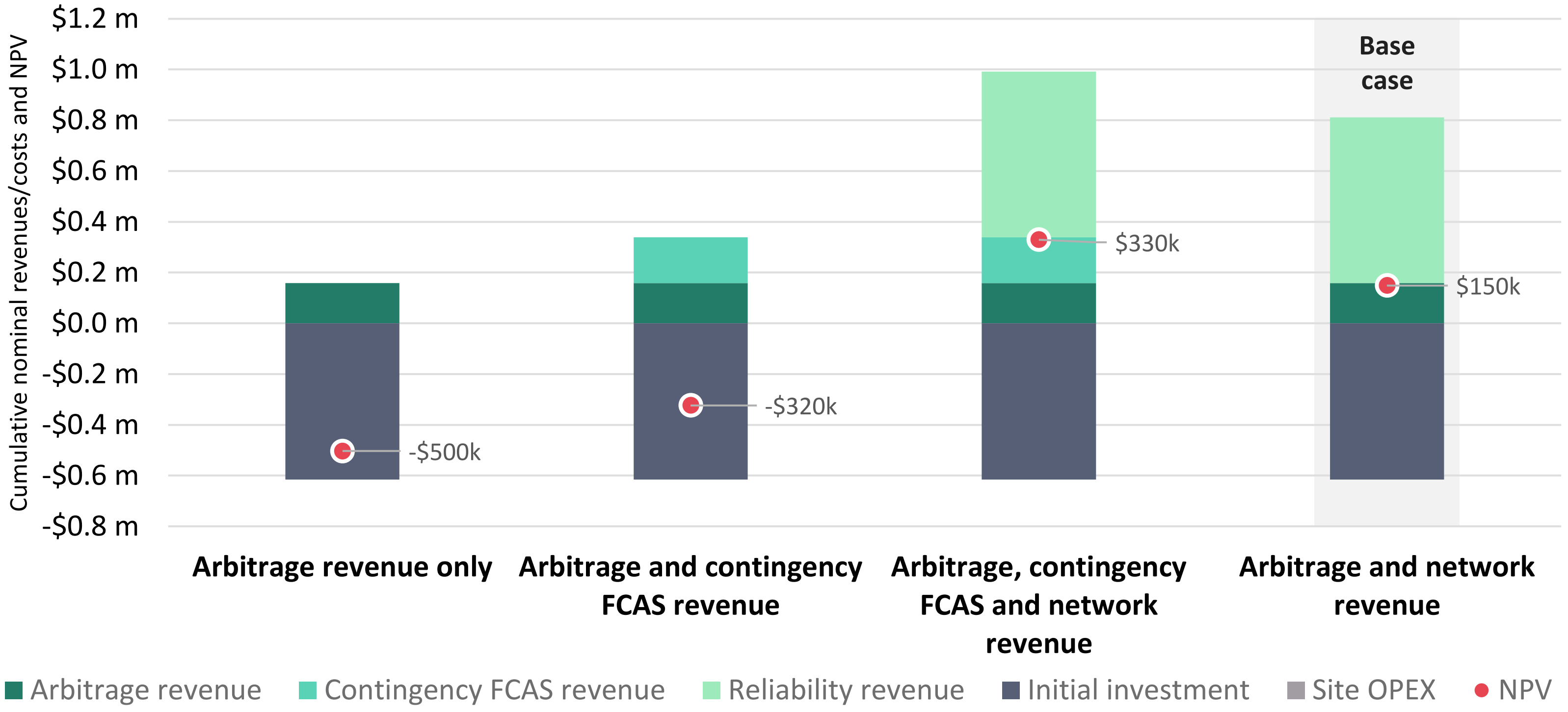
After assessing the selecting a base case location, sensitivity was then performed on the other customisable factors to test:

- The impact of accessible revenue streams
- The impact of the BESS location
- The impact of changing market revenue forecast assumption
- The impact of the selected VCR
- The impact of changing the BESS power
- The impact of changing the BESS duration
- The impact of the CAPEX assumption

After modelling the different scenarios and testing sensitivities a hypothetical low and high case were built (see page 36 for assumptions) to illustrate to MRSG the potential variance in NPV based on the modelling assumptions.

Reliability value needs to supplement market revenues to reach a positive NPV of $149k

Results for a 300kW/600kWh BESS on WND013 – Varying revenue streams



Key insights:

- Energy arbitrage alone is not enough to make the business case work.
- Reliability revenue has a large impact on NPV.
- FCAS is a fair share of the market revenue but likely not accessible[1]. This has therefore been removed from the base case.

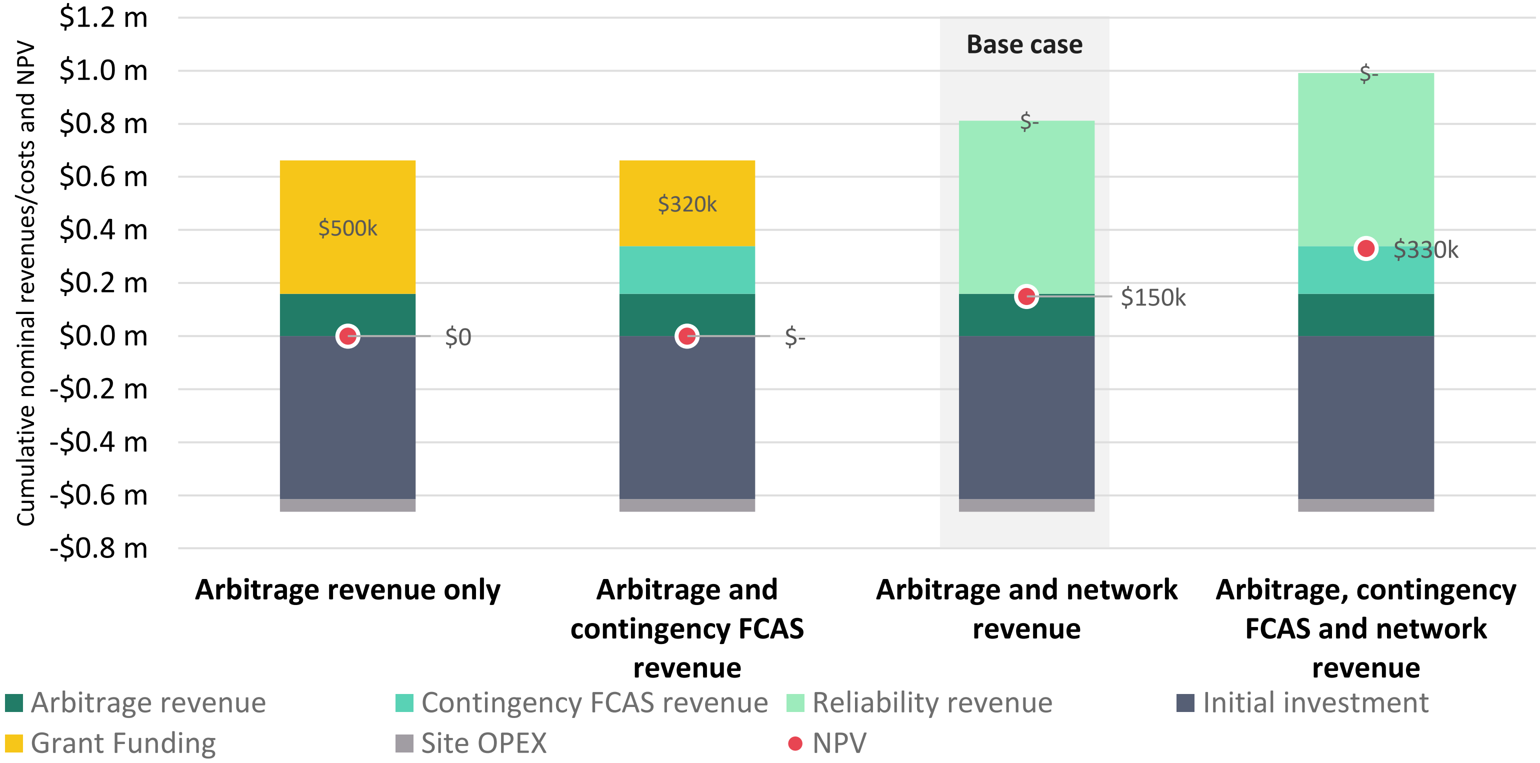
Modelling constants

- Feeder: WND013
- BESS power: 300kW
- BESS duration: 2 hrs
- Revenue forecast: Medium
- VCR: $17.60/kWh (Climate zone 7)

Notes: (1) Unless managed as part of a virtual power plant (VPP) it is unlikely that a battery of the sizes considered will be able to access contingency FCAS markets. For regulation FCAS, technical barriers currently prevent VPPs from participating in this market, however this may evolve in the future.

If network and ancillary revenue cannot be secured[1], $500k funding will be required to break even

Results for a 300kW/600kWh BESS on WND013 – Varying grant funding amount



Key insights:

- The business case does not stack up when network revenues are ignored
- $500k grant funding would be required if only arbitrage revenues assumed
- Contingency FCAS is possible to access through a VPP, however it would not be enough on its own to make a positive business case and $320k funding would still be required

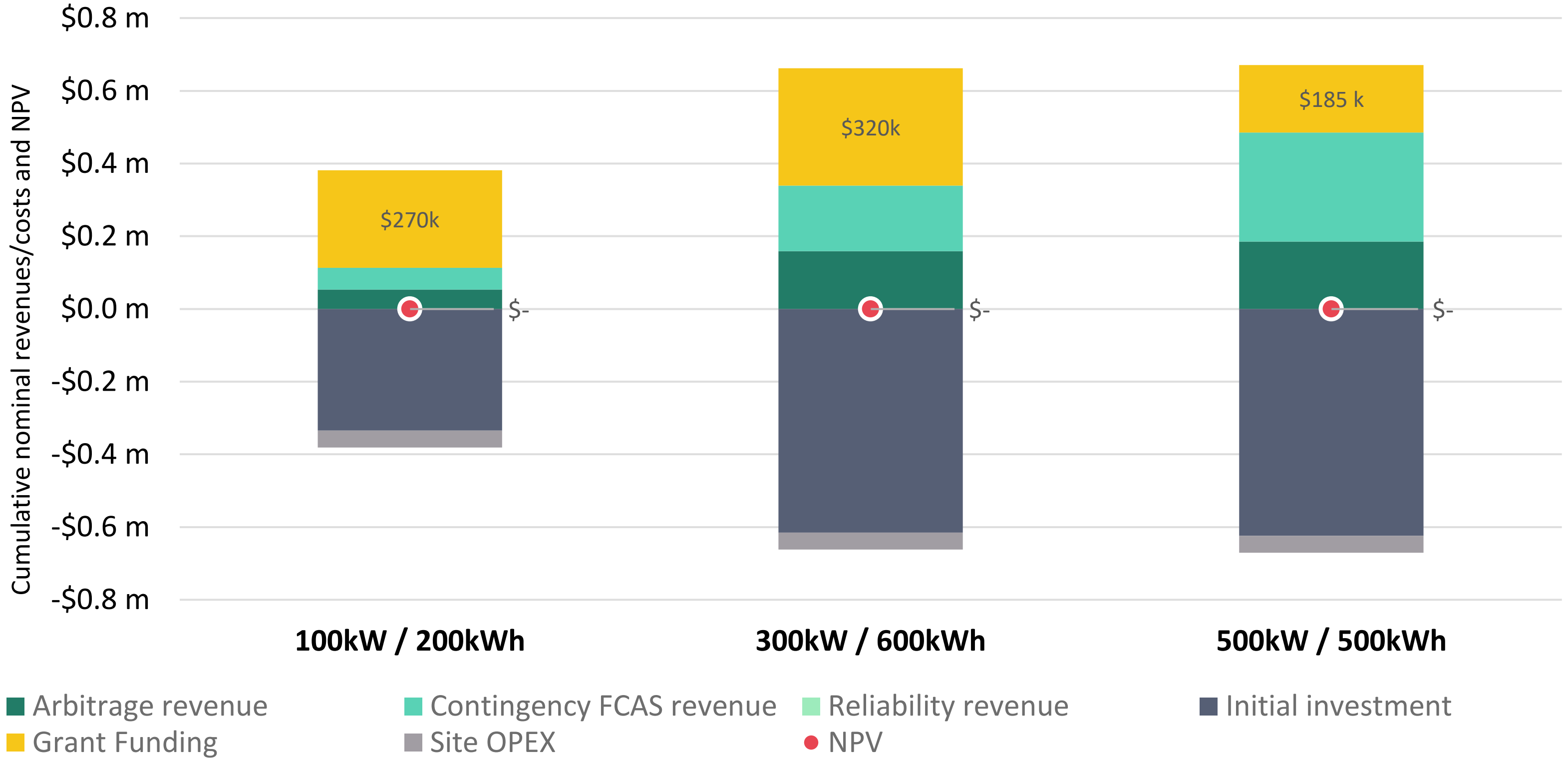
Modelling constants

- Feeder: WND013
- BESS power: 300kW
- BESS duration: 2 hrs
- Revenue forecast: Medium
- VCR: $17.60/kWh (Climate zone 7)

Notes: (1) Network revenues assume that Powercor leverage the neighbourhood battery for reliability purposes. A bilateral agreement would have to be made to secure this as a revenue stream. To secure ancillary revenue, the battery would need to be enrolled into a VPP as this market can only be accessed by 1MW power increment.

If FCAS can be secured, a larger power but shorter duration battery is preferred as it minimises the funding requirement

Results for a BESS on WND013 – Grant funding required for various BESS sizes



Key insights:

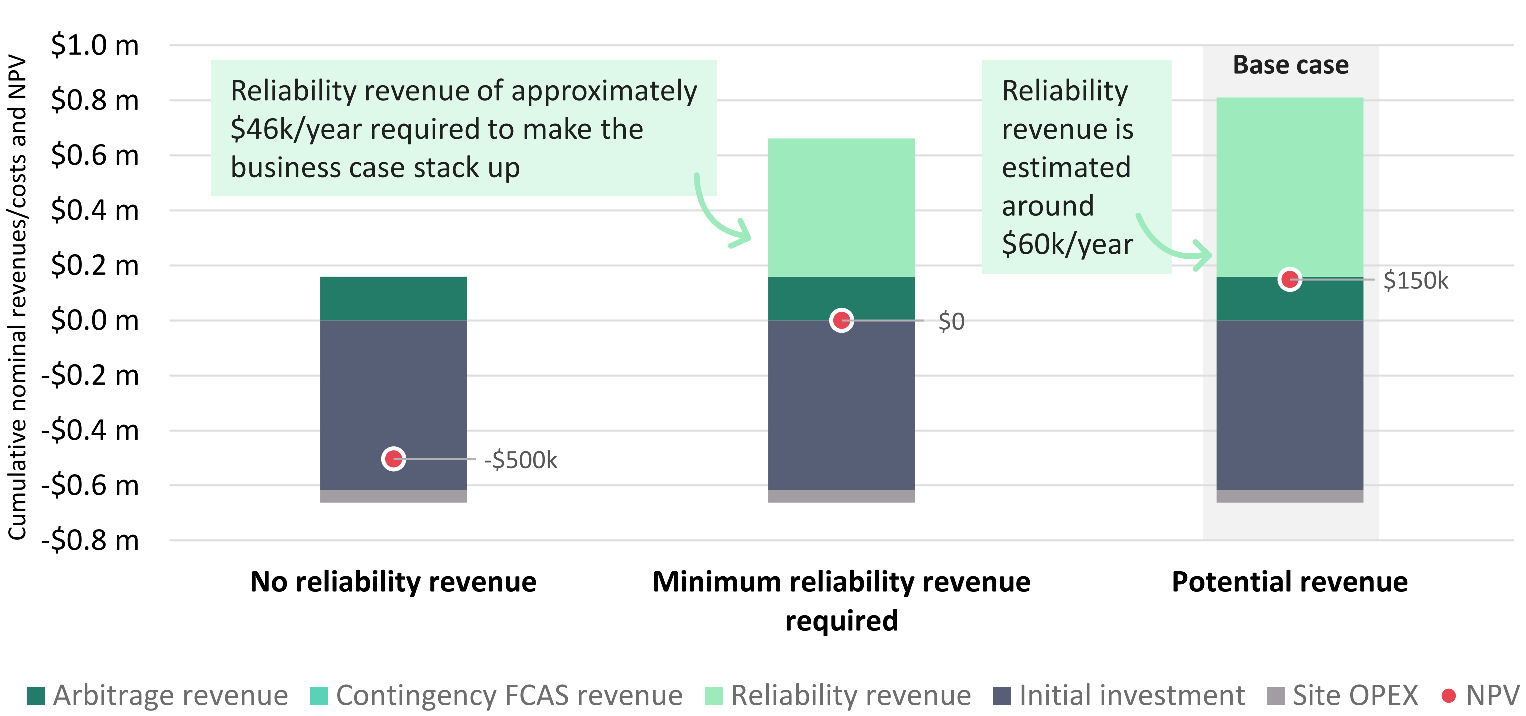
- The 500kW/500kWh is the preferred option if FCAS revenue can be secured

Modelling constants

- Arbitrage and contingency FCAS revenue streams considered only
- Feeder: WND013
- Revenue forecast: Medium
- VCR: $17.60/kWh (Climate zone 7)

Reliability drives a positive business case and depends on Powercor's appetite to operate the battery for reliability purposes

Results for a 300kW/600kWh BESS on WND013 – Varying reliability revenue



Key insights:

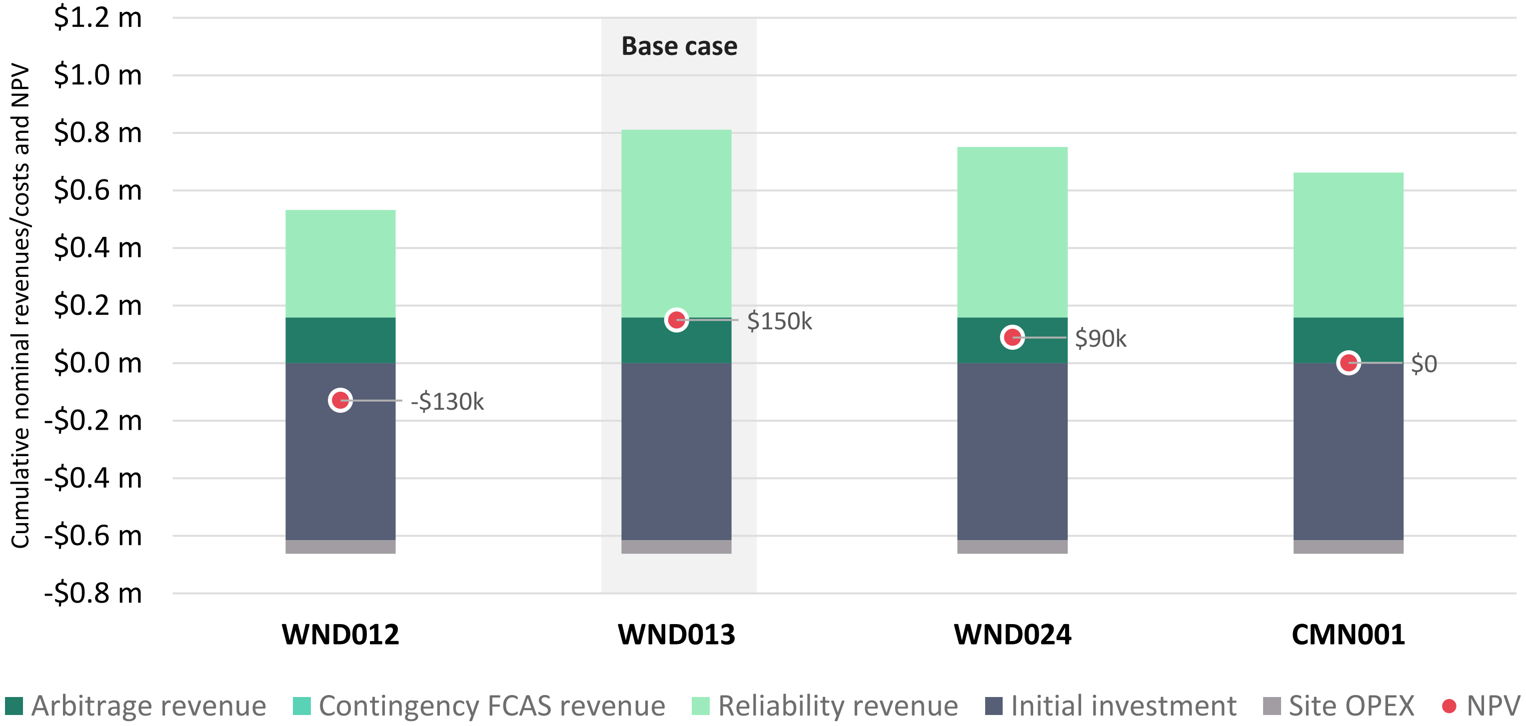
- Not considering reliability results in a negative business case
- Potential revenues are based on the value for customer reliability for the Macedon Ranges, however actual revenue is dependent upon Powercor

Modelling constants

- Feeder: WND013
- BESS power: 300kW
- BESS duration: 2 hrs
- Contingency FCAS: No
- Revenue forecast: Medium

Reliability revenues are also location dependant and WND013 is the most promising location

Results for a 300kW/600kWh BESS – Varying feeder location



Key insights:

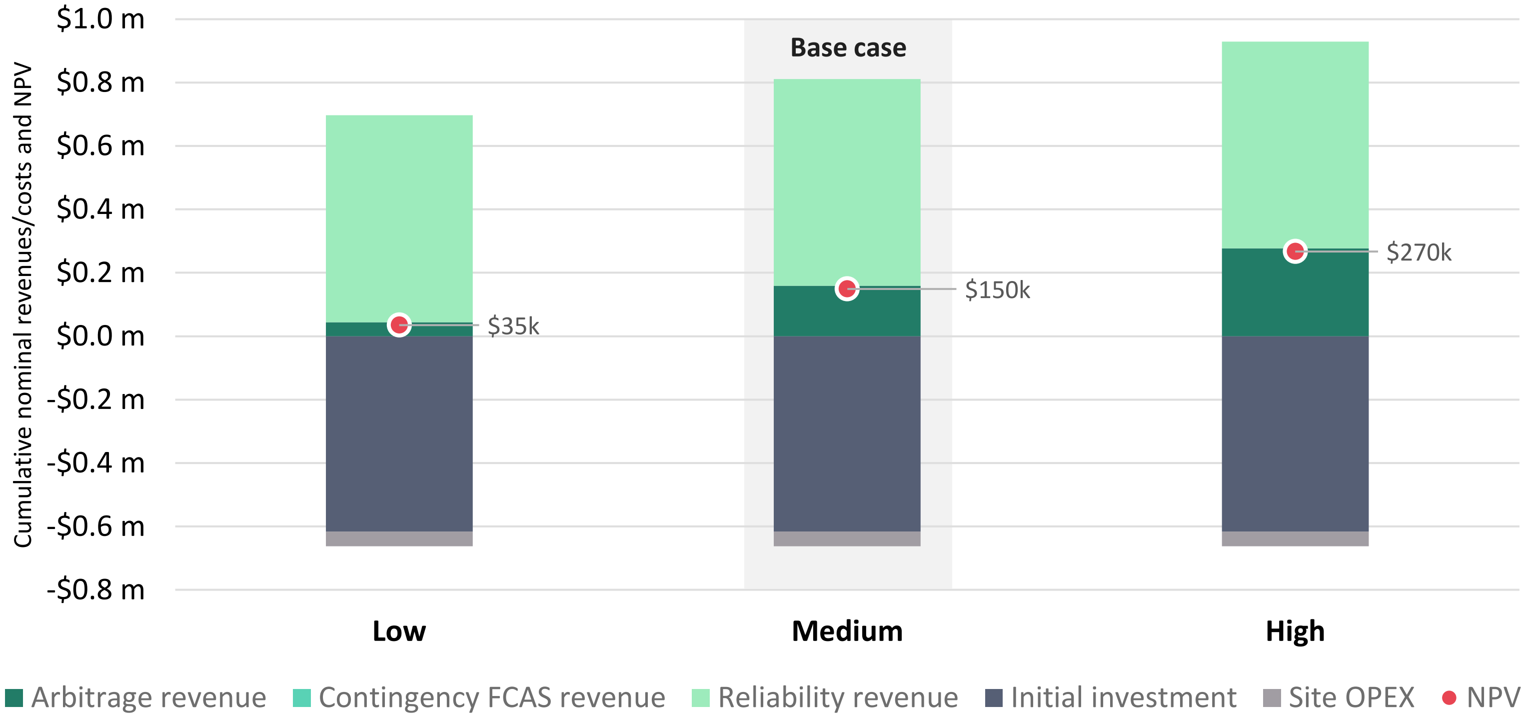
- The reliability revenue is the only factor that impacts the NPV result when comparing different feeder locations
- Based on historical outage data presented on slide18, WND013 feeder has the highest potential for reliability improvements and hence returns the greatest revenues and NPV result.

Modelling constants

- BESS power: 300kW
- BESS duration: 2 hrs
- Contingency FCAS: No
- Revenue forecast: Medium
- VCR: $17.60/kWh (Climate zone 7)

Depending on the price scenarios, arbitrage revenues can impact the final NPV by ~± 75%

Results for a 300kW/600kWh BESS on WND013 — Varying market revenue forecast[1]



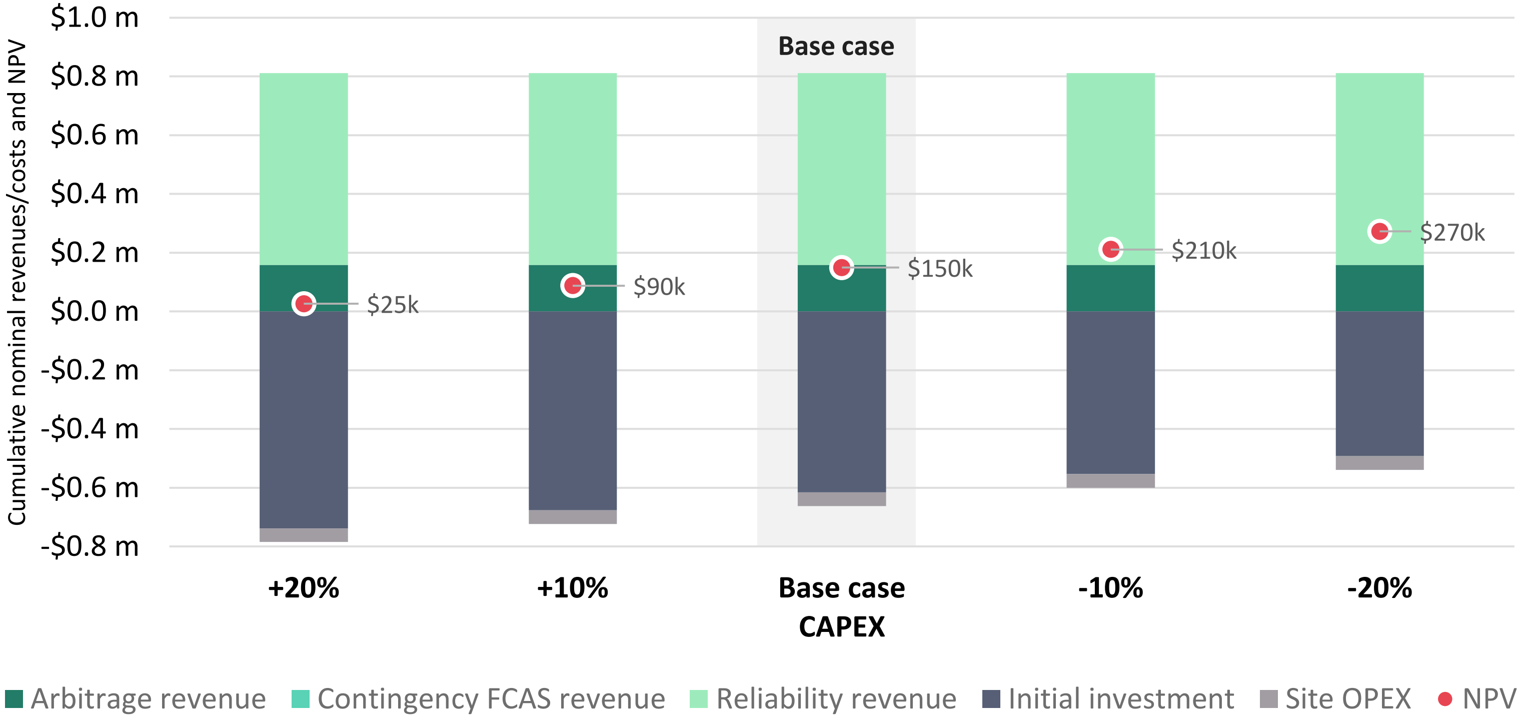
Modelling constants

- Feeder: WND013
- BESS power: 300kW
- BESS duration: 2 hrs
- Contingency FCAS: No
- Revenue forecast: Medium
- VCR: $17.60/kWh (Climate zone 7)

Note: (1) Low, medium and high forecasts are defined on page 16.

A 10% change in the CAPEX from the base case assumption equates to a 40% change in final NPV

Results for a 300kW/600kWh BESS on WND013 — Varying CAPEX assumptions



Key insights:

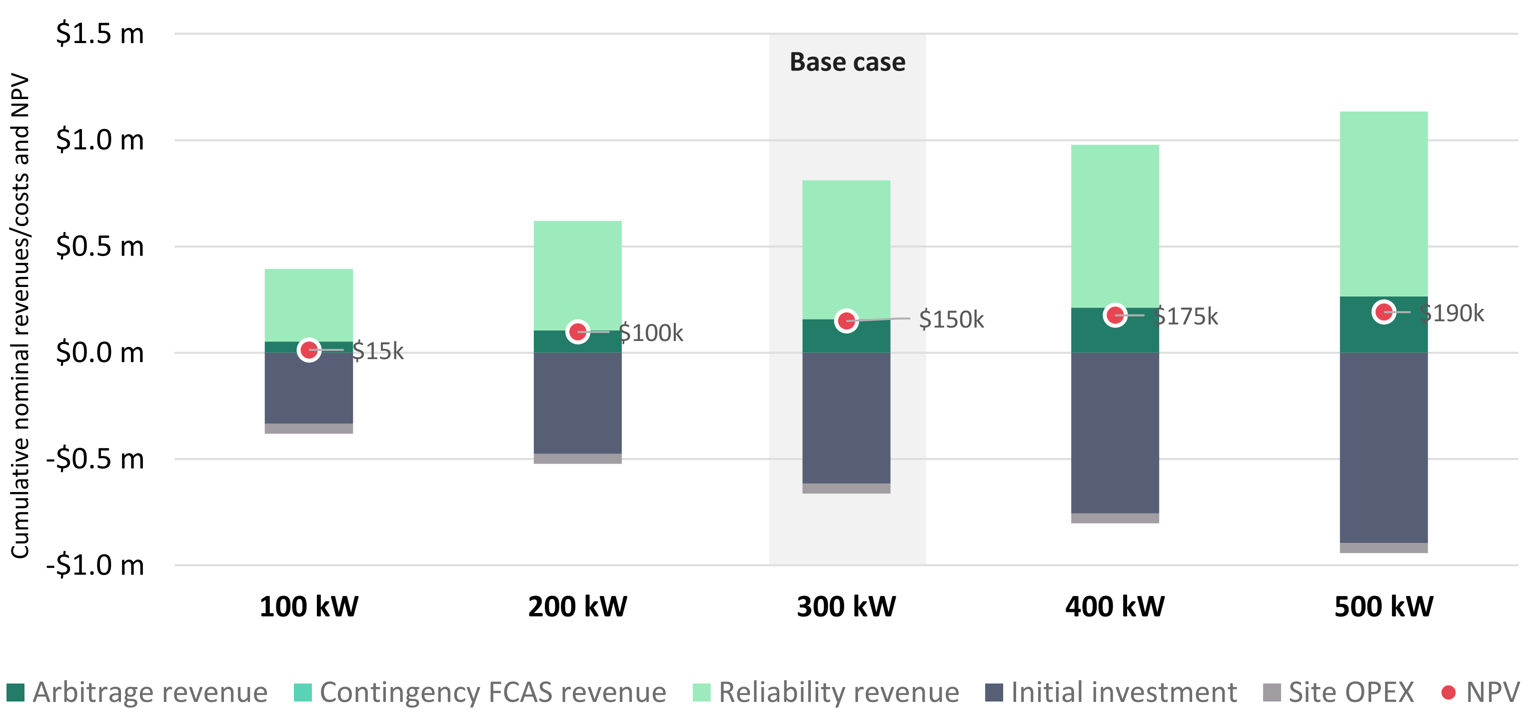
- Taking a conservative approach on the CAPEX assumptions still yields a positive NPV under the other base case assumptions.
- Decreasing the CAPEX increases the NPV

Modelling constants

- Feeder: WND013
- BESS power: 300kW
- BESS duration: 2 hrs
- Contingency FCAS: No
- Revenue forecast: Medium
- VCR: $17.60/kWh (Climate zone 7)

Increasing BESS power increases NPV, in the limit of available reliability revenue

Results for a 2hr BESS on WND013 – Varying BESS power

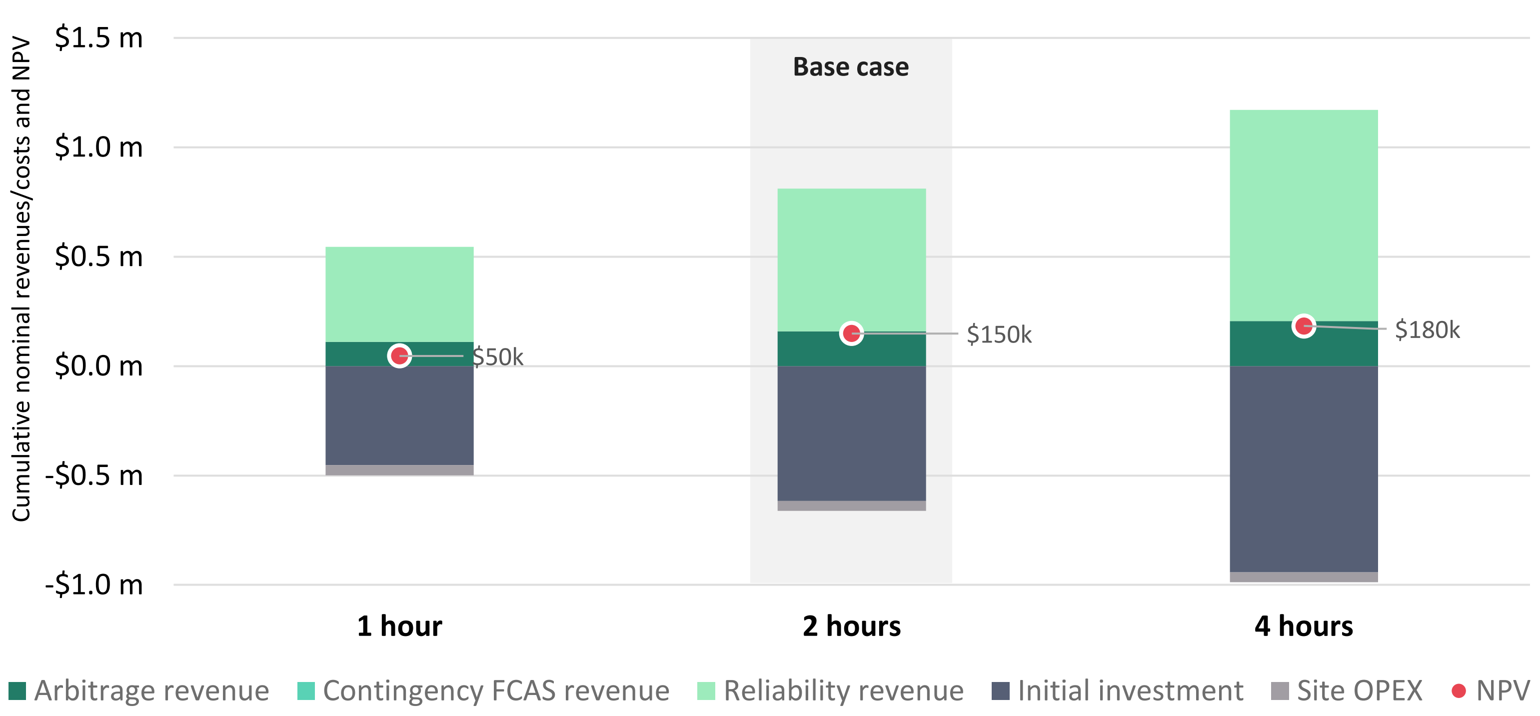


Modelling constants

- Feeder: WND013
- BESS duration: 2 hrs
- Contingency FCAS: No
- Revenue forecast: Medium
- VCR: $17.60/kWh (Climate zone 7)

Increasing BESS duration results in increased revenues and a higher NPV, in the limit of available reliability revenue

Results for a 300kW BESS on WND013 – Varying BESS duration

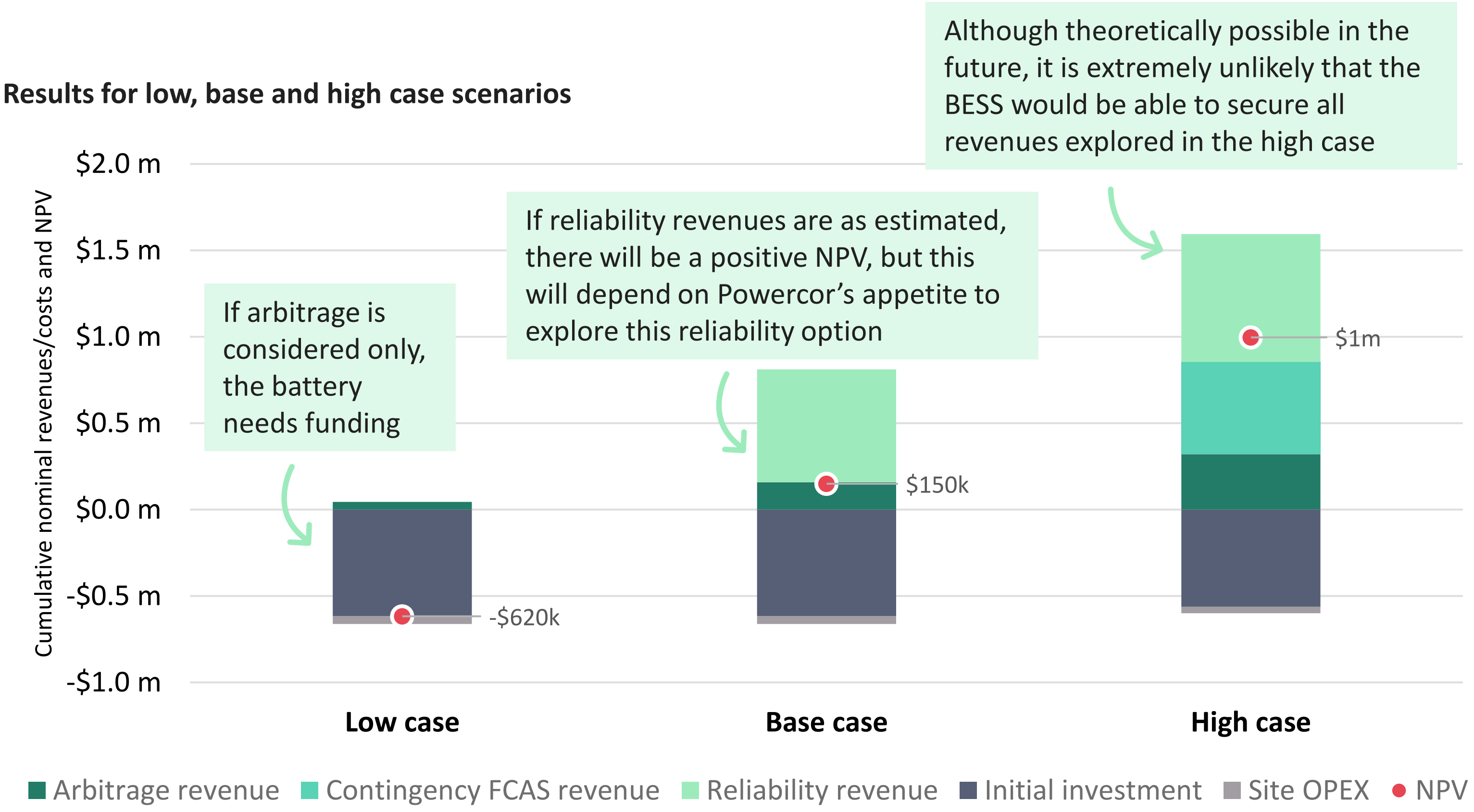


Modelling constants

- Feeder: WND013
- BESS power: 100kW
- Contingency FCAS: No
- Revenue forecast: Medium
- VCR: $17.60/kWh (Climate zone 7)

There is still high uncertainty around revenue monetisation which significantly impacts the business case

Results for low, base and high case scenarios



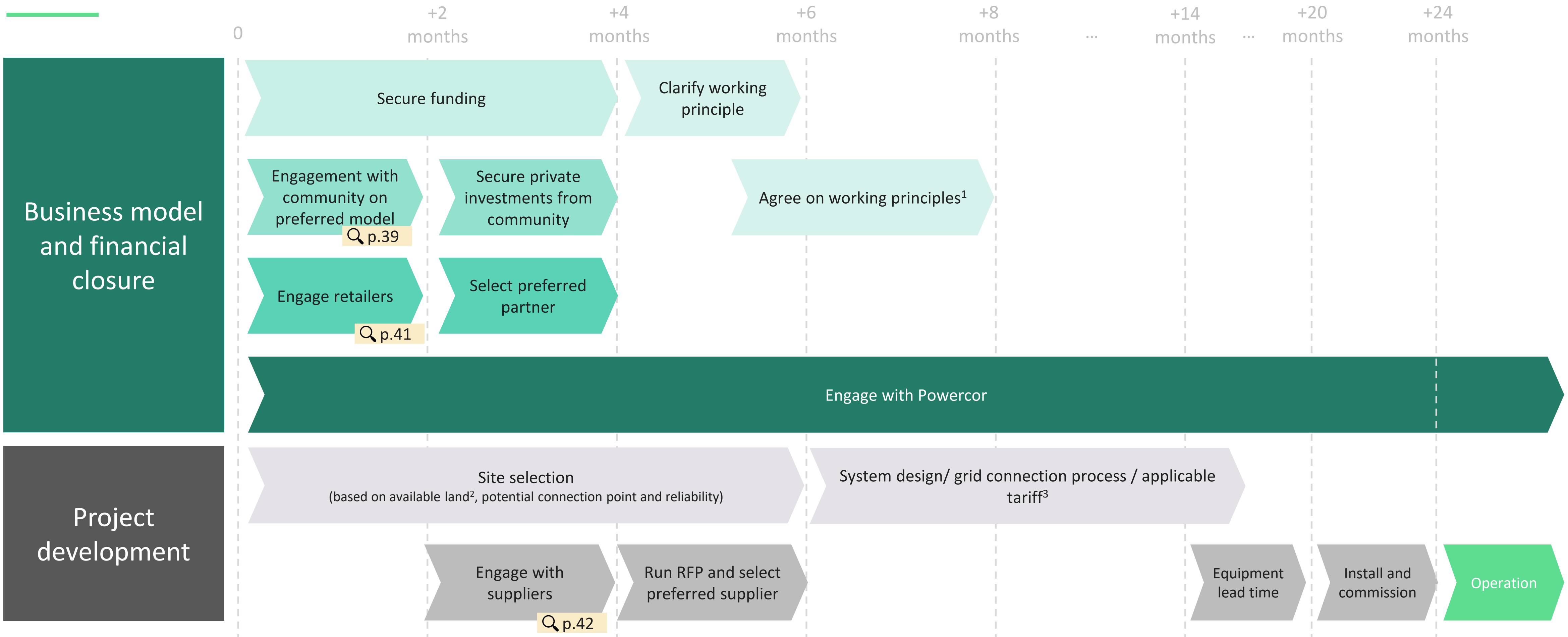
Modelling assumptions:

	Low	Base	High
Feeder	WND013	WND013	WND013
BESS power	300 kW	300 kW	500 kW
BESS duration	2 hr	2 hr	1 hr
Contingency FCAS	No	No	Yes
Revenue forecast	Low	Medium	High
VCR ($/kWh)	$0.00	$17.60	$22.23
CAPEX	+10%	Base	-10%

6

Implementation plan

Implementation plan (indicative)



Notes:

1. Working principles between MRSG, the retailers and (potentially) Powercor.
2. From May 2022, any neighbourhood batteries will be exempt from any planning permits.
3. From July 2022, a neighbourhood battery trial tariff will be available. https://media.powercor.com.au/wp-content/uploads/2022/02/28084618/Community-Battery-Trial-Tariff-factsheet.pdf. We estimate that overall this tariff will enable the battery to be at equilibrium or make a slight benefit (~2k AUD per year referenced)

Out of the various business models considered, DNSP ownership is MRSGs preferred approach

1 Retailer ownership

- Best positioned to access market services
- Not well positioned to access network support services, bilateral agreement with DNSP would be required.
- Well positioned to engage customers with on-bill participation models such as tariffs and subscriptions
- **Example:** Enova Energy shared neighbourhood battery

2 DNSP ownership

- Network ringfencing regulation prohibits DNSPs from providing market services or owning an asset that is used to provide market services. A lease agreement would be required with a retailer in order to access market services.
- DNSPs are the only stakeholder who have clear visibility of network constraints and are best placed to optimise for network services.
- **Example:** Tarneit NBI is owned by Powercor and leased to Simply Energy

3 Third party ownership

- Third parties include community groups, private investors, local and state governments as well as a combination of these.
- These stakeholders often lack the required technical and commercial expertise to develop such projects and negotiate with retailers and DNSPs
- These stakeholders have the greatest opportunity to innovate and typically prioritise the benefits of social equity and decarbonisation over economic return.
- Example: Yarra Energy Storage Service Trial

MRSG preference:

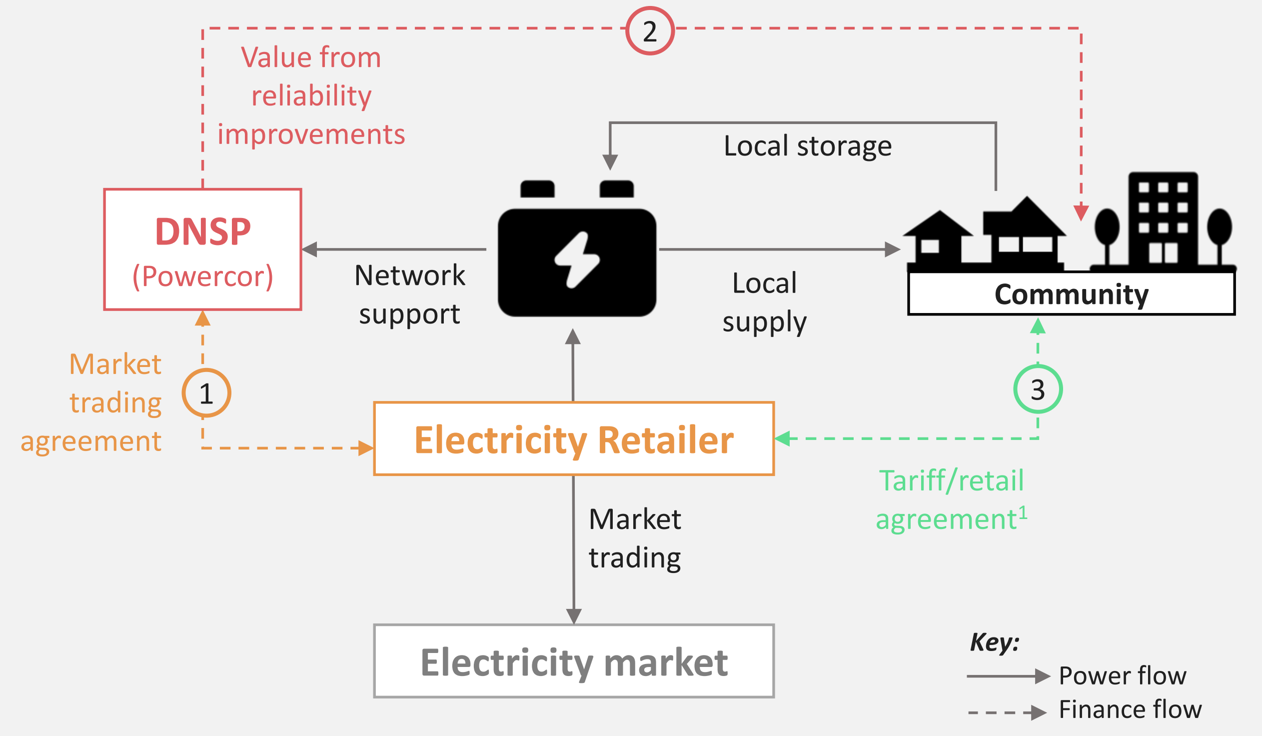
The objectives of the battery varies with the ownership model. From MRSG community consultation, a key objective for the battery is to improve reliability.

MRSG would like to pursue the second ownership model where the DNSP is the owner and operator of the battery. The benefits that would entice the DNSP to consider this option are shown on page 30.

This model will enable the battery to unlock greater value for the community.

In a DNSP-owned model, the community would benefit from reliability improvements

DNSP ownership business model



1 Market trading arrangement w/ a retailer

- In order to access market services, the DNSP will need to have a commercial arrangement with a registered electricity retailer to operate the battery and trade energy in the electricity market.
- Retailers have a profit motive and as such they will have certain financial hurdles in order for it to be attractive arrangement.

2 Reliability improvements for the community

- The use of the battery for network services will improve reliability and reduce the number and extent of outages.
- This has direct value for the community

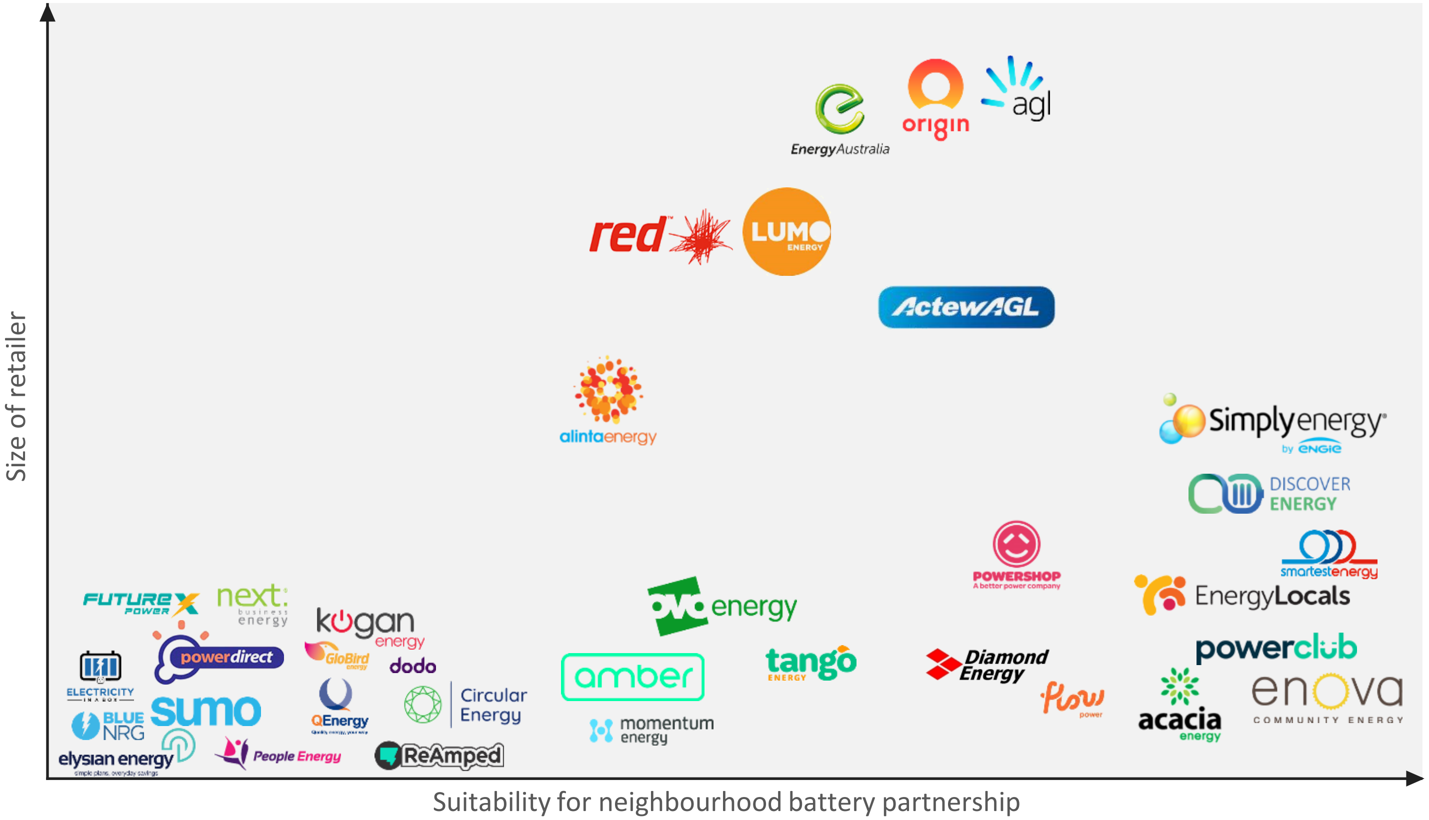
3 Customer tariff/retail agreement

- Retail agreements could be made through the retailer to provide benefits directly to customer bills.
- This however requires the community to transition to the selected retailer, alternatively, profits are transferred back to the MRSG to be more fairly distributed to the community.

Potential retailers who the DNSP may engage

Partnership suitability is dependent upon the retailers VPP capabilities

Victorian electricity retailer mapping: Size vs partnership suitability



Note: The purpose of this page is to provide MRSG with an overview of player in the field. This list is not exhaustive nor a recommendation to engage with a particular party. Top 7 retailers take up >90% market share in Vic. Locations of retailers are indicative only and should not be used to direct compare two or more retailers. Suitability is based on VPP offerings and Enea's current knowledge of the space. **Source:** AEMC Competition Review 2020

Retailers with experience with neighbourhood batteries include

- Acacia (Yarra Energy Foundation)
- Simply Energy (Tarneit)
- Enova Community Energy (Beehive) – *under voluntary administration*

Other retailers with a potential suitable appetite for a neighbourhood battery include:

- Discover Energy
- Energy locals
- Smartest Energy
- Powerclub

7

Recommendations and next steps

The business case results can assist to directly answer some of the questions from DELWP

DELWP question	Responses		
1. What is the total capacity (MW & MWh) of batteries recommended to be installed or installed?	In option 1 (arbitrage and contingency FCAS), the battery project is not financially viable and the capacity depends on the grant funding available and the connection point. The below battery sizes were tested which all require funding. If this funding was to be provided, all batteries would be able to operate at a profit.		
	100kW/200kWh (~$750k funding required: 250k for battery and 500k for project development)	300kW/600kWh (~$850k funding required: 350k for battery and 500k for project development)	500kW/500kWh (~$700k funding required: 200k for battery and 500k for project development)
	In option 2 (reliability value targeted), the capacity will depend on the islandable network section size and requires network data from Powercor for detailed sizing.		
2. What is the estimated/actual initial CAPEX? (battery only)	$340,000	$616,000	$661,000
3. What is the estimated/actual CAPEX and OPEX for the life of the battery?	$5,000 pa	$5,000 pa	$5,000 pa
4. What are the forecast the cost savings to network and to customers due to this project?	Network: $31,000 pa[1] Customers: $90,000 pa[2]	Network: $60,000 pa Customers: $28,000 pa	Network: $54,000 pa Customers: $40,000 pa
5. How many community members do you estimate would be positively impacted by the project (directly and indirectly)?	Directly, each kW of capacity will roughly equate to one customer on that feeder who can charge or discharge the battery (see assumptions on page 17). Indirectly the battery could benefit the entire Macedon ranges population through a profit share arrangement.		
6. How many household or community members were consulted over the course of the project?	According to the AEF's community engagement work, 109 households were contacted via email, 76 responses were received and numerous other in-person discussions were conducted at a local market.		
7. How many households are connected to your neighbourhood battery, or (for Stream 1 projects) are estimated would be?	Depends on battery size and location. As estimated on page 17, each kW of battery capacity may serve one customer connection point at a time. Other considerations such as actual energy use and network topology need to be considered once the site and size has been selected.		
8. Estimated expenditure (ex GST) for local procurement?	TBD		

Notes: (1) Network cost savings relate to the reliability revenue which in turn is the potential savings from the STPIS scheme (2) Customer savings assume the market arbitrage revenue and contingency FCAS revenue minus a 10% margin from the retail operator.

Key findings

1 – Market revenues are accessible through a retailer

- Arbitrage and FCAS will require to onboard a retailer in the project
- For FCAS to be accessible, the retailer would need to operate it as part of a VPP. Contingency FCAS could equal $16,000 per year in the base case.

2 – Network reliability will be key for the project to stack up

- Enea estimates that $46,000 per year would enable the base case project to be viable (or $30,000 if contingency FCAS is accessible)
- Enea estimates the reliability value for Powercor in the STPIS scheme is around $60,000 in the base case
- It will come down to whether the MRSG and its project partners manage to secure monetisation of reliability services from Powercor

3 – Other Value streams such as voltage control for DER integration or congestion relief are either not easily quantified or monetised

4 – Battery size depends on available funding

- If only FCAS and arbitrage are available
  - 100kW/200kWh battery requires $750k funding
  - 300kW/600kWh battery requires $850k funding
  - 500kW/500kWh battery requires $700k funding

5 – The connection process can be time-consuming

- A minimum of six months is required to connect to the network
- Increased scrutiny thanks to the project profile might help decrease the timeline

6 – Recent changes improve project development and economics

- A neighbourhood battery tariff is now available
- Construction permit not required

Recommendations and next steps (1/2)

This initial business case highlighted that two main options can be considered for the battery revenues

Option 1 – Market revenue only

1 – Secure funding from state or local government

2 – Identify and engage with a retail partner, and secure financial closure.

3 – Select site and project size based on land availability and connection options. In this option, the site location does not impact revenues.

4 – Note that this option is not the preferred one as there is no clear community benefit

Recommendation on battery size: If FCAS revenue can be secured accordingly to the market modelling, the 500kW/500kWh battery is the preferred option. This will depend on the retailer's risk appetite in the FCAS market.

Option 2 – Market and network reliability revenues

1 – Secure funding from state or local government and Powercor. This will likely require MRSG to clarify working principles/business models with Powercor and the retailer (cf. point 2 and 3)

2 – Engage with Powercor to design operational principles between the market and network.

3 – Powercor to engage with a retail partner.

4 – Select site and project size based on land availability, connection options and reliability potential. In this option, the site location will impact revenues and need to be selected in collaboration with Powercor.

Recommendations and next steps (2/2)

Option 2 (Market and network reliability revenues) is the recommended option to maximise the benefit of the proposed battery to the community:

- It enables MRSG to address the community's Top 2 expectations to provide blackout protection and reduce Customer Minutes Off Supply (CMOS)
- It creates the most value for all stakeholders, maximising the battery value add to the system
- It aligns with Victoria's commitment to improving the resilience of the electricity grid.

To secure reliability revenues, Enea recommends that MRSG engage with the local network service provider:

- To unlock the reliability value stream, the battery will have to be operated by or integrated with Powercor's control room
- Powercor will most likely have a more granular view of the reliability benefits and can help identify precise potential sites

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