Technical & Financial analysis

Community battery feasibility project

Client: CVGA

February 2022

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Executive summary

Technical & financial analysis

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Vippy has assessed the technical and financial viability of a range of potential battery solutions at 3 sites in regional Victoria. Most are not viable when assessing financials alone, but if certain conditions are met, some of the projects could be worthy of further consideration.

SUMMARY & KEY FINDINGS

- CVGA has asked Vippy to assess the feasibility of community batteries in their local area.
- One of the identified community battery project types involves locating batteries at community facilities for the purposes of bill savings, combined with essential community back-up power for supply during grid outages.
- 3 sites have been put forward by CVGA for analysis: Daylesford Town Hall, Kerang Library, and Cressy Hub.
- Vippy assessed the technical and financial viability of potential battery solutions at each site, testing sizes from 13kWh to 200kWh and a range of behind-the-meter and market-facing value stacks under different tariff arrangements.
- Most of the sites were not viable when viewed strictly through a financial investment or sustainability lens. Back-up provision was relatively high, particularly in summer from larger batteries.
- Specifically, Daylesford, Kerang and the emergency shelter could be deemed to be worthy of further investigation for a community battery. We do not recommend further analysis at the Creswick site.
- If one or more of these conditions are met, the projects not yet ruled out of contention could be worthy of further consideration:

  A) solar PV should be oversized relative to load. Doing this with a battery boosts energy independence and improves the financial viability of the project.

  B) The site can be switched to ToU network tariffs and (ideally) wholesale price exposed tariffs to tap more earnings*

  C) The site has a strong intrinsic or financial value from back-up power provision.

  D) The site is relatively large i.e. (>160MWh p.a.) and is on a network tariff which relatively high peak demand charges. These factors allow potential for peak demand reduction revenue.

Oversizing solar and selecting tariffs with arbitrage opportunities are both important for driving battery economics. Bigger batteries coupled with solar PV provide more back-up power coverage.

KEY INCIDENTAL FINDINGS

On behind-the-meter battery economics

- Oversized solar (minimum 50% exported) is important for driving increases in energy independence, as well as providing a source of low-cost energy for tariff arbitrage.
- Batteries perform poorly on flat tariff structures. At a minimum, all battery projects in this small-business segment should switch to 'Powercor's Small Business ToU tariff' offers a great spread of arbitrage (~16c peak / 3c off-peak) to drive additional value.
- Larger loads (>160MWh p.a.) than those assessed here are more likely to be on tariffs which are advantageous for peak demand reduction value from batteries. There is also a potential VEECs/carbon value uplift for larger projects.

On market-facing revenues

- Switching to wholesale-exposed pricing (with appropriate control system) will allow the battery to capture daily arbitrage and extreme (high and low) price arbitrage opportunities. Doing this this turbo charges the value capture and makes larger battery sizes more economic than otherwise. Actual revenues may vary substantially from year-to-year, and additional market risk may be apparent.
- Market facing activity can come at the expense of behind-the-meter requirements – potentially reducing energy independence and back up power coverage.
- FCAS is not likely to be overly lucrative at this smaller-scale but is worth considering if a retailer offers an accessible VPP option in the future.

Backup Power

- Bigger batteries lead to more back-up power coverage, in most cases.
- Coupling with oversized solar PV when islanding is key to extending backup power coverage.
- Backup power coverage is reduced when the battery is busier performing other activities – for example – wholesale arbitrage.

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We recommend proceeding to extrapolation, provided we apply the lessons of this analysis to increase the likelihood of finding viable opportunities. We also need to ensure data collection is streamlined moving forward.

NEXT STEPS

- CVGA to review the analysis and provide feedback. Any edits will be incorporated in final version (should it be required).
- Extrapolation as per the project plan is still recommended, provided that the key lessons from this analysis are used to select sites which are more likely to be viable.
- CVGA to put forward additional sites for analysis and collect data in appropriate format and on time. Data collection and preparation was a major factor in the delayed start and time-consuming analysis here, which we'd need to improve for extrapolation.*
- We'd like to propose an option whereby extrapolation of further sites be undertaken by CVGA and/or project partners via granting of a Vippy software license to CVGA. This would allow as many iterations or analyses as required, with instant feedback granted to stakeholders within the tool. We can provide training and support as needed.

*To operate within budget, we typically pass the onus of data collection and preparation to our clients. For extrapolation to occur within the allotted budget we'd need your co-operation here to prepare and upload the data.

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Introduction

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CVGA are assessing the viability of installing batteries with back-up power at community facilities, with the purpose of achieving bill savings, improving energy independence, and improving reliability of supply.

PROJECT CONTEXT

- The Central Victoria Greenhouse Alliance (CVGA) represents 11 council areas in regional Victoria.
- CVGA is managing a feasibility analysis of potential community battery projects in their community and has asked Vippy to support them in delivering the project.
- Reliability of power has been identified as one of the key community concerns, of which a community battery could be a potential solution.
- Vippy has been asked to assess the suitability of several community facilities for behind-the-meter batteries which also provide essential community back-up power at times of grid outage.
- 3 sites have been put forward by CVGA for analysis. Vippy has assessed the technical and financial viability of potential battery solutions at each site, testing a range of sizes and value stacks under different tariff arrangements.

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CVGA has put forward three sites for battery technical and financial feasibility analysis. An additional 'generic site' was assessed with an 'emergency shelter' load.

Sites assessed

Site	Gross load (annual)	Net load (after solar)	Solar PV installed	Solar kWh consumed	Export limit?
Daylesford Town Hall	50.3MWh*	39.9MWh	10kWp*	77%*	-
Kerang Library	32.7MWh	31.8MWh	10kWp*	7%	-
Creswick Community Hub	33.2MWh*	11.5MWh	20kWp*	88%*	0kVA
Emergency Shelter (generic)		n/a	20kWp	n/a	

* Estimated or calculated figure, due to missing data

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We assessed a range of battery sizes at each site, before ultimately limiting the analysis to five battery sizes ranging from 13 – 200kWh.

Battery technology sizes and costings

Size	Capacity (kWh) Usable	Power (kW) Continuous	Equivalent product	Cost ($/kWh) All inclusive ex GST
X-Small	13	5	Tesla Powerwall x 1	$1000
Small	26	10	Tesla Powerwall x 2	$1000
Medium	50	20	-	$850
Large	100	36.5	Relectrify x1	$850
X-Large	200	73	Relectrify x 2	$850

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We assessed a range of scenarios – each with unique factors such as battery value stack, site tariff selection, and market data.

Scenarios assessed (value stacks, tariffs, datasets)

Scenario name	Battery value stack	Tariff	Dataset notes
Baseline	Tariff arbitrage Solar self-consumption Back up power*	• Origin anytime tariff • Shell 2-rate tariff (Creswick only)	No datasets used in analysis
Wholesale (2019) + ToU network - MID	+ Wholesale arbitrage	• Wholesale exposed retail tariff, based on Amber Electric's pricing. • Two-rate Powercor tariff (9am-9pm peak weekdays)	• Victorian wholesale price 2019. • This is a 'mid-high year' for WS battery earnings, the most typical of recent 5 years.
Wholesale+ FCAS (2019) - MID	+ Wholesale arbitrage + FCAS (6 markets)		• Victorian wholesale price 2019 & FCAS price 2019. • A 'mid-high' year for battery WS and FCAS earnings, the most typical of recent 5 years.
Wholesale (2020) - HIGH	+ Wholesale arbitrage		• Victorian wholesale price 2019 • A high year for WS battery earnings, the best in the last 5 years.
Wholesale (2017) - LOW			• Victorian wholesale price 2019 • A low year for WS battery earnings, the lowest in the last 5 years.

* Back up power not explicitly assessed as a financial value stream in this analysis due to subjective value of back up power.

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Site by site analysis

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Daylesford Townhall

Key Findings

The Daylesford Town Hall is a community hall and events facility is regional Victoria

ABOUT DAYLESFORD TOWN HALL

Distance from Melbourne:
111km NW

Facilities
- Community events
- Library

Opening hours:
- By appointment / booking

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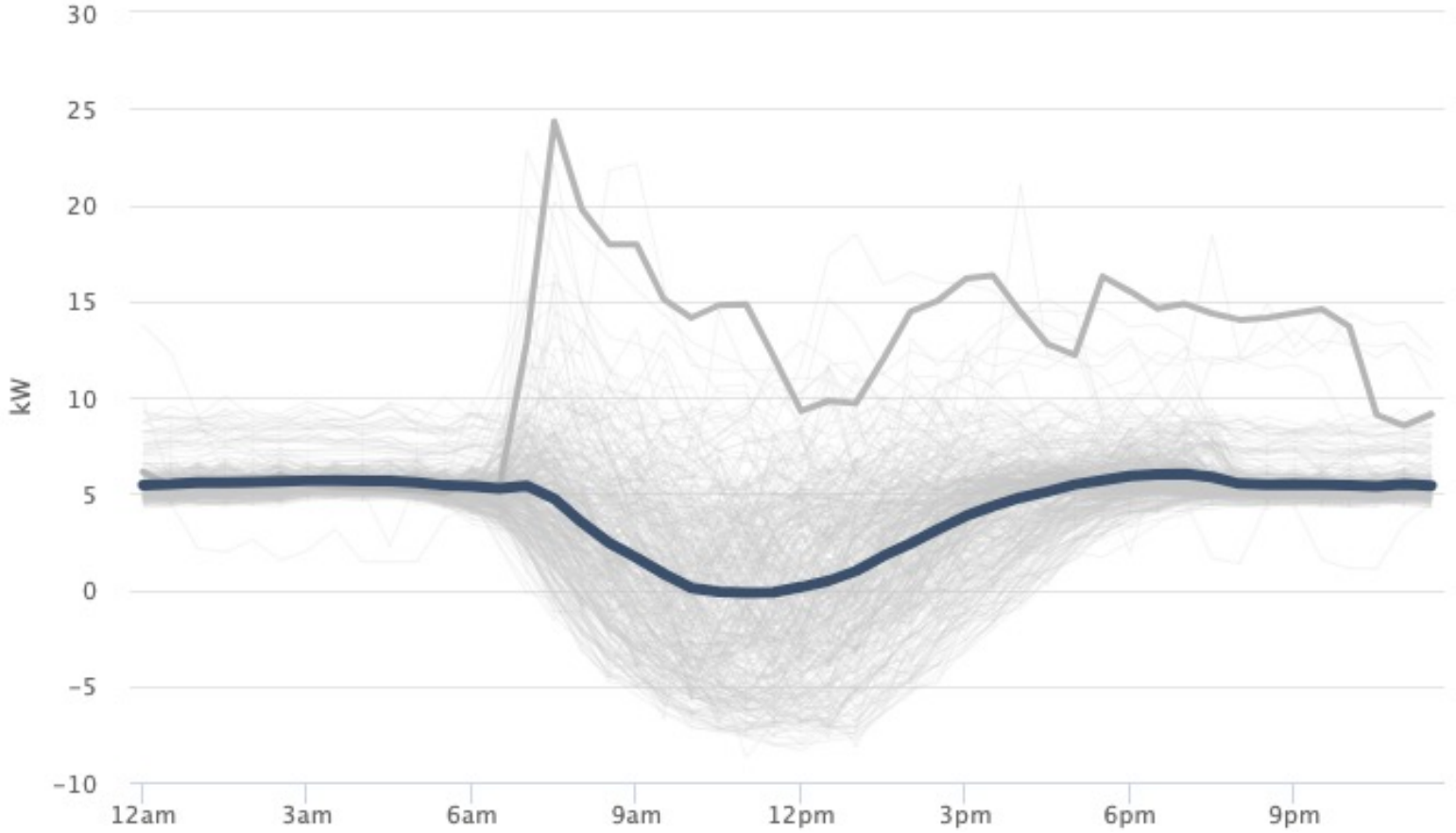
Daylesford Town Hall has the largest load of the 3 sites. It has a 10kw solar system installed, with an estimated 50% of generation exported to the grid.

Net load profile for all days - Pre-Battery – Daylesford Town Hall



Average day

Peak day

All days

Gross load:
50.3MWh*

Net load:
39.9MWh

Solar exports
3.1MWh

* Estimate (data not available) based on assumed solar generation of 1380kWh/kw

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Daylesford Town Hall has the highest bills of all sites, with a flat rate 'anytime' tariff with Origin.

Business as usual bills in Year 1 (no battery)

2022	Quantity	Unit	Rate	Unit	MLF	DLF	Amount
Retail							$8,907
Daily supply	365	days	1.263	$/day			$461
Energy	39,894	kWh	21.70	c/kWh	1.00	1.00	$8,657
Feed-in-tariff	-3,141	kWh	6.70	c/kWh	1.00	1.00	-$210
Total					exc.	GST	**$8,907**

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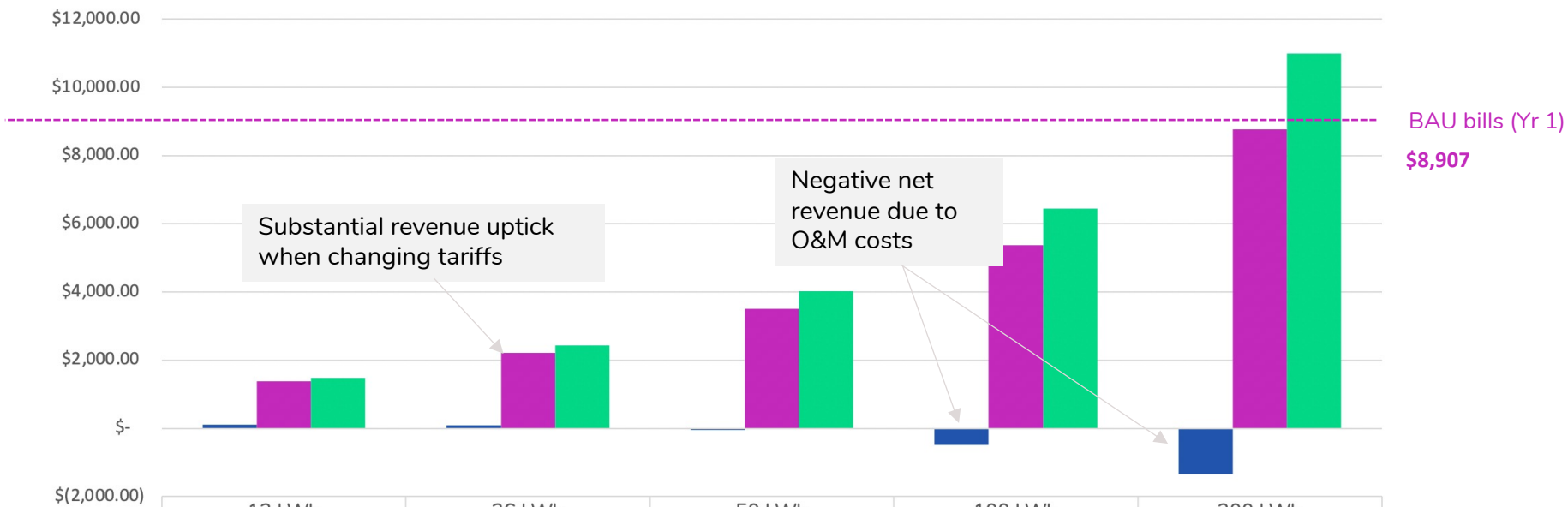
When assessing the impact of the battery, revenue is virtually non-existent on the current tariff. It increases when moving to a wholesale-exposed and ToU network tariff, and again with the addition of FCAS.

Annual battery revenue (net)

Net revenue in $ (Year 1)



	13 kWh	26 kWh	50 kWh	100 kWh	200 kWh
Current tariff - Origin Flat	$113.70	$84.78	$(55.93)	$(480.66)	$(1,330.38)
Wholesale (2019) + ToU network	$1,386.59	$2,217.81	$3,501.10	$5,369.14	$8,761.46
Wholesale (2019) + ToU network + FCAS (2019)	$1,487.07	$2,443.20	$4,027.46	$6,439.34	$11,002.80

Note: Net revenue includes bill savings, net FCAS revenue and ongoing maintenance costs for battery

ToU = Time of Use

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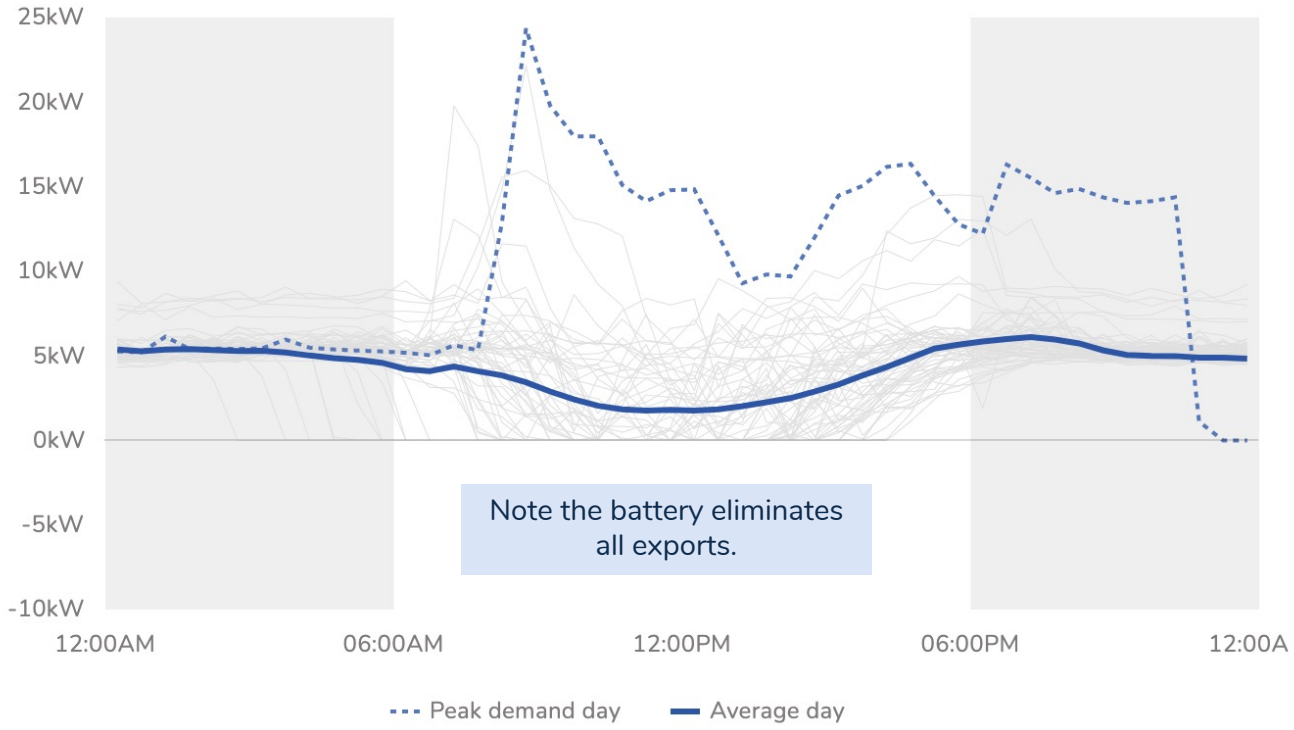
Under the current Origin tariff, capturing excess solar is the only value capture opportunity available. However, with such a small solar system, the battery is rarely called into action.

50kWh battery – Origin Anytime tariff

Load Profile

Net load profile, by day (kW), 2022



Battery utilisation
Average cycles/day (1=100%)

16%

Very low battery utilisation.

Energy independence
% self powered by solar/battery

29% v's 21% in BAU

Very little uptick in energy independence due to undersized solar for solar-battery system

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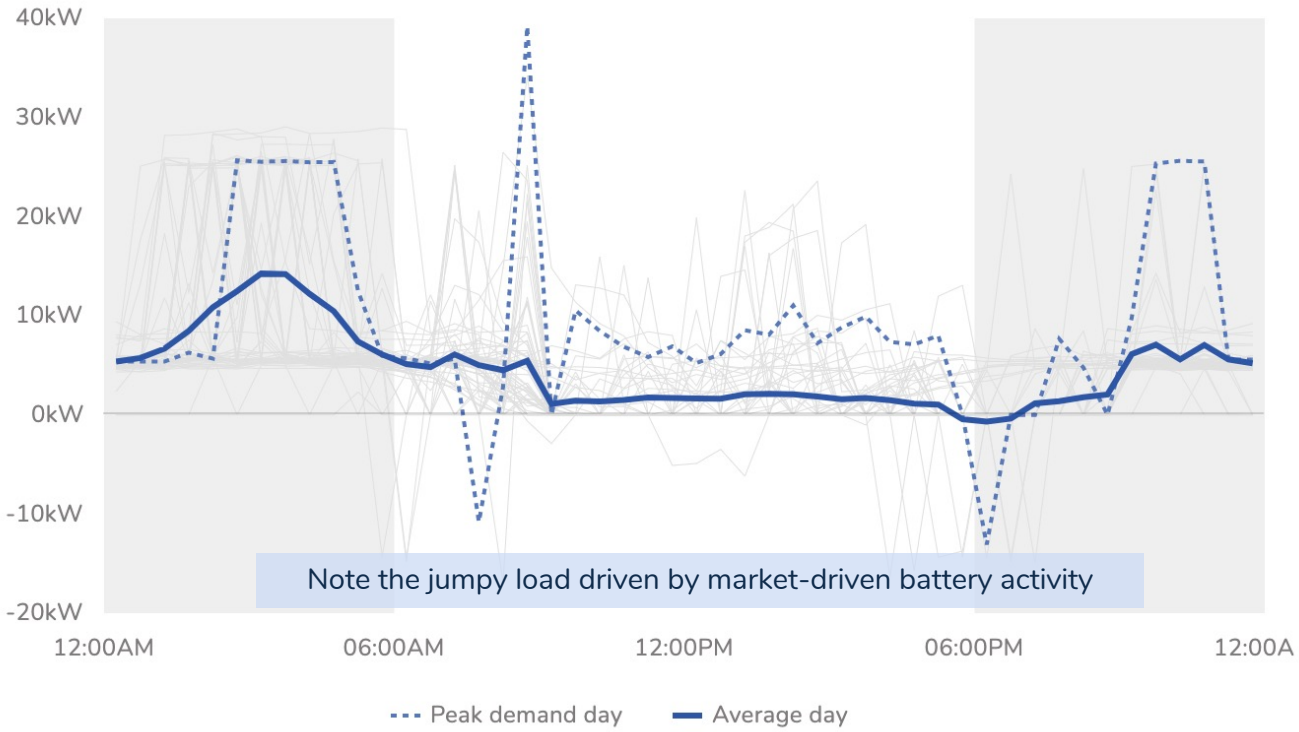
Changing to a wholesale exposed tariff, combined with a network ToU tariff, works the battery substantially harder to capture more value.

50kWh battery – Origin Anytime tariff

Load Profile

Net load profile, by day (kW), 2022



Note the jumpy load driven by market-driven battery activity

Battery utilisation
Average cycles/day (1=100%)

79%

Substantial increase in battery utilisation

Energy independence
% self powered by solar/battery

22% v's 21% in BAU

Lower energy independence due to increase in grid charging

Energy import/export

Energy consumed	40,085	kWh	3.377	c/kWh
Energy exported	-1,016	kWh	89.344	c/kWh

Big price differential for import versus exports is the main source of value in this scenario.

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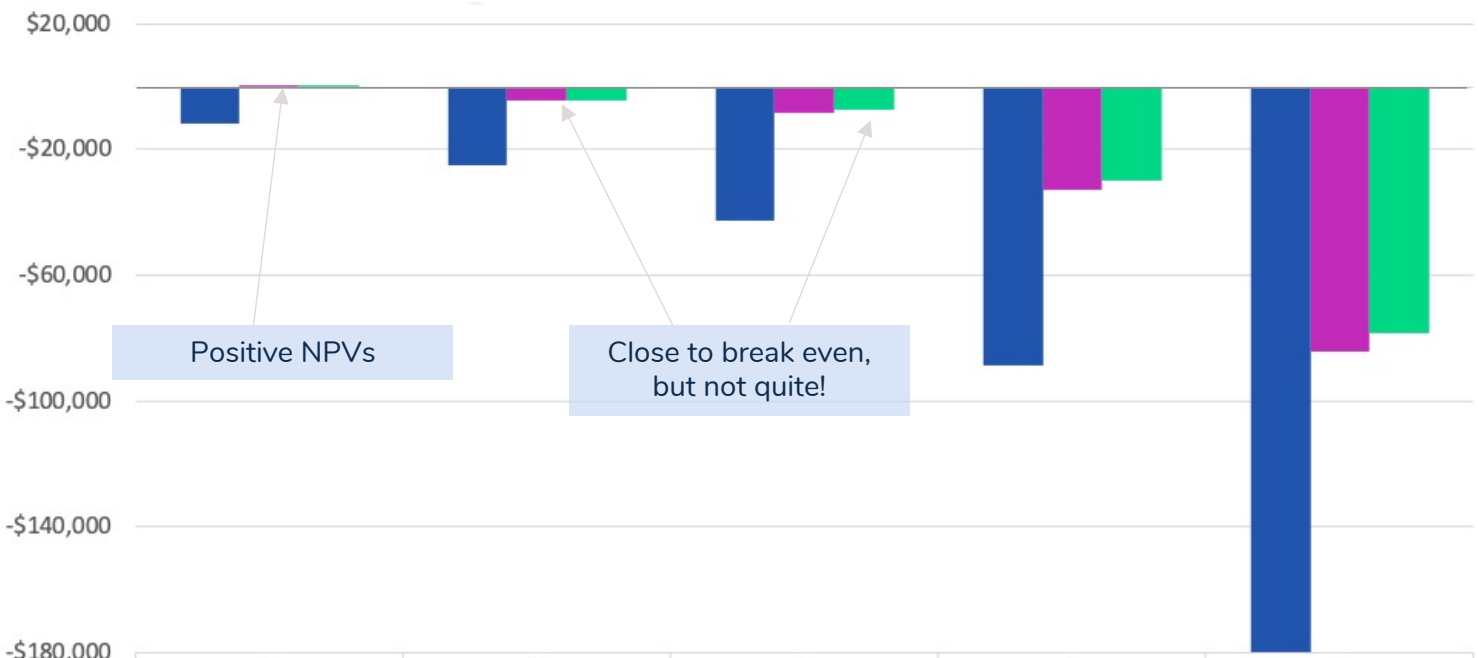
When assessing financials over a 15-year investment horizon, only the 13kWh battery had a positive NPV in the market facing scenarios

NPV of modelled battery sizes

Net present value in $ (2022)



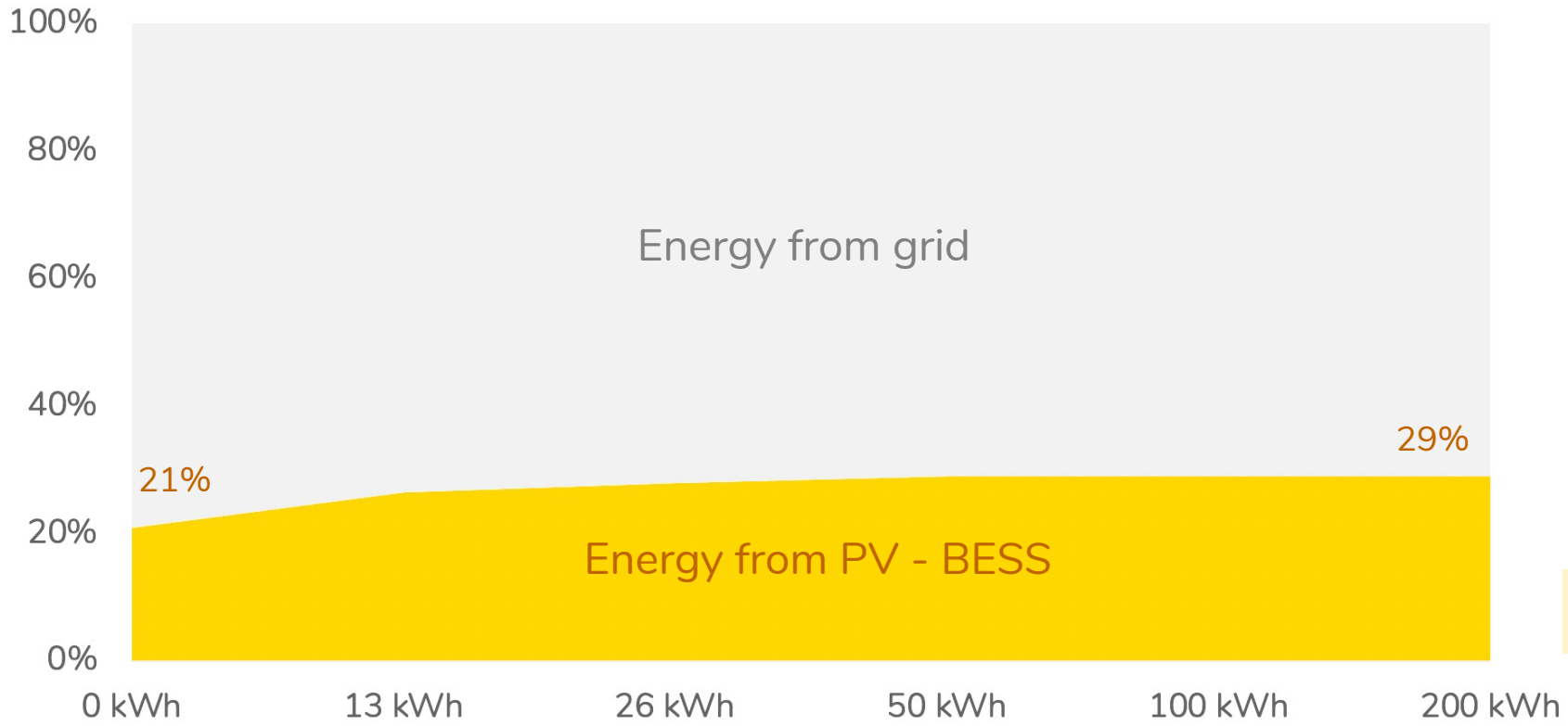
	1	2	3	4	5
Current tariff - Origin Flat	-$11,787	-$24,945	-$42,643	-$88,829	-$181,202
Wholesale (2019) + ToU network	$438	-$4,459	-$8,481	-$32,646	-$84,278
Wholesale (2019) + ToU network + FCAS (2019)	$428	-$4,269	-$7,469	-$29,932	-$78,259

Net present value assessed over 15 years @ 3% discount rate.

From a sustainability perspective, batteries do not offer the Town Hall a substantial uptick in the site's energy independence. This is due to the relatively small solar system exporting only minimal energy.

% of gross load met by solar-battery system (v's grid)

% of annual load served by solar-battery versus grid – Current tariff scenario.



Only minimal gain in independence due to undersized solar PV for batteries.

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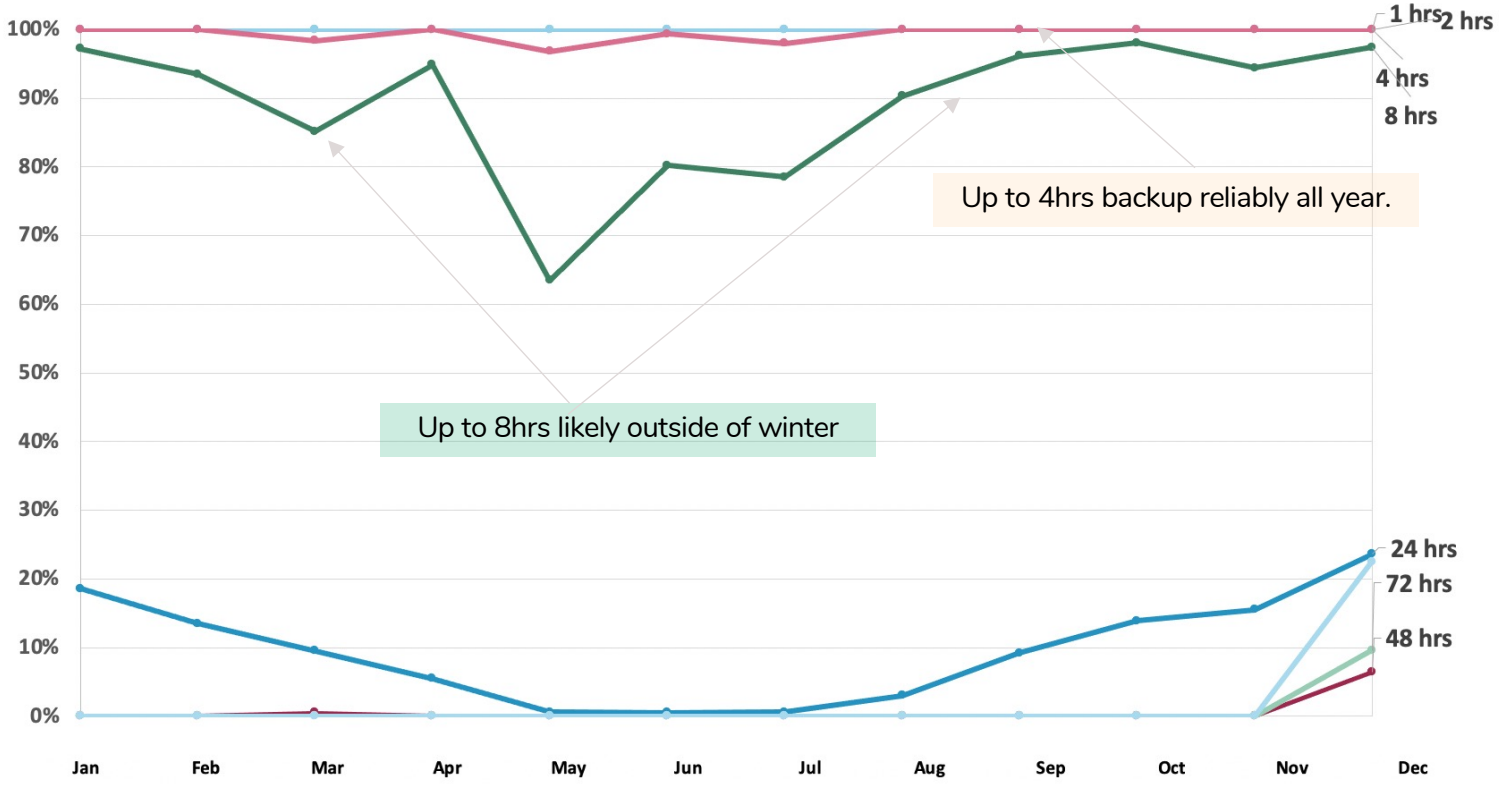
We assessed the amount of back up power a battery could provide the site should a random outage occur. A 50kWh battery would reliably provide 4hr coverage all year (>95%) and 8hrs outside of winter (>90%)

Backup power duration – 50kWh – current tariff

% of intervals in month, where X hours of backup power is met, should random outage occur



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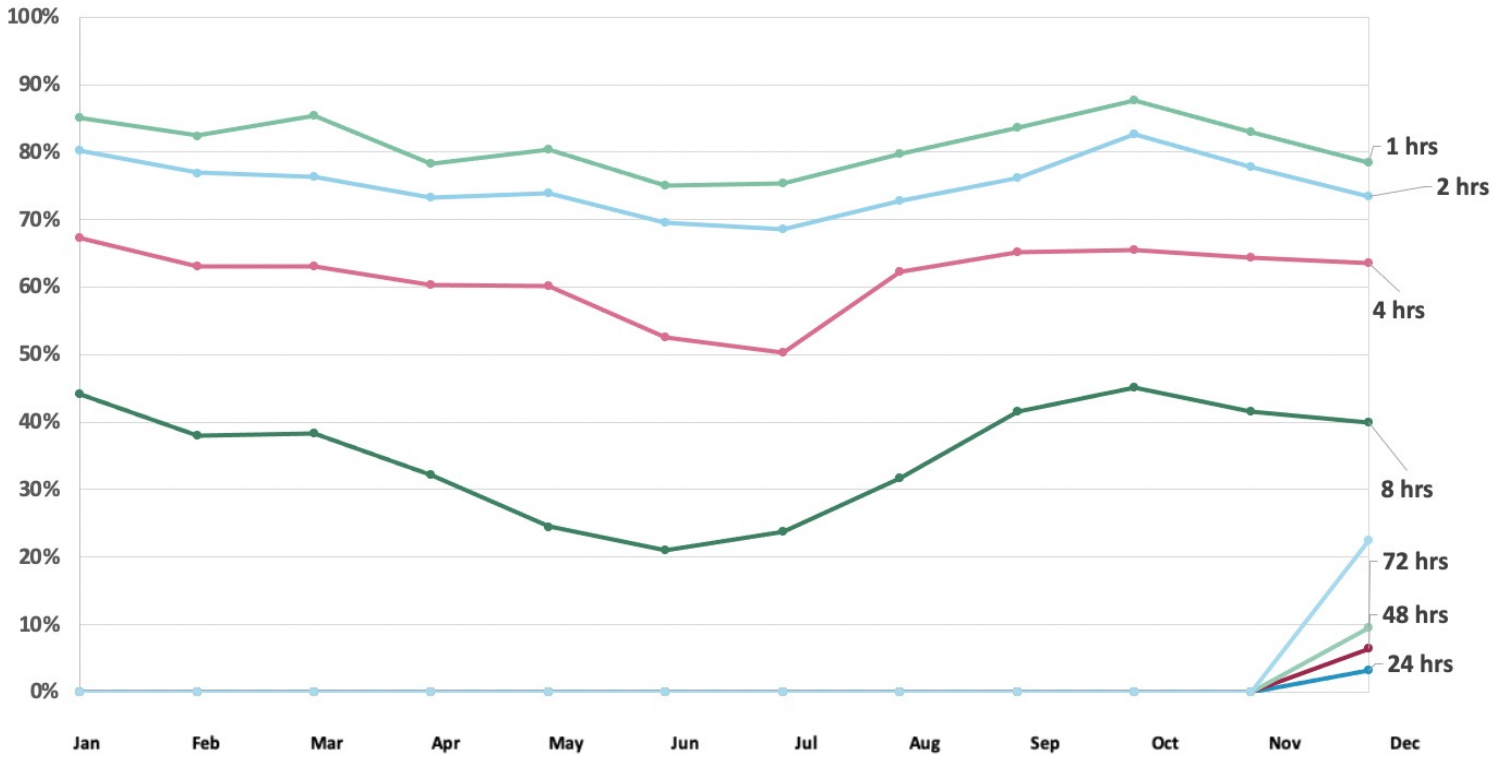
The same battery on a wholesale exposed tariff has substantially lower back up power capability. It is more likely to have a lower state-of-charge, owing to higher utilisation.

Backup power duration – 50kWh – Wholesale tariff (2019) + ToU Network tariff

% of intervals in month, where X hours of backup power is met, should random outage occur at anytime.



On wholesale tariff
Up to 2hrs backup likely all year.
Up to 8hrs only 20-45% likely depending on season.

*Assumes assumes battery cannot pre-charge before a random outage through predicting it's likelihood.

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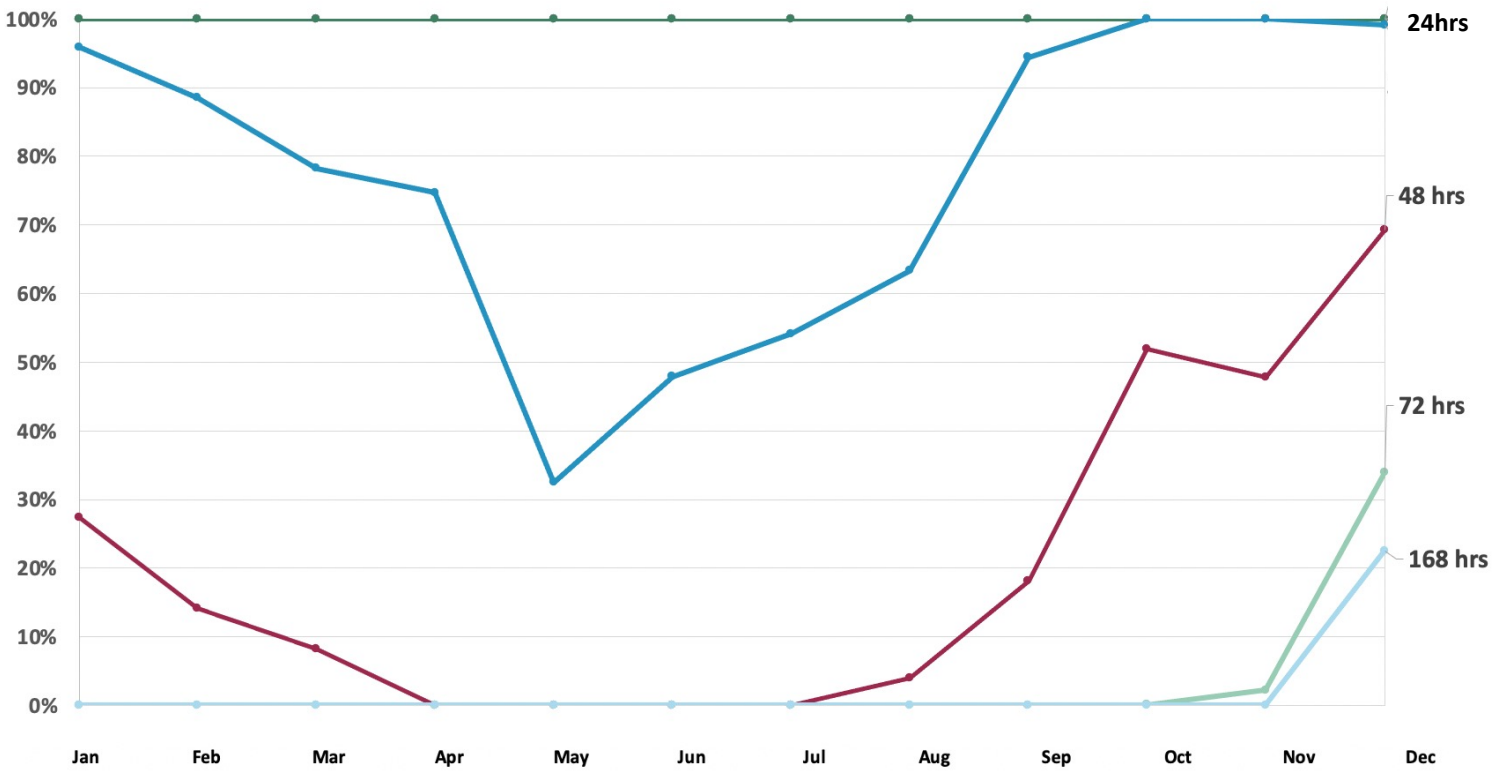
The XL 200kWh battery is highly likely to meet 24hrs back up duration in summer, with a 50% likelihood in winter.

Backup power duration – 200kWh – current tariff

% of intervals in month, where X hours of backup power is met, should random outage occur at anytime.



*Assumes assumes battery cannot pre-charge before a random outage through predicting it's likelihood.

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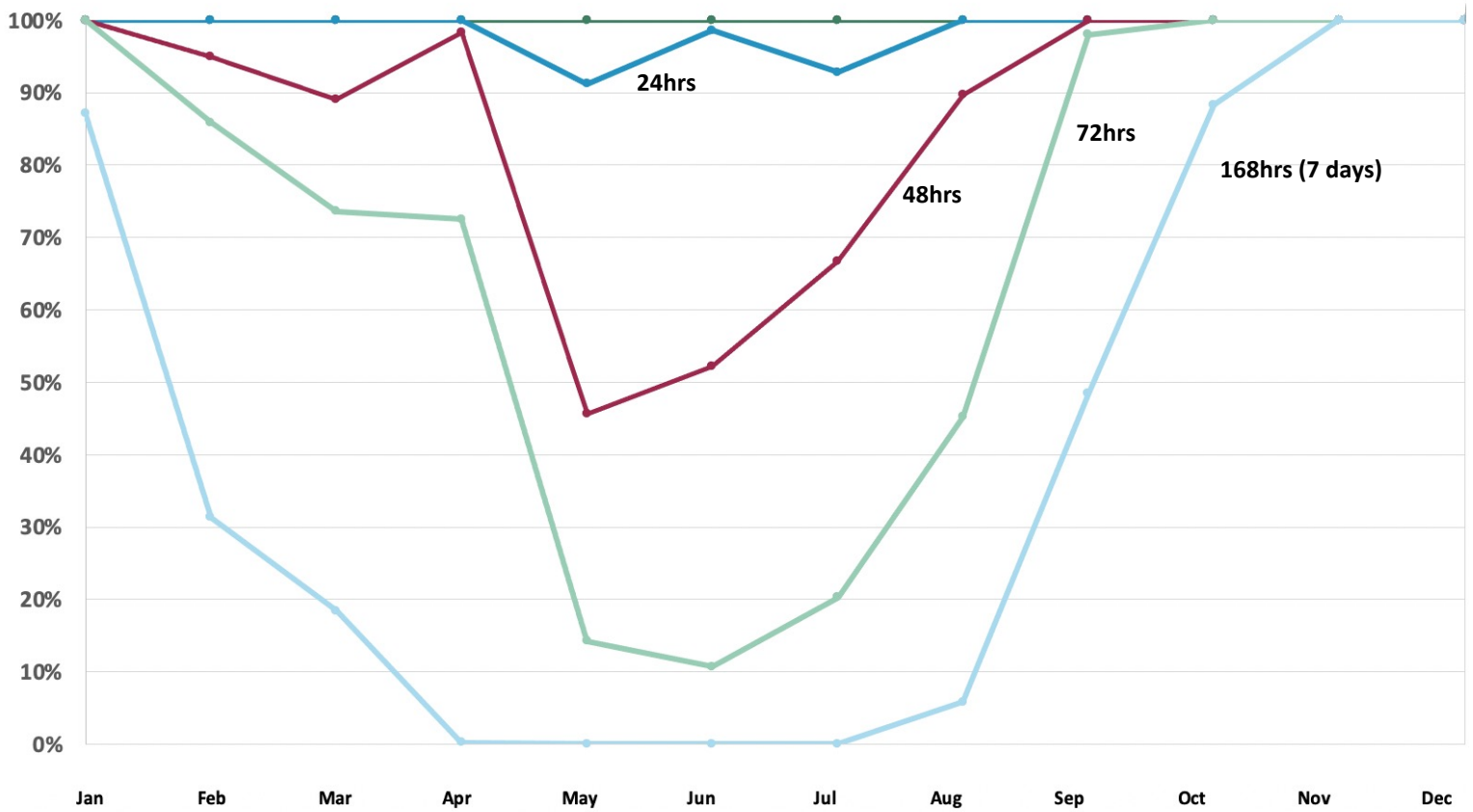
If Daylesford could deploy 20kW of new solar with the 200kWh battery, emergency power would be available for a likely minimum duration of 24hrs, year-round.

Backup power duration – 200kWh – current tariff

% of intervals in month, where X hours of backup power is met, should random outage occur at anytime.



*Assumes assumes battery cannot pre-charge before a random outage through predicting it's likelihood.

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Daylesford Town Hall presents a potentially suitable location for a community battery, particularly if more solar can be added and/or if back up power is desirable.

SUMMARY

- Daylesford Town Hall is not a viable site for a battery when considering financials alone (except for the 13kWh battery which was viable in market facing scenarios)
- The relatively small solar system (10kW) does not export sufficient energy to allow much uplift in energy independence, nor solar-related arbitrage. Whilst not assessed here, adding more PV to the site would improve battery viability and reduce grid consumption.
- Up to 8 hours of back up could be reliably provided by a 50kWh battery for most of the year. The amount of back-up power coverage reduces considerably when the battery is market-facing.
- We recommend further investigation into installing a battery at the site, if one or more of these conditions are met:
    - A) more solar PV can be added
    - B) The site can be switched to ToU network tariffs, and ideally wholesale price exposed tariffs*
    - C) The site places a strong value on back up power

*This comes with risks which need to be managed.

Kerang Library

Key Findings

The Kerang Library (Sir John Gorton Library) is a library and community facility is Kerang, Victoria

ABOUT KERANG LIBRARY

Distance from Melbourne:
280km NW

Facilities
- Community events
- Library

Opening hours:
- M-F 10am-5pm
- Sa 10 -12am
- Su Closed

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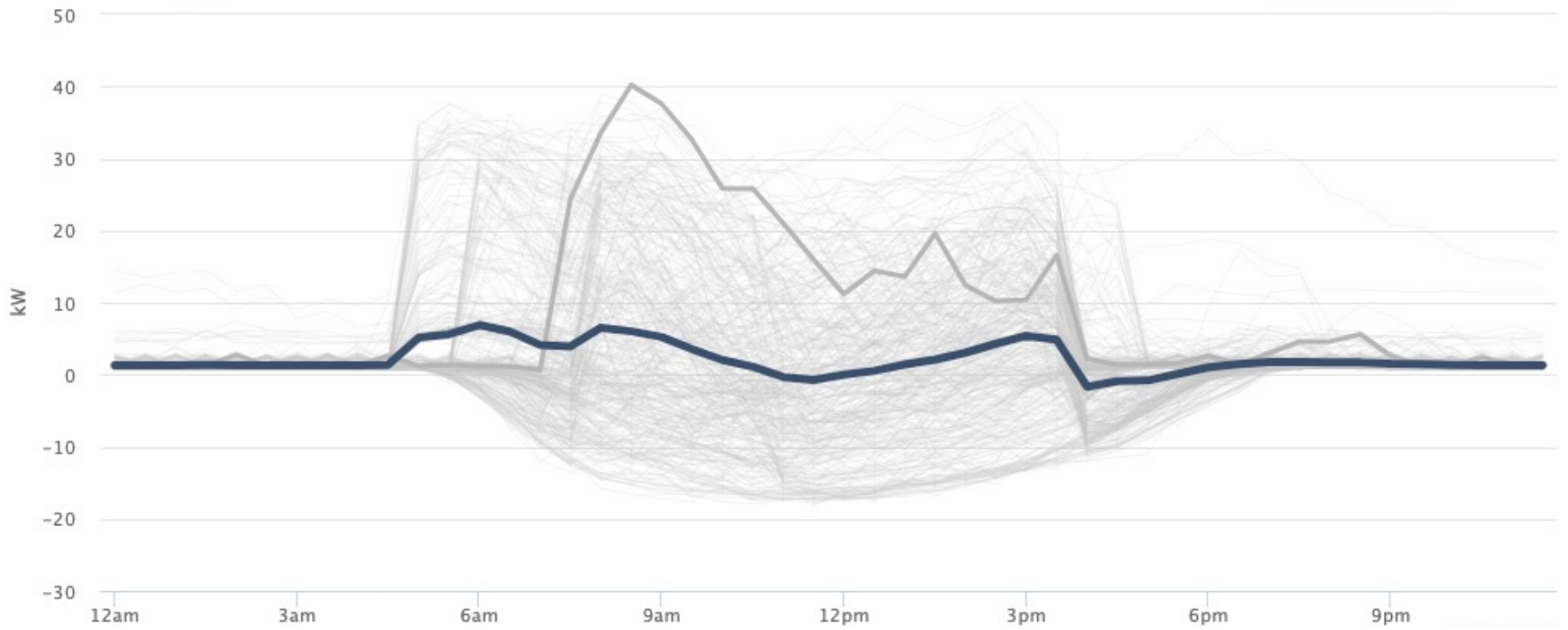
Kerang Library has a moderate load but relatively low daytime usage. It has a 10kw solar system installed, with most solar exported to the grid (93%).

Net load profile for all days - Pre-Battery – Kerang Library



Gross load:
32.8MWh

Net load:
31.8MWh

Solar exports
12.8MWh

Comprises 93% of generation which is highly unusual. See ‘Data issues uncovered during modelling’ for possible explainations

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Kerang Library has the second highest bills of the three sites in the BAU (pre-battery) case. It has a two-rate time of use tariff with Shell, with a 9am – 9pm peak tariff window on weekdays.

Business as usual bills in Year 1 (no battery)

2022	Quantity	Unit	Rate	Unit	MLF	DLF	Amount
Retail							$6,650
Fixed	365	days	0.87	$/day			$318
Peak	15,560	kWh	30.862	c/kWh	1.00	1.00	$4,802
Feed-in-tariff	-12,804	kWh	6.70	c/kWh	1.00	1.00	-$858
Off Peak	16,231	kWh	14.714	c/kWh	1.00	1.00	$2,388
Total					exc.	GST	**$6,650**

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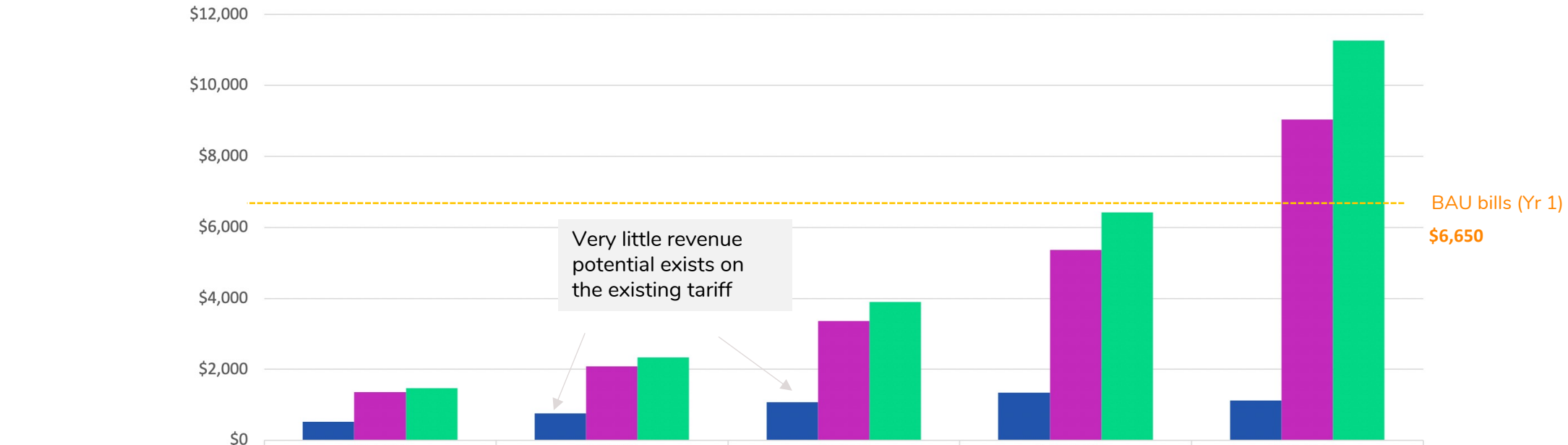
When assessing a battery, bill savings are muted until the tariff turns wholesale exposed, after which they increase in line with storage capacity.

Annual battery revenue (net)

Net revenue in $ (Year 1)



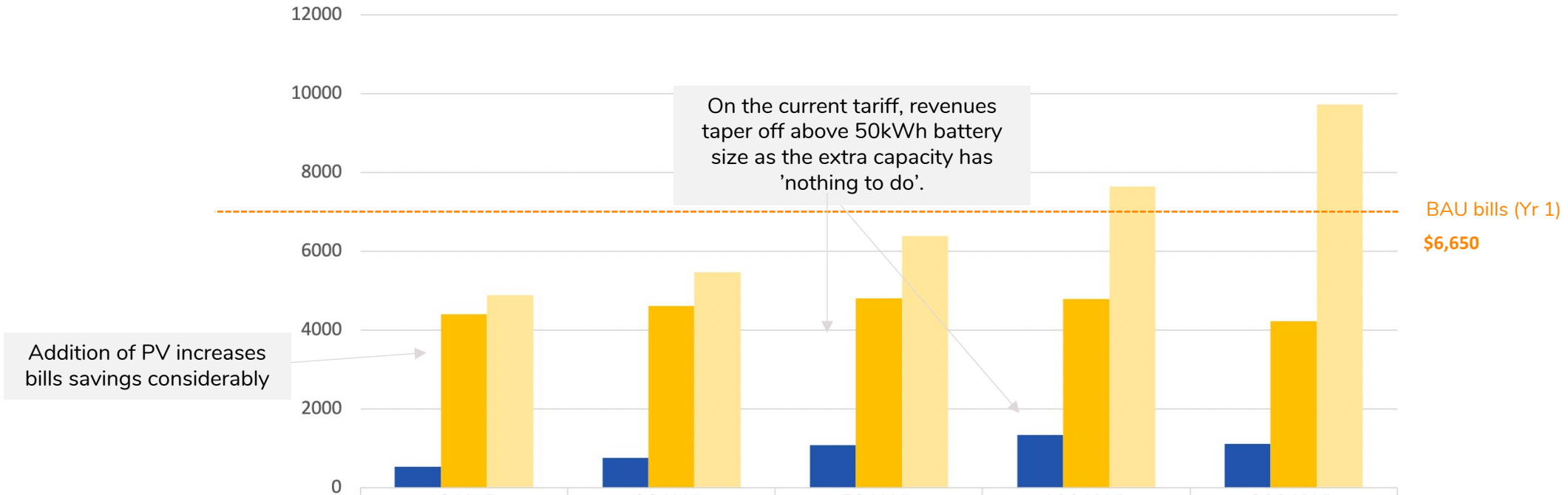
	13 kWh	26 kWh	50 kWh	100 kWh	200 kWh
Current tariff - Shell 2-rate	$530	$767	$1,080	$1,343	$1,117
Wholesale (2019)	$1,363	$2,091	$3,359	$5,364	$9,036
WS (2019) + FCAS (2019)	$1,475	$2,344	$3,906	$6,419	$11,266

Note: Net revenue includes bill savings, net FCAS revenue and maintenance costs for battery

However, bill savings are much healthier with an additional 20kW solar PV installed.

Annual solar + battery revenue (net)

Net revenue in $ (Year 1)

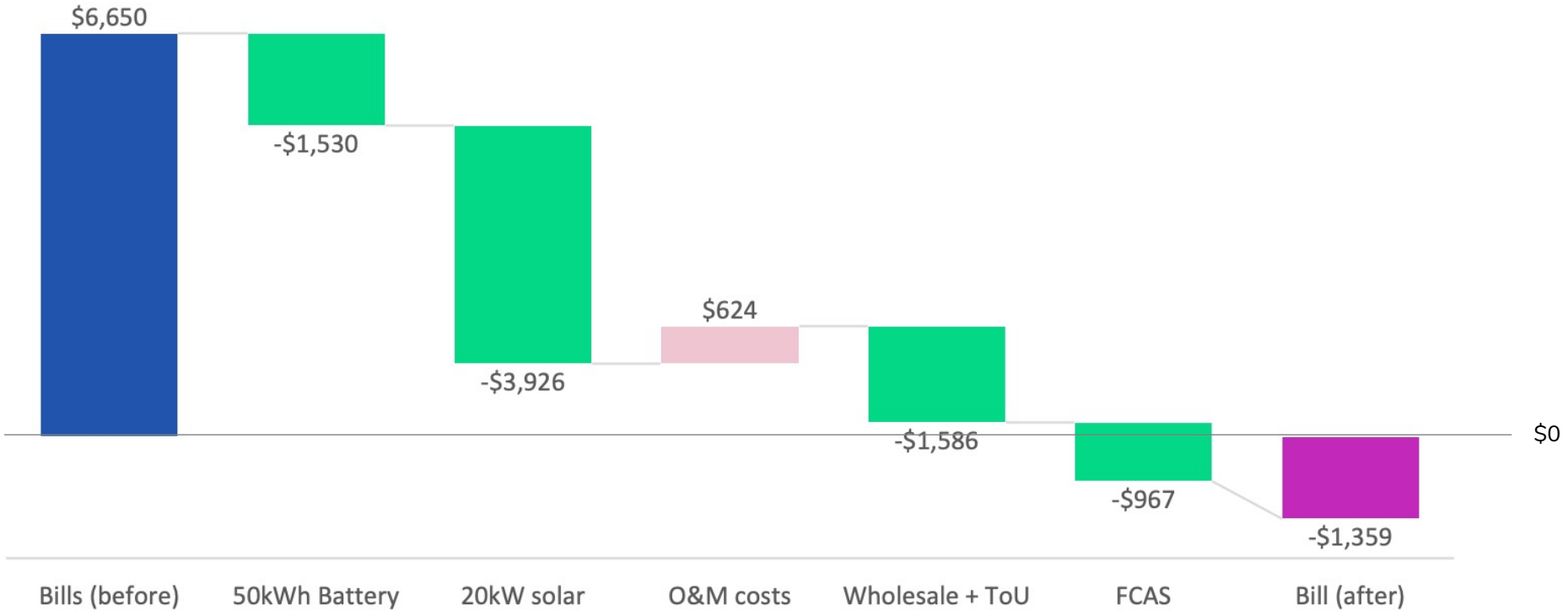


	13 kWh	26 kWh	50 kWh	100 kWh	200 kWh
Current tariff - Shell 2-rate	529.84	767.35	1079.95	1342.84	1117.22
Current tarff + 20kW solar	$4,407.04	$4,621.68	$4,806.12	$4,793.90	$4,236.45
WS (2020) + ToU net + 20kW Solar	$4,895.56	$5,464.14	$6,392.28	$7,644.47	$9,737.55

Note: Net revenue includes bill savings, net FCAS revenue and maintenance costs for solar + battery

Kerang's electricity bills can reach net negative if a battery is deployed with a range of supporting actions, such as more solar PV, changing to wholesale exposed and ToU tariffs, and tapping FCAS value

Incremental value pool analysis of 50kWh battery – Kerang.



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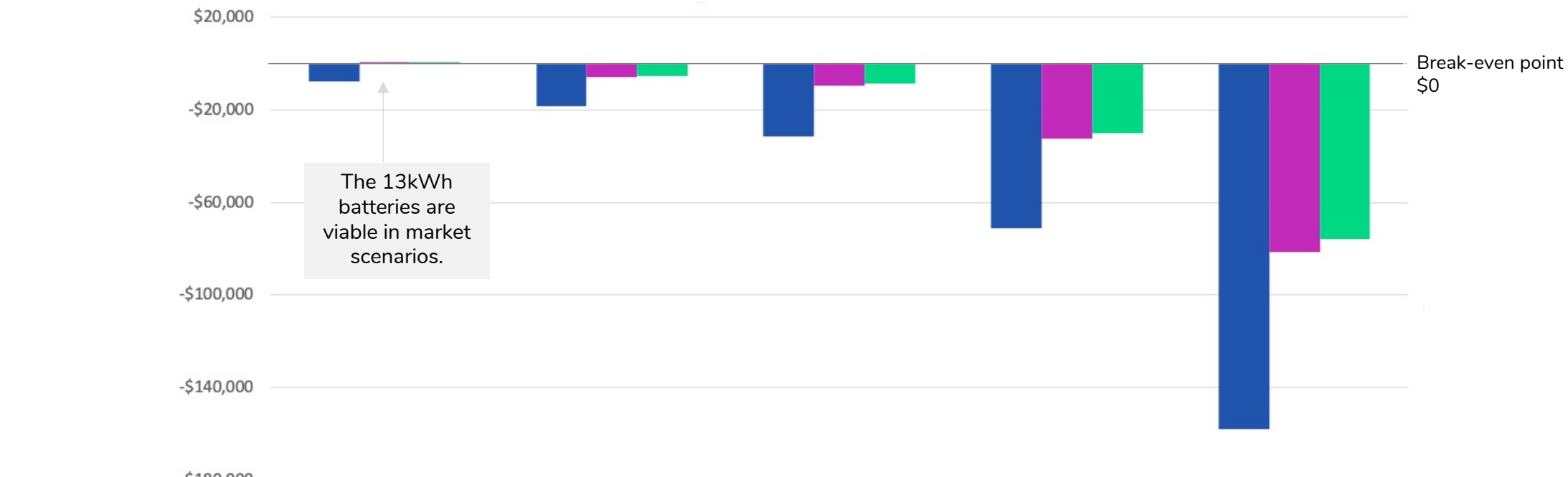
Through a strictly financial lens, adding a battery is not a viable investment for Kerang Library (with the exception of the 13kWh market facing batteries).

NPV of modelled battery sizes

Net present value in $ (2022)



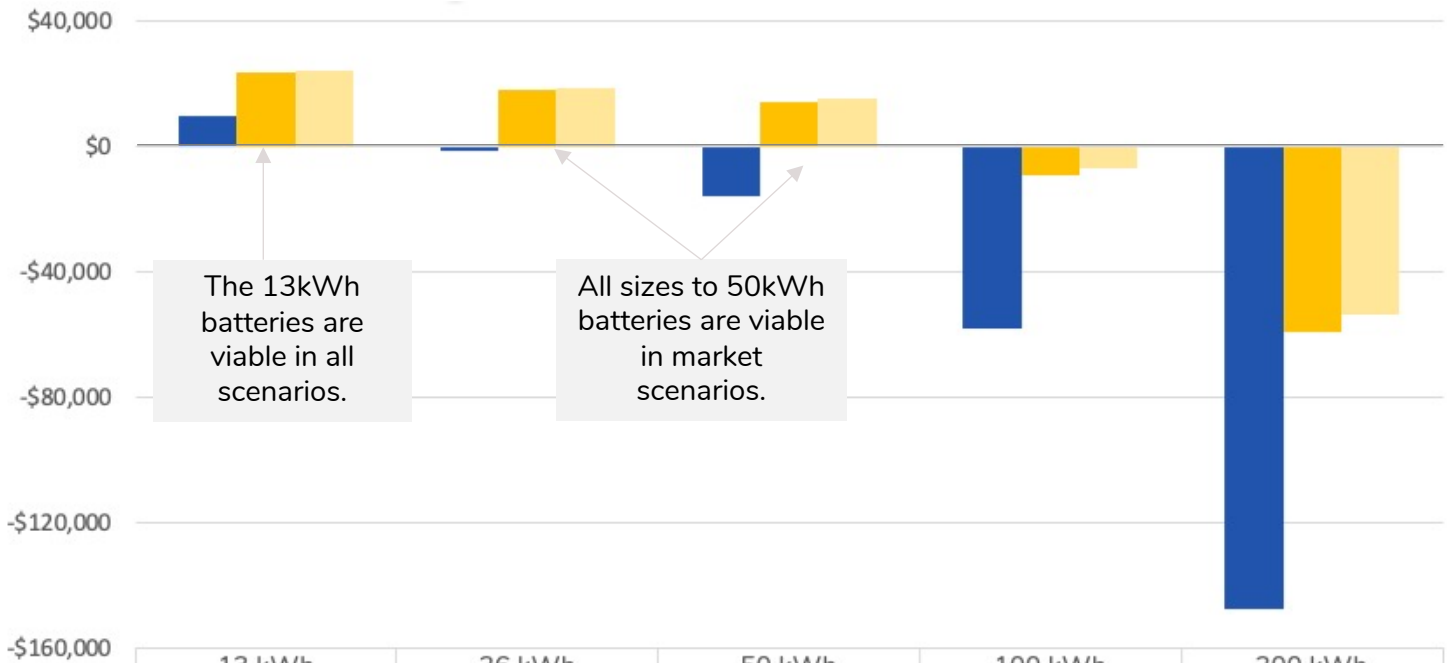
	13 kWh	26 kWh	50 kWh	100 kWh	200 kWh
Current tariff - Shell 2-rate	-$7,791	-$18,389	-$31,734	-$71,315	-$157,695
Wholesale tariff (2019)	$212	-$5,681	-$9,845	-$32,696	-$81,639
WS (2019) + FCAS (2019)	$324	-$5,273	-$8,738	-$30,248	-$75,829

Net present value assessed over 15 years @ 3% discount rate.

However, when assessing the combined solar + battery investment, sizes up to 50kWh are viable if market revenues are included.

NPV of modelled battery sizes

Net present value in $ (2022)



Break-even point $0

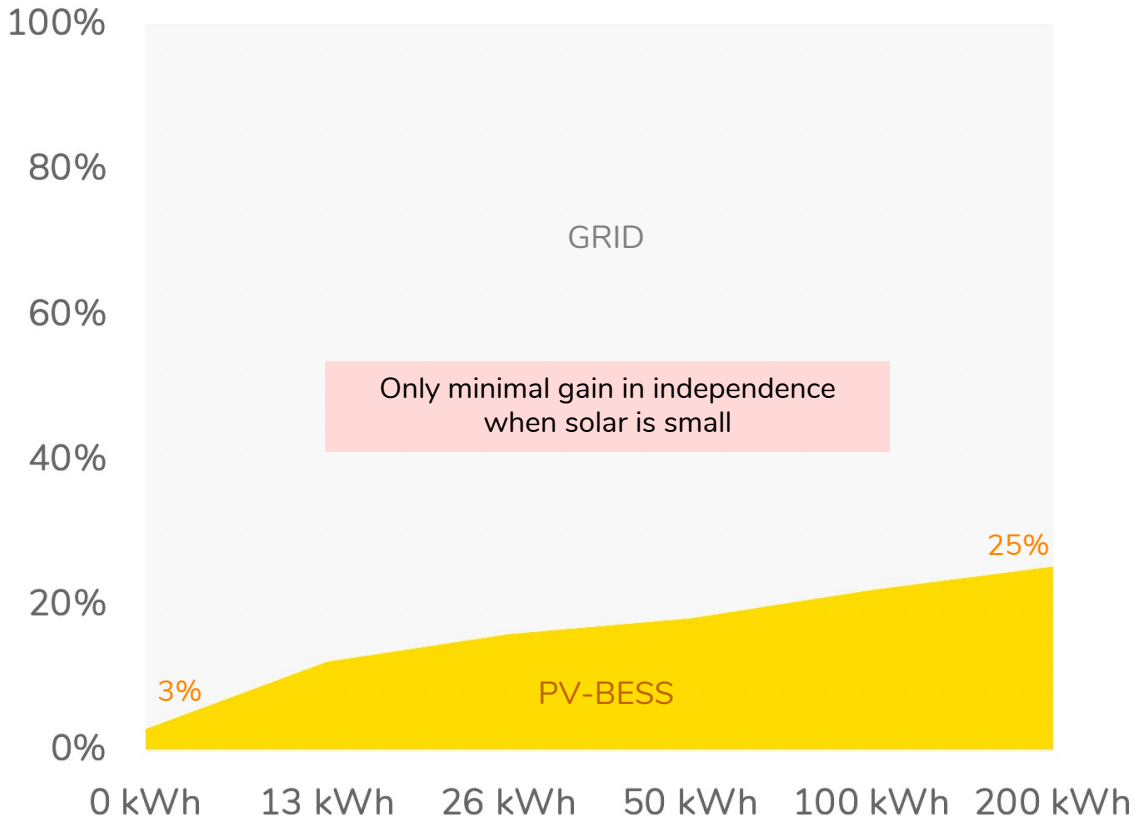
	13 kWh	26 kWh	50 kWh	100 kWh	200 kWh
Current tariff + 20kW PV	$9,632	-$1,186	-$15,762	-$57,985	-$147,552
Wholesale tariff (2019) + 20kW PV	$24,052	$18,399	$14,360	-$8,973	-$59,151
Wholesale tariff (2019) + FCAS (2019) + 20kW PV	$24,164	$18,807	$15,467	-$6,524	-$53,341

Net present value assessed over 15 years @ 3% discount rate.

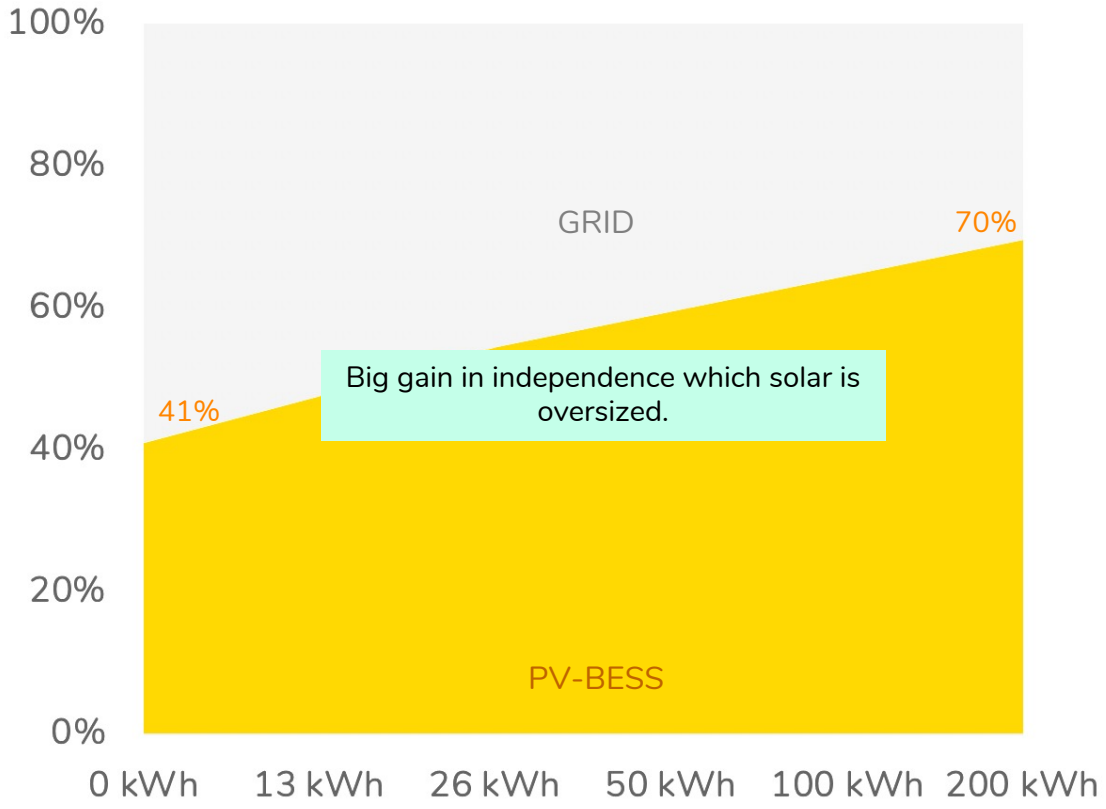
From a sustainability perspective, batteries offer a gain in energy independence when solar is oversized, as demonstrated by the addition of 20kW of new solar on the right-hand chart.

% of gross load met by solar-battery system (v's grid)

% of annual load served by solar-battery versus grid – Current tariff scenario.



10KW PV (CURRENT SYSTEM)

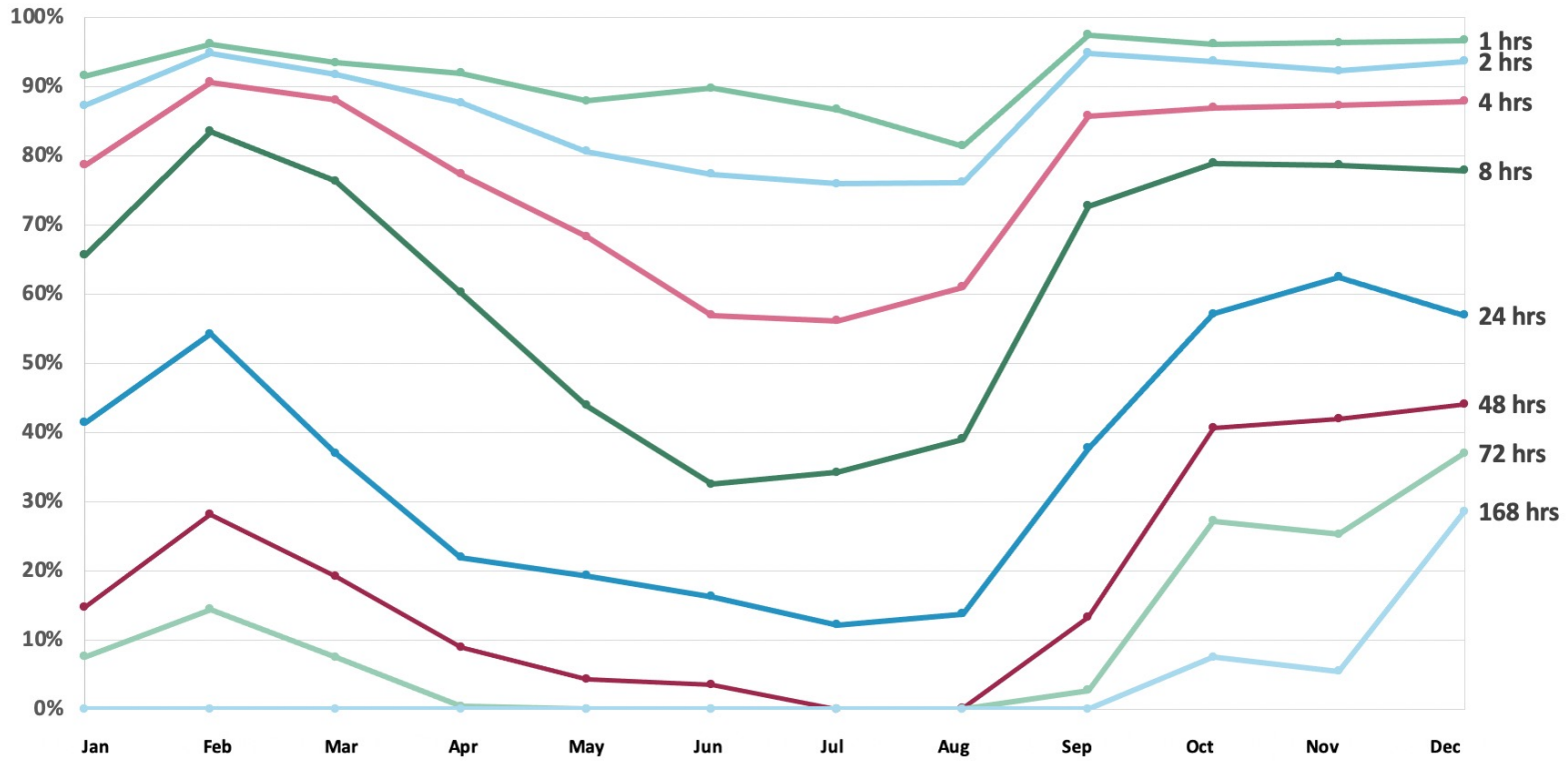


30KW PV (10 + 20KW NEW)

Assessing back up power, the 50kWh battery does fairly well at covering a short term outage (1-8hrs), particularly in summer

Backup power duration – Kerang – 50kWh – Current tariff

% of intervals in month, where X hours of backup power is met, should random outage occur at anytime.



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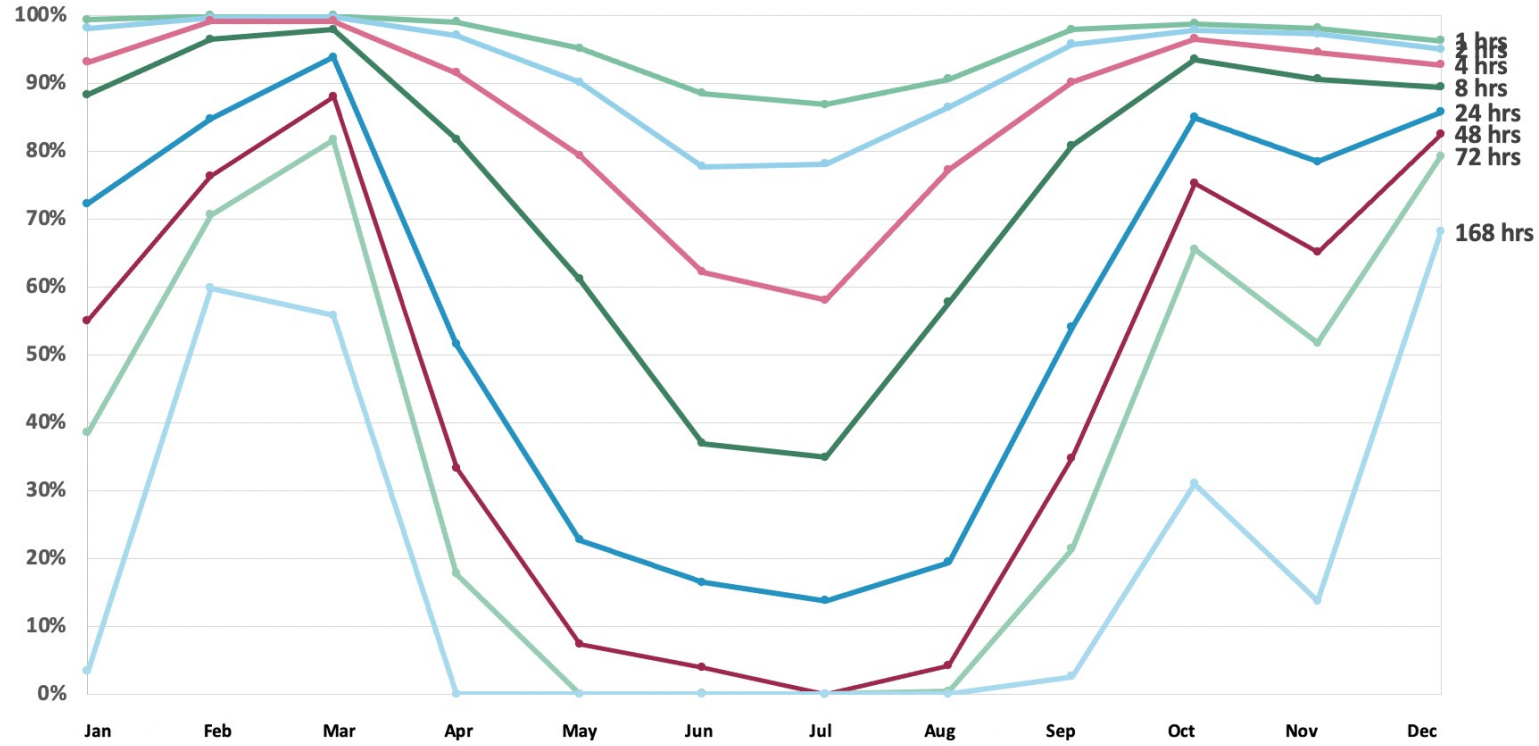
The addition of 20kW PV extends the 50kWh battery back-up coverage, especially in summer.

Backup power duration – Kerang – 50kWh + 20kW PV – Current tariff

% of intervals in month, where X hours of backup power is met, should random outage occur at anytime.



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Kerang is similar to Daylesford in that it's marginally uneconomic for most battery sizes. However, if batteries and solar PV can be installed in combination with tariff changes, projects up to 50kWh in size are financially viable.

SUMMARY

- Kerang Library is not a viable site for a battery when considering financials alone (except for the 13kWh battery which was viable in market facing scenarios). Daylesford and Kerang rank roughly on par here.
- Kerang has roof capacity for additional solar PV which would substantially improve the financial investment return and make the site viable for sizes up to 50kWh on economics alone under the market-facing tariffs*.
- Solar + batteries would substantially increase the energy independence of the site to 50-70%.
- Backup power coverage is marginally less than the other sites in winter, but still 1-2 hours can be met reliably all year with a 50kWh battery.
- We recommend further investigation into installing a battery if one or more of these conditions are met
  - A) more solar PV can be added
  - B) The site can be switched to ToU network tariffs, and ideally wholesale price exposed tariffs*
  - C) The site places a strong value on back up power

*This comes with market risks which need to be managed.

Cressy Hub

Key Findings

The Creswick Hub (dubbed Cressy Hub) is a community library and events facility is Creswick, Victoria

ABOUT CRESSY HUB

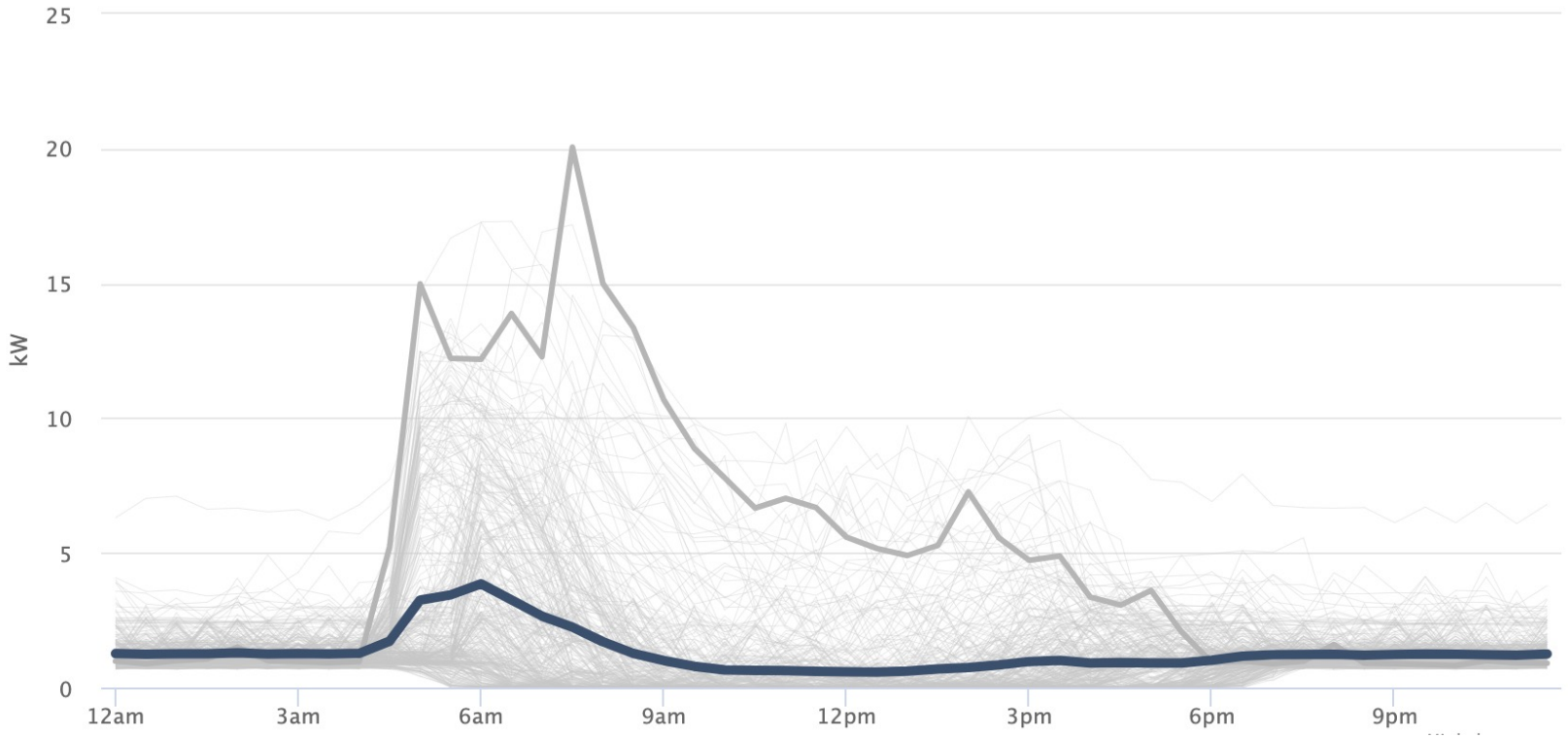
Distance from Melbourne:
122km NW

Facilities
- Community events
- Library

Opening hours:
- M-F 9am-5pm
- Sa 9 -12am
- Su Closed

Cressy Hub has a medium load and a 20kW solar system. The site appears to have no export capability.

Net load profile for all days - Pre-Battery – Cressy Hub



Average day

Peak day

All days

Gross load:
33.17MWh*

Net load:
11.55MWh

Solar exports clipped
5.4MWh *

* Estimate (data not available) based on 80% of estimated solar generation being consumed

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Cressy Hub has the lowest energy bills of the three sites at approx. $3000 per annum. It has a flat 'anytime' tariff with Origin.

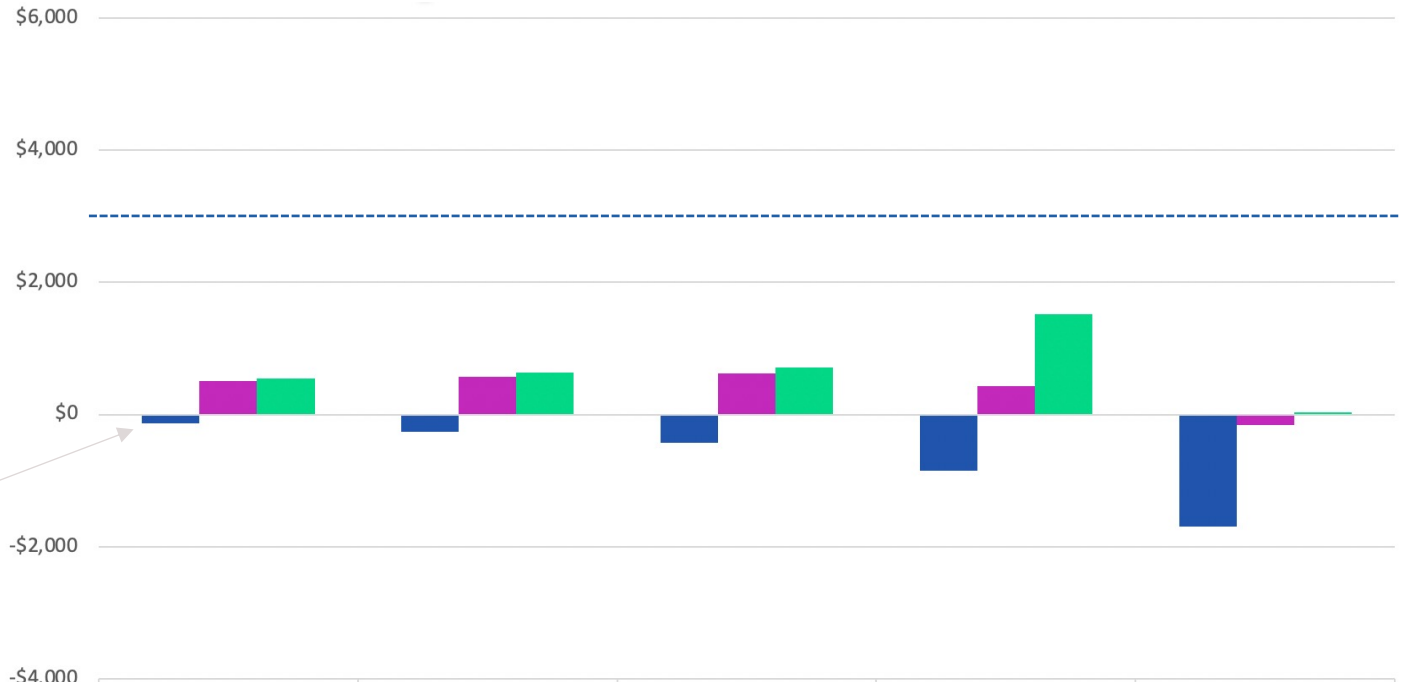
Business as usual bills in Year 1 (no battery)

2022	Quantity	Unit	Rate	Unit	MLF	DLF	Amount
Retail							$2,965
Daily supply	365	days	1.263	$/day			$461
Energy	11,538	kWh	21.70	c/kWh	1.00	1.00	$2,504
Total					exc.	GST	**$2,965**

When assessing the impact of the battery on bills, revenue is negative on current tariffs with a 0kVA export limit, owing to the complete lack of earning opportunities.

Annual battery revenue – 0kVA export limit

Net revenue in $ (Year 1)



Negative revenue: For all sizes, O&M costs exceeds value from capturing otherwise clipped PV

	13 kWh	26 kWh	50 kWh	100 kWh	200 kWh
Current tariff - Origin Flat (0kVA export)	-$130	-$260	-$425	-$850	-$1,699
Wholesale (2019) + ToU network (0kVA export)	$502	$573	$621	$425	-$165
Wholesale (2019) + ToU network + FCAS (0kVA export)	$550	$638	$710	$1,521	$37

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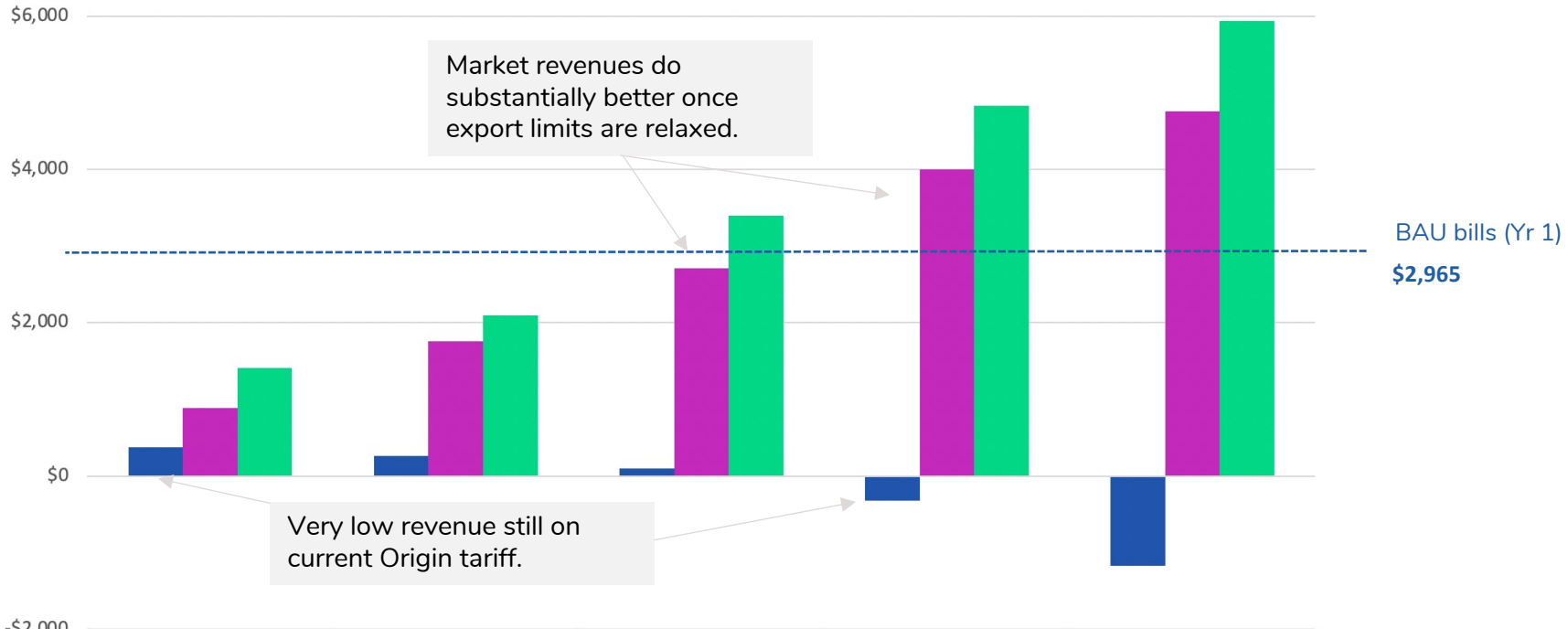
However, when the the export limit is relaxed to 30kVA, batteries can earn more revenue, particularly when market facing revenues are available.

Annual battery revenue (net) – 30kVA export limit

Net revenue in $ (Year 1)



	13 kWh	26 kWh	50 kWh	100 kWh	200 kWh
Current tariff (30kVA export limit)	$377	$267	$104	-$320	-$1,170
WS (2019) (30kVA export)	$888	$1,758	$2,708	$4,002	$4,755
WS (2019) + ToU net + FCAS (2019) (30kVA export)	$1,413	$2,094	$3,394	$4,828	$5,942

Note: Net revenue includes bill savings, net FCAS revenue and ongoing maintenance costs for battery

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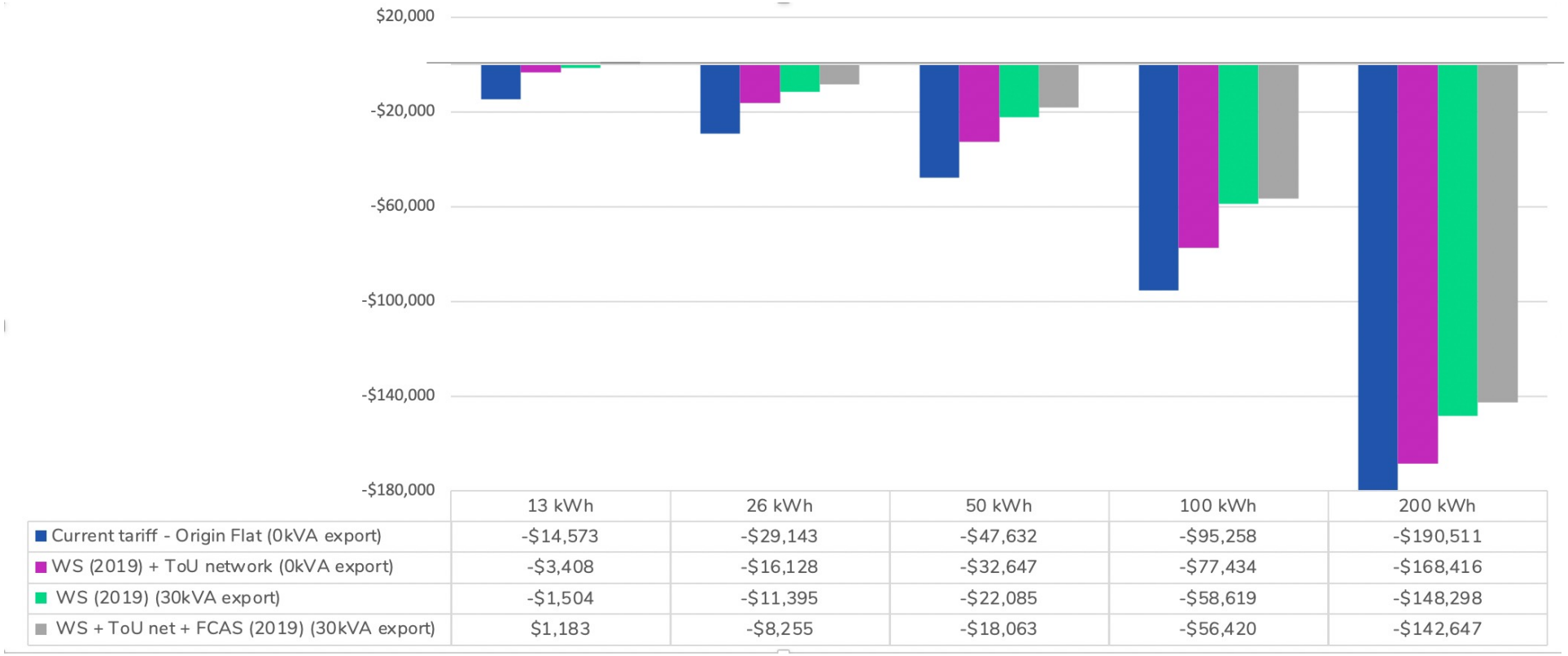
A battery is not a particularly good investment at Cressy Hub when assessing financials alone.

NPV of modelled battery sizes – 0kVA export limit / 30kVA export limit

Net present value in $ (2022)



	13 kWh	26 kWh	50 kWh	100 kWh	200 kWh
Current tariff - Origin Flat (0kVA export)	-$14,573	-$29,143	-$47,632	-$95,258	-$190,511
WS (2019) + ToU network (0kVA export)	-$3,408	-$16,128	-$32,647	-$77,434	-$168,416
WS (2019) (30kVA export)	-$1,504	-$11,395	-$22,085	-$58,619	-$148,298
WS + ToU net + FCAS (2019) (30kVA export)	$1,183	-$8,255	-$18,063	-$56,420	-$142,647

Net present value assessed over 15 years @ 3% discount rate.

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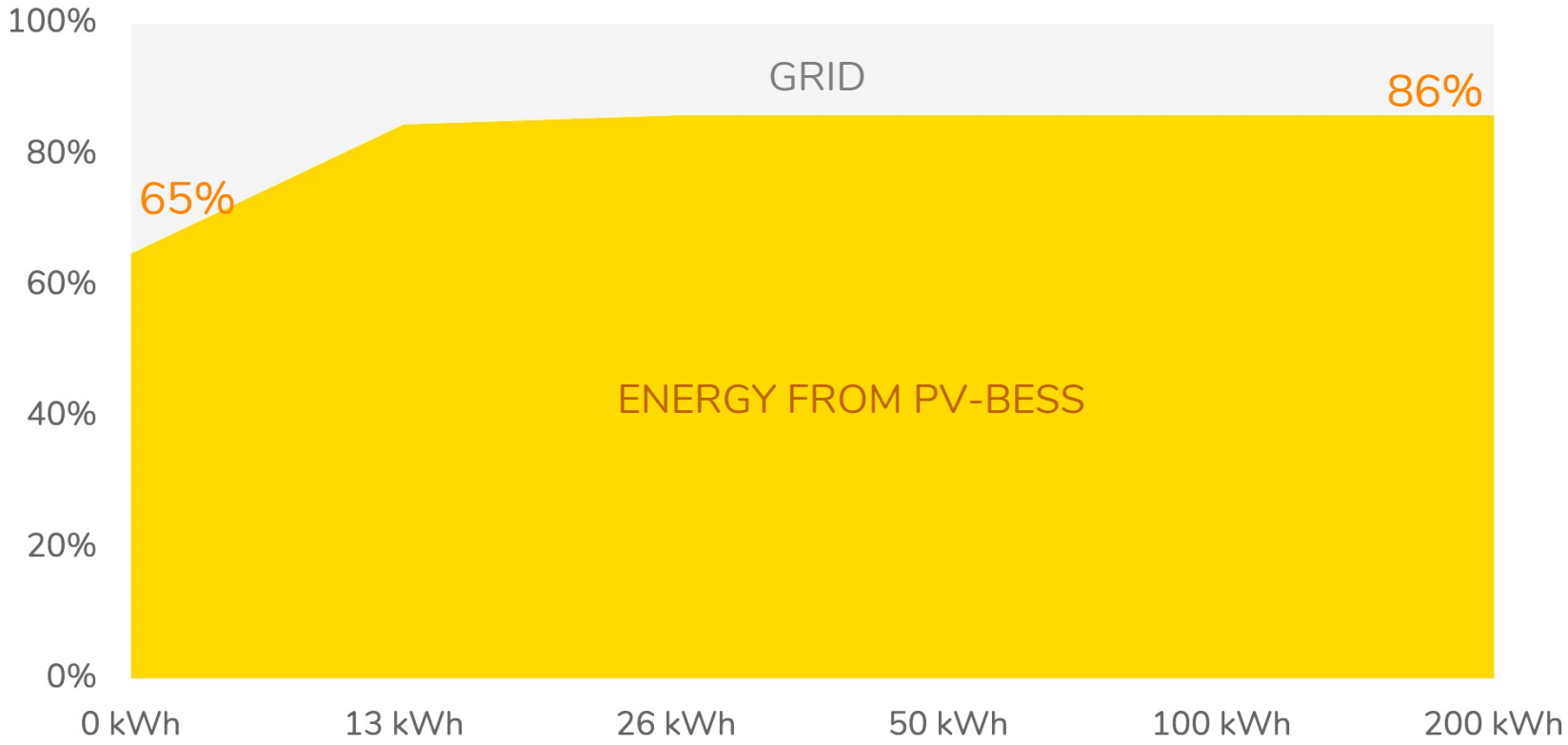
From a sustainability perspective, batteries appear to drive energy independence nicely upwards, but a data issue may be making this appear better that reality.

% of gross load met by solar-battery system (v's grid)

% of annual load served by solar-battery versus grid – Current tariff. 0kVA export scenario.



Potential data issue identified.
The energy independence in the 'no-battery' case is relatively high for a solar system, even at a business with good load matching.

It could be correct, but more likely it point to a data issue, most likely related to the actual solar PV size being larger than what we've modelled. (Based on publicly available information, we've assumed a 10kW(DC) solar PV size to back calculate the gross load).

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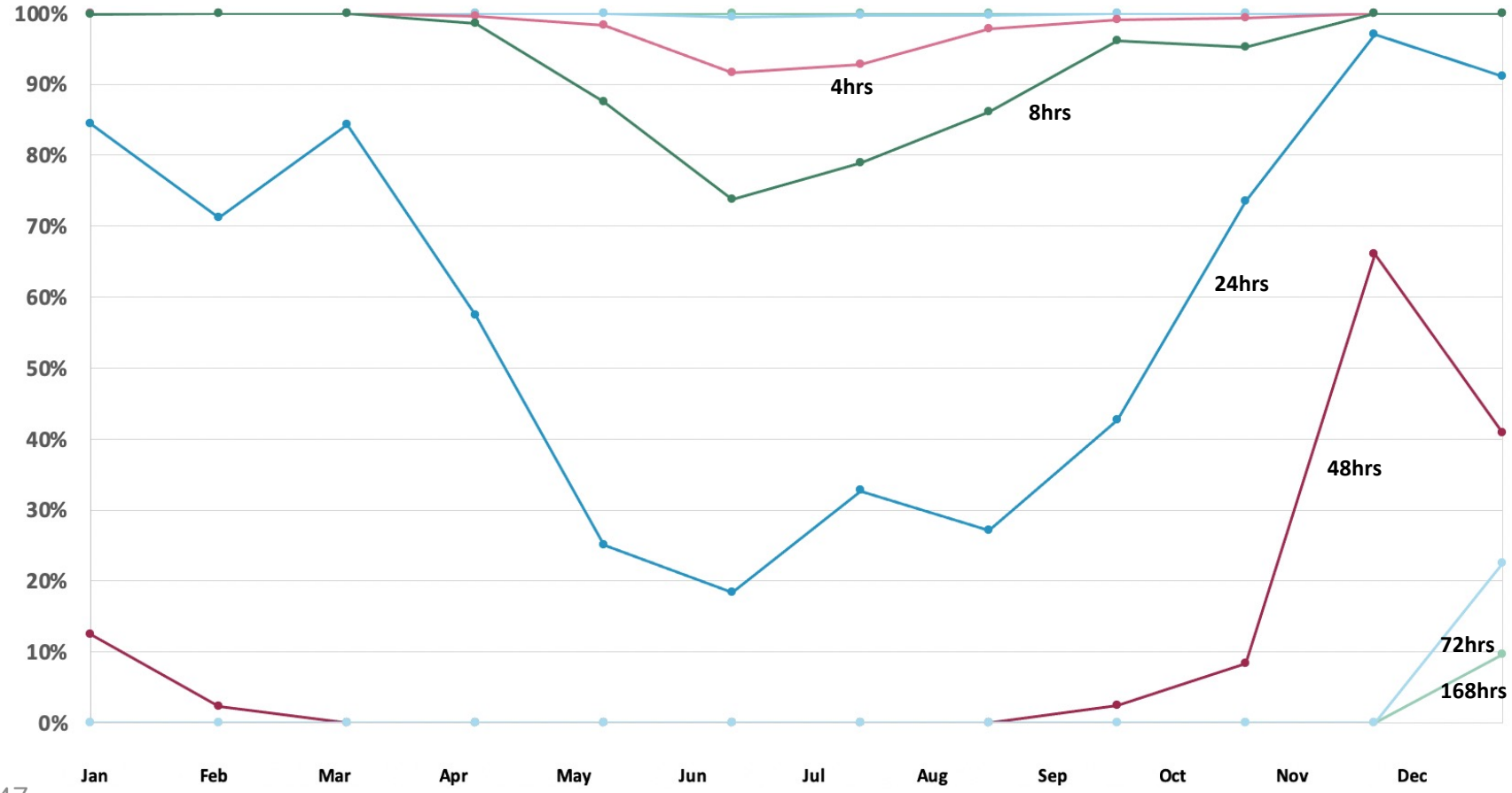
Assessing back up power, the 50kWh battery does well at providing up to 8hrs of back up for the majority of the year, with 24hrs likely in summer.

Backup power duration – Cressy – 50kWh – 0kVA export limit

% of intervals in month, where X hours of backup power is met, should random outage occur at anytime.



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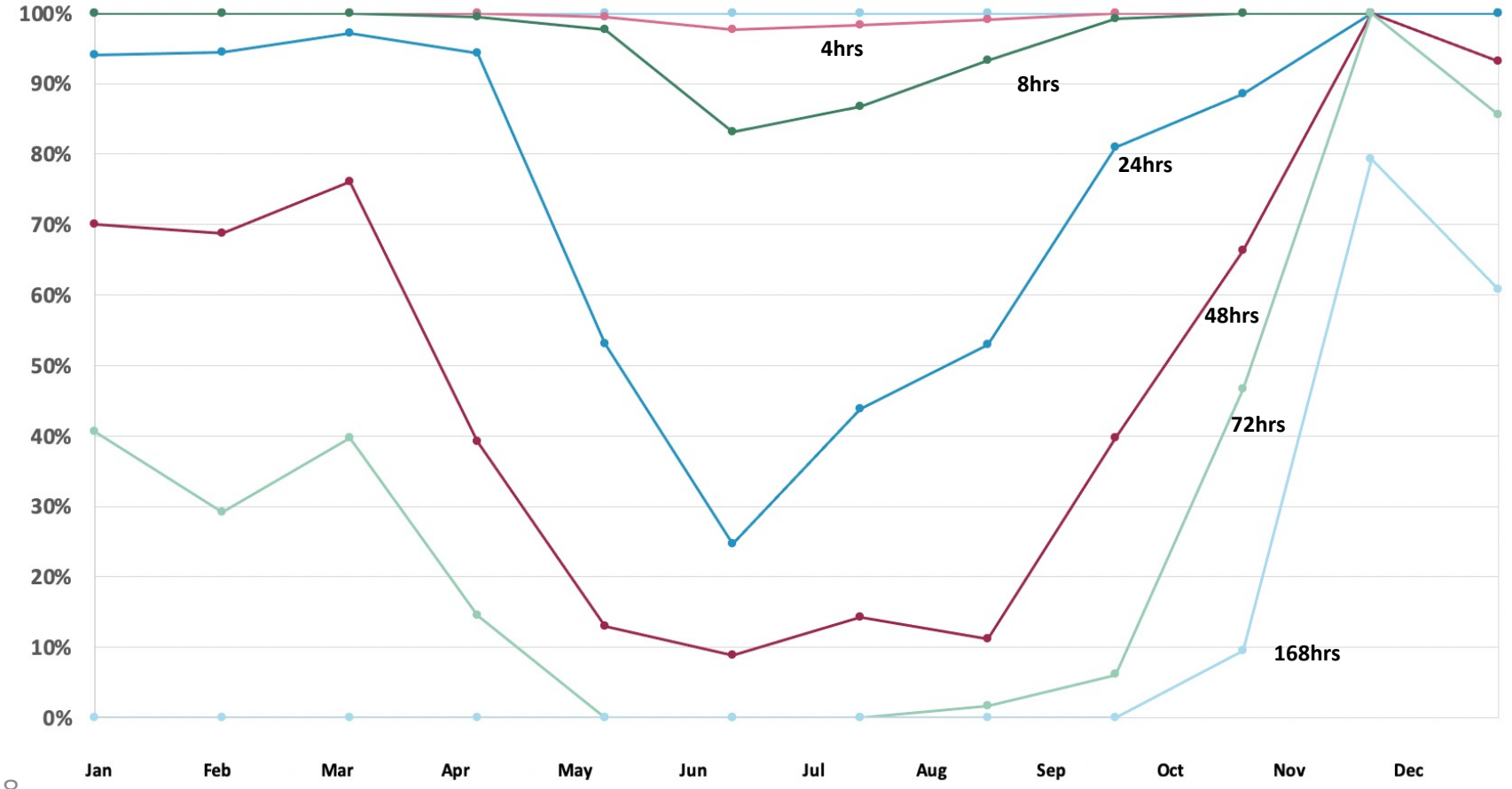
There isn't a huge change in back up power available when relaxing the export limit at the Cressy site.

Backup power duration – Cressy – 50kWh – 30kVA export limit

% of intervals in month, where X hours of backup power is met, should random outage occur at anytime.



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Cressy Hub does not present a viable site to deploy a community battery.

SUMMARY

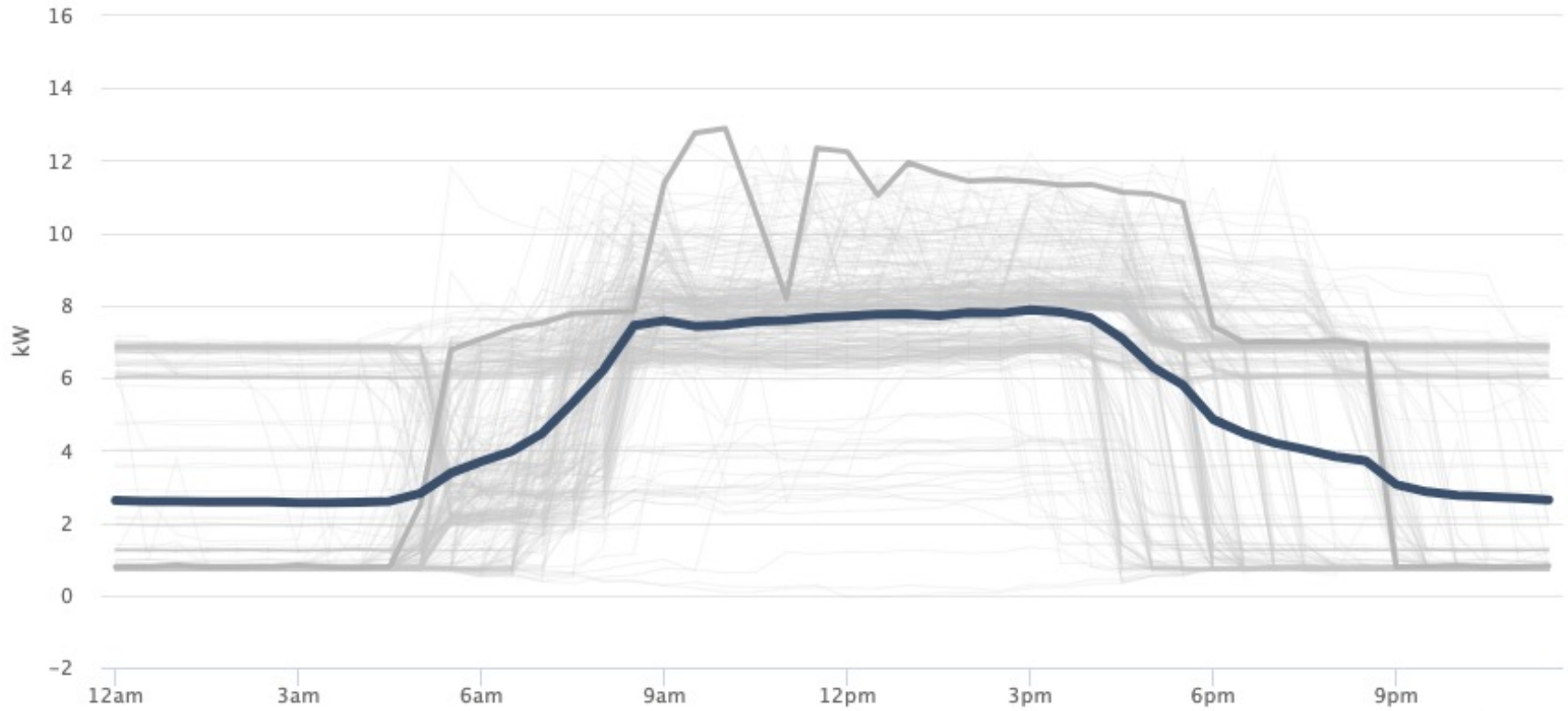
- Cressy Hub is the least viable of the three sites assessed
- We do not recommend installing batteries at Cressy for financial or sustainability reasons.
- Energy independence is already high, at an estimated 65%. Possible data issues were present at Cressy, which may be affecting this estimate.
- At a minimum, we suggest attempting to relax the export limit to reduce solar curtailment, should the network permit.

Emergency Shelter

Key Findings

The 'emergency shelter' load was created to reflect a community support centre which provides essential power, food and shelter for approximately 100 people.

Net load profile for all days when in use - Pre-Battery – Emergency Shelter



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The 'emergency shelter' load is assumed to consume an average of 134kWh a day in emergency mode, with more on hot or cold days due to HVAC load.

Load assumptions – emergency shelter

Breakdown of usage assumptions	kWh/day
HVAC	96
Electronics charging	6
Commercial kitchen	20
Other	12
Total daily average	134

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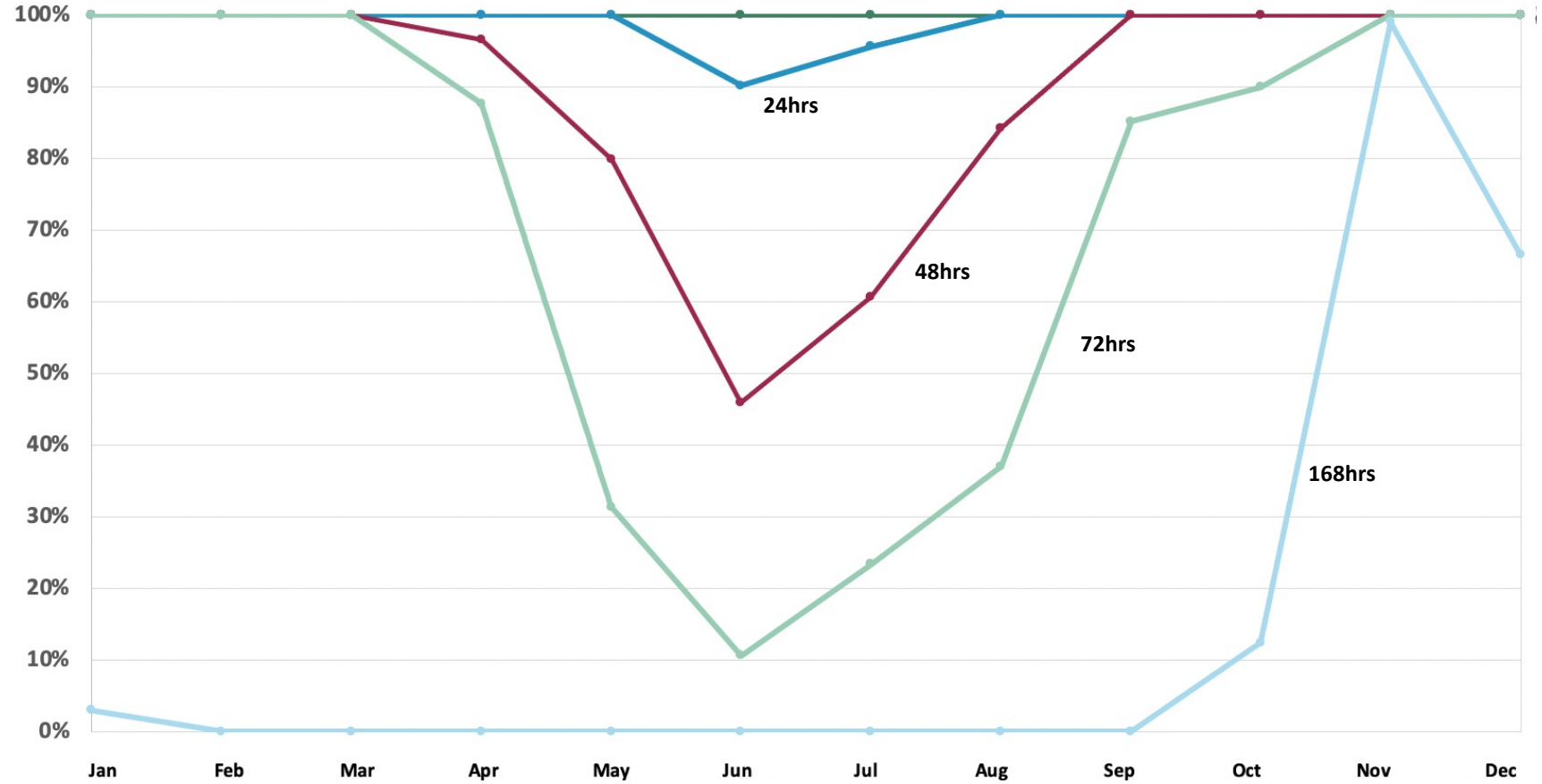
20kW PV + 200kWh of battery storage would provide at least 24 hours of days of reliable storage year round, with 72 hours coverage typical in summer.

Backup power duration – Emergency Shelter – 20kW PV + 200kWh

% of intervals in month, where X hours of backup power is met, should random outage occur at anytime.



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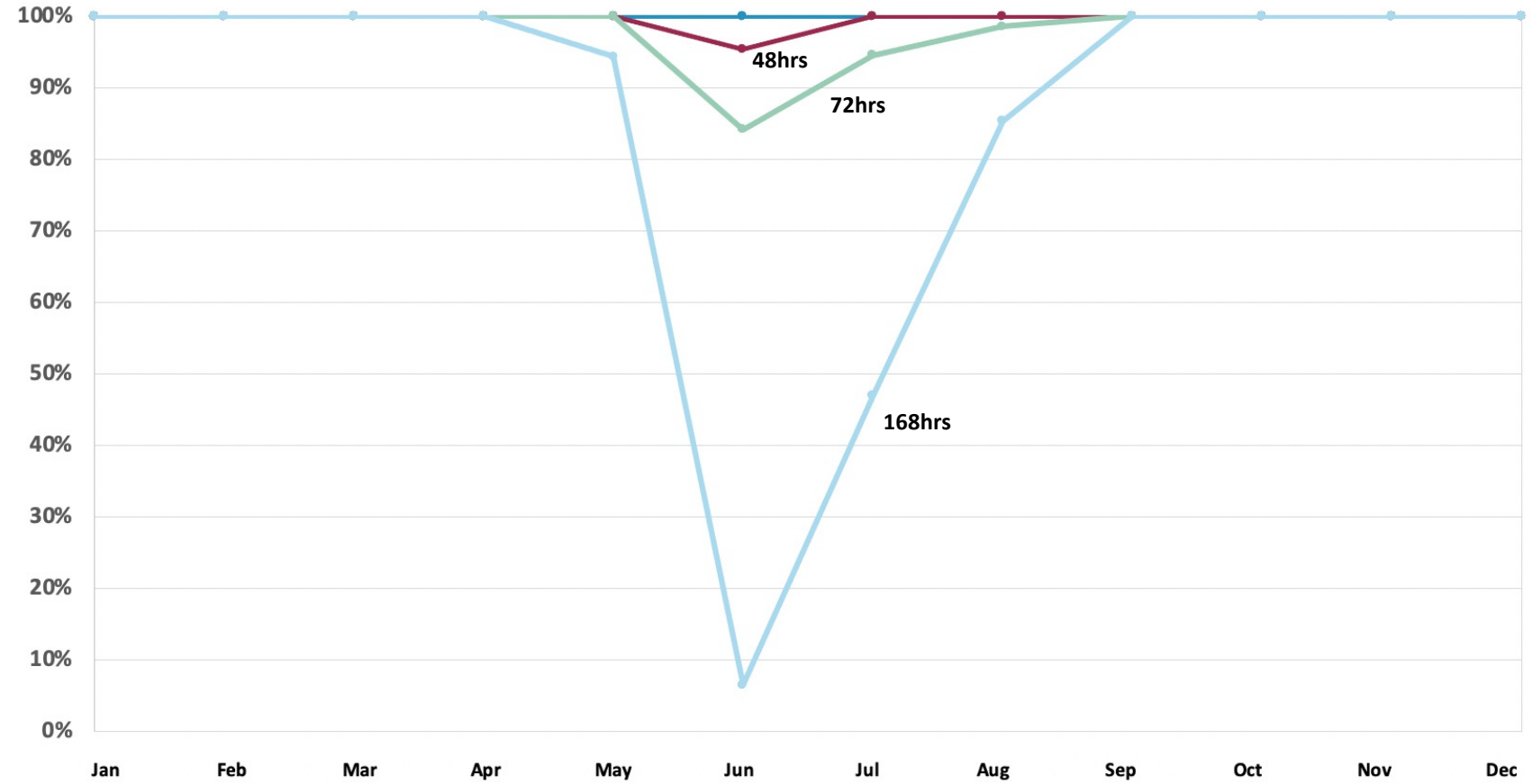
40kW PV + 200kWh battery would reliably provide 72hrs backup coverage in in winter with 168hrs (7 days) coverage likely in summer.

Backup power duration – Emergency Shelter – 200kWh BESS + 40kW PV

% of intervals in month, where X hours of backup power is met, should random outage occur at anytime.



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Solar and batteries can provide ample back up power for a potential emergency shelter.

SUMMARY

- Depending on the needs and seasonality of the emergency shelter, the analysis shows that a solar and battery system (with back up and islanding capability) can adequately provide multiple days of essential back up power for most of the year without requiring a generator.
- This exploratory analysis is generic in nature and should not be relied on for any specific site.
- More detailed load and engineering modelling is required prior to proceeding to an investment in back-up power provision for an emergency shelter.

*Depending on the needs of the site, a back up generator may still be required.

Further analysis

Technical & financial analysis

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Investment outcomes are sensitive to changes in wholesale prices and price volatility, which can vary from year to year. Actual outcomes may perform better (or worse) than those modelling here.

MARKET SENSITIVITY ANALYSIS

NET PRESENT VALUE OF BATTERIES IF A CERTAIN WHOLESALE YEAR WAS REPEATED FOR ALL YEARS

DAYLESFORD	Wholesale (2019)	Wholesale (2020)	Wholesale (2017)
13 kWh	$438	$16,752	$2,366
26 kWh	-$4,459	$10,098	-$7,057
50 kWh	-$8,481	$2,969	-$19,005
100 kWh	-$32,646	-$28,327	-$58,854
200 kWh	-$84,278	-$94,310	-$143,723

KERANG	Wholesale (2019)	Wholesale (2020)	Wholesale (2017)
13 kWh	$212	$6,639	$8,523
26 kWh	-$5,681	-$932	-$2,346
50 kWh	-$9,845	-$8,410	-$15,777
100 kWh	-$32,696	-$37,765	-$55,605
200 kWh	-$81,639	-$100,615	-$140,925

Default data used in wholesale tariff analysis

About wholesale datasets

Unless alternative data is provided, we use historic years as default to provide provide guidance on value capture from wholesale arbitrage. In no way does this constitute a forecast.

We recommend all clients purchase an interval grade forecast from a reputable third-party and confirm forecast assumptions prior to investment.

We used 2019 in our default ‘WS price’ analysis as it offered conservative assessment if revenue, that on average, represented a mid-point of the last 5 years for battery value capture.

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Typically, about half of all wholesale earnings comes from a handful of extreme price events during the year. For example, in the main wholesale dataset assessed (Vic 2019) approximately 50% market earnings came from just two days of the year.

BATTERY STATE OF CHARGE VERSUS WHOLESALE MARKET PRICE – JANUARY 27.

Daylesford 50kWh battery – Wholesale 2019 scenario

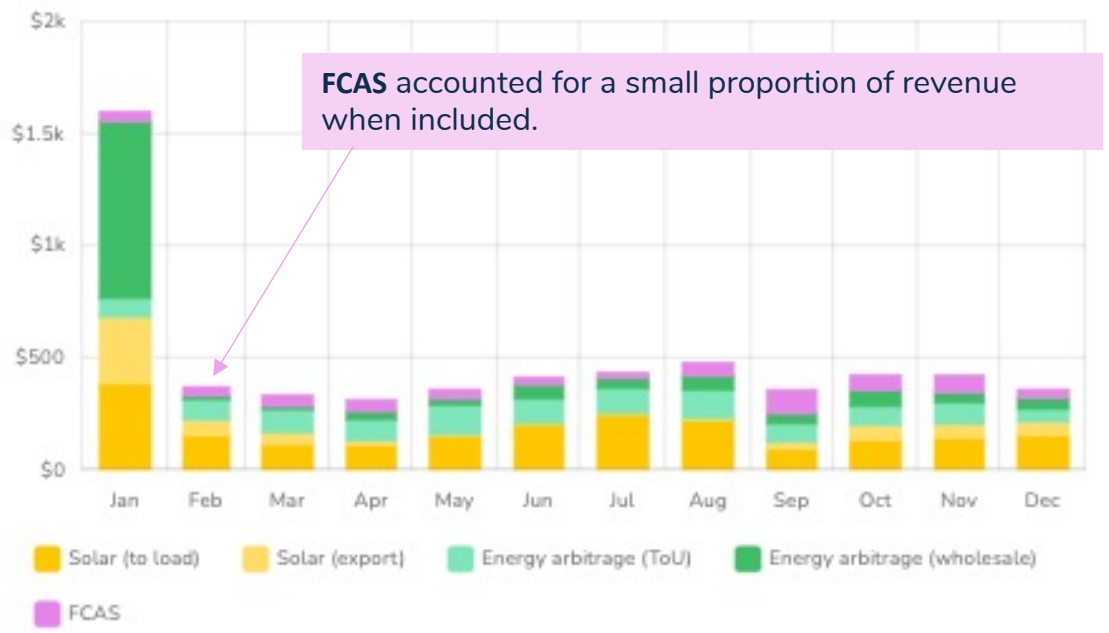
The battery takes advantage of the volatile price to maximise repeatedly charge and discharge to maximise earnings.

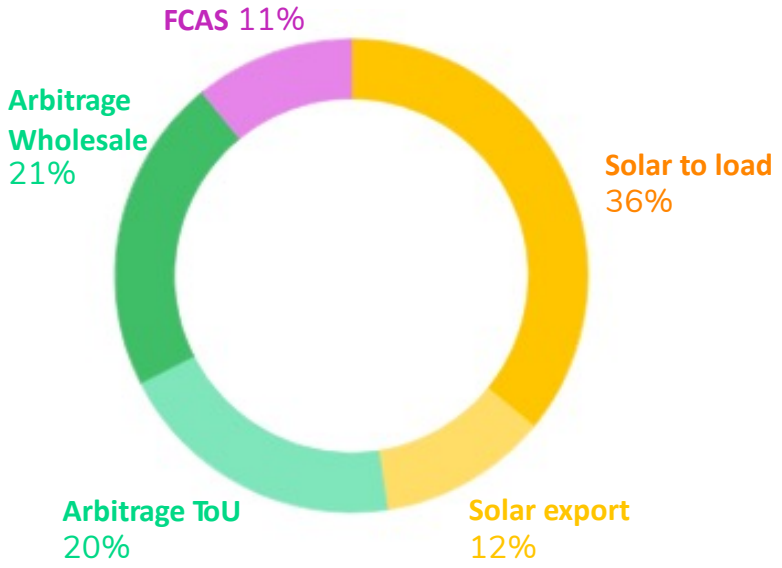
Note: The remainder of wholesale value capture typically comes from lower value arbitrage activity which occurs on a more regular basis (i.e. daily)

FCAS revenues are relatively low (compared to wholesale arbitrage) due to several factors which derate customer FCAS earnings at such a small scale of project.

Earnings by value stream – Kerang Library – 20kW PV + 50kWh – WS + FCAS scenario

Year 1 earnings $





Factors reducing FCAS revenue:

Droop Setting: 42%. The AEMO applied revenue derating discount FCAS participation from smaller battery systems.

FCAS proponent revenue share: 30%. The earnings commission for the aggregators + controls provider.

FCAS year-on-year revenue de-escator: -15% p.a. The assumed annual year-on-year reduction in earnings potential from FCAS.

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Assumptions

Technical & financial analysis

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Several data challenges were identified when undertaking the modelling.

Data issues uncovered when modelling

Site	Data issues
Daylesford Town Hall	• The interval data provided was affected by Covid lockdowns, being the 12 months from December 2019. Scaling to remove this impact was not possible as load was net of solar PV.
Creswick Community Hub	• No interval data was provided for solar exports and there was no feed-in-tariff on the power bills provided. It was assumed that solar export are constrained to 0kVa. We still simulated a scenario where exports limits were relaxed to 30kVA. whereby generation was set at 1380kWh/kWp in year 1 and 80% was consumed on site. • The interval data provided was affected by Covid lockdowns, being the 12 months from December 2019. Scaling to remove this impact was not possible as load was net of solar PV.
Kerang Library	• We have modelled the data as provided, but unusually only 7% of solar generated is consumed onsite. There appears to be an unusually low daytime load at Kerang. One potential reason is the size provided of 10kWp is actually a 20kWp system, or else the metering is incorrectly set up at the site and is double counting solar. • The data has been corrected to account for Covid lockdowns, by stitching together July-Dec 2019, with Jan – Jun 2021 to create a full 12 months of data.
Emergency Shelter (generic)	• No load data for an emergency shelter provided. The data was generated by taking a HVAC dominant load profile and scaled to the estimated kWh load.

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Technical & financial assumptions

Battery	
Name	Various
Capacity	13 / 26 / 50 / 100 / 200 kWh (usable)
Power (continuous max)	5 / 10 / 20 / 36.5 / 73
CAPEX	$1000 / $850
O&M Cost	1.0% p.a.
Capacity degradation	3.0% p.a.
Round trip efficiency	85.0%
Initial state of charge	60.0%
Arbitrage threshold	$25.0
Demand reduction discount	20.0%
Wholesale Arbitrage discount	25.0%
FCAS discount	15.0%

Solar	
Name	20kW
Solar Profile (New PV)	Kerang Solar Profile
kWp DC	20.0 kWp
DC/AC ratio	1.0
CAPEX	1000.0$/kWp
O&M Cost	1.0% p.a.
PV Module degradation	0.5% p.a.
Maintenance cost escalator	0.0% p.a.
Inverter replacement interval	12.0 years
Inverter replacement cost (today)	140.0 $/kW
Inverter replacement cost escalator	-3.0% p.a.
Enable LGC calculation	False

Connection Details	
Power factor	1.0
Marginal loss factor	1.0
Distribution loss factor	1.0
Export limit default	None kW
Export limit adjustment cost	$2500 capex (0 - > 30kVA)

Financial

Discount rate	3.0%
Analysis years	15 years

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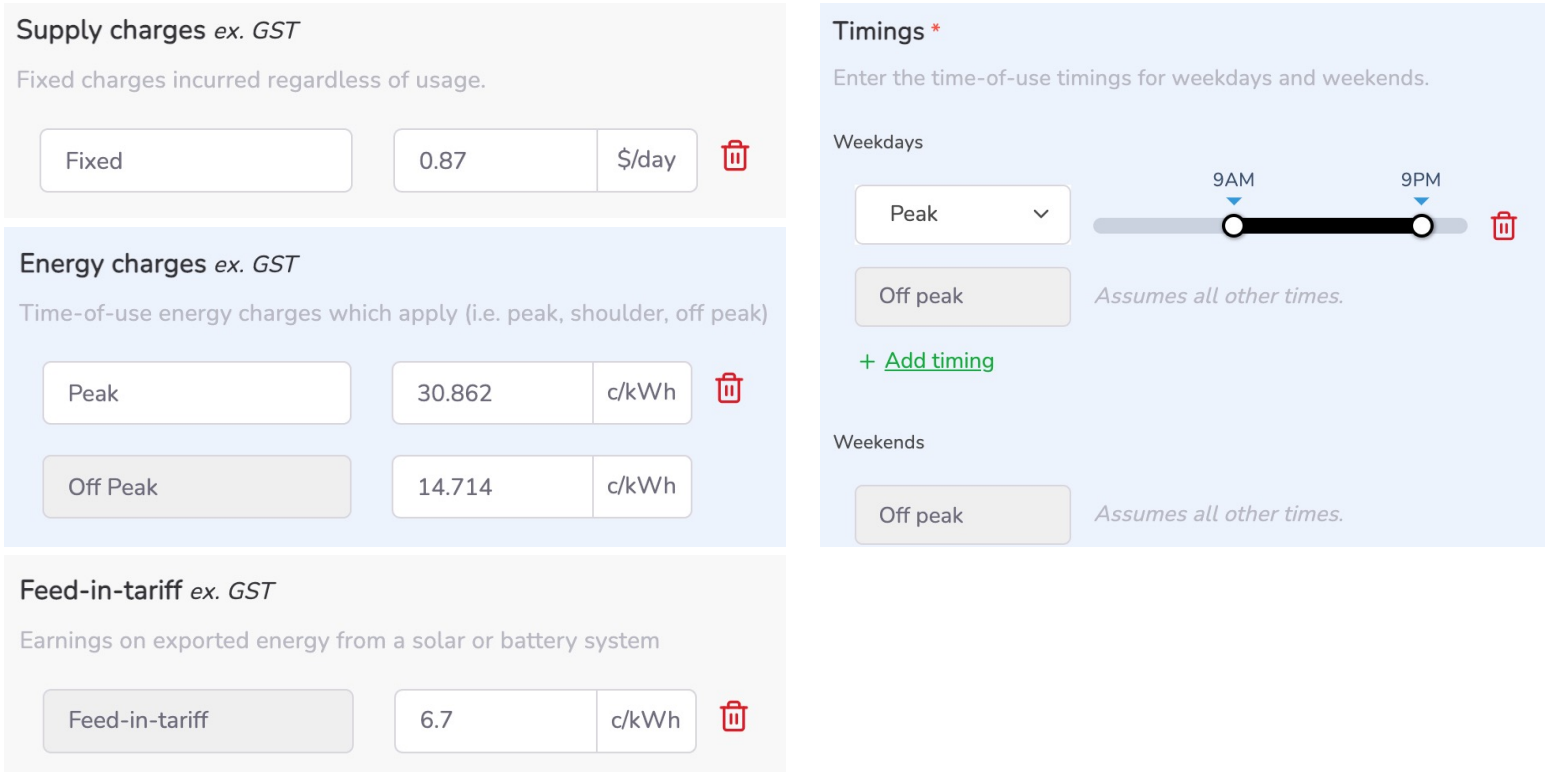
Shell 2-rate Tariff (Kerang)

Tariff data



Origin Anytime Tariff (Creswick + Daylesford)

Tariff data

Supply charges *ex. GST*

Fixed charges incurred regardless of usage.

Daily supply	1.263	$/day

+ Add

Energy charges *ex. GST*

kWh based energy charges, which apply at all time.

Energy	21.7	c/kWh

Feed-in-tariff *ex. GST*

Earnings on exported energy from a solar or battery system

Feed-in-tariff	6.7	c/kWh

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Amber (wholesale exposed tariff) and Powercor Small Business ToU tariff.

Tariff Data

Network Tariff	
Tariff Name	Powercor Small Business TOU
Tariff Code	NDTOU
Cost escalator	1.5%

Details	Network	Powercor	
	Name	Powercor Small Business TOU	
	Type	Network	
	Tariff Code	NDTOU	
	Tariff Year	2021-07-01	
Fixed Charges	Supply	49.31c/d	
Volume Charges	Peak	14.71c/kwh	Jan-Dec, mon-fri, 9am to 9pm
	Off Peak	3.28c/kwh	all other times.

Retail Tariff	
Tariff Name	Amber Vic (ex Network)
Tariff Code	
Cost escalator	1.5%
Feed-in-tariff escalator	0.0%

Supply charges *ex. GST*

Fixed charges incurred regardless of usage.

Meter	0.18	$/day
Membership	0.493	$/day
Total supply charges	0.673	$/day

Other usage charges *ex. GST*

kWh-based usage charges, such as market and environmental charges, incurred on top of the wholesale market spot price.

Other charges	3.1	c/kwh

These two tariffs are used together in the analysis as a quasi ‘unbundled’ tariff.

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