# BOOM!

# Contents


Executive Summary ..... 3
Introduction ..... 4
Shared Battery Technologies ..... 5
  Solshare ..... 5
  Embedded Network ..... 7
Identifying Candidate Properties ..... 9
Modelling Methodology ..... 10
  Solshare ..... 10
Results ..... 15
  Solshare ..... 15
  Embedded Network ..... 17
Suggested Approach for Future Neighbourhood Battery Projects with CHOs ..... 18
Ongoing Operations & Maintenance ..... 20
Appendix A: Modelling Assumptions ..... 21
Appendix B: Risk Assessment ..... 22
Appendix C: Comparison of Business Model Scenarios ..... 23

# Electrifying Community Housing - Community Batteries

Project summary

Prepared by Dr David Perry, BOOM! Power

The following report relates to the funding agreement between the State of Victoria and BOOM! Power, for the project entitled "Electrifying Community Housing - Community Batteries".

The project aimed to produce business cases for neighbourhood batteries across 76 community housing buildings (2876 households). BOOM! Power modelled business cases using existing site conditions and energy profiles, or schematics and designs for new developments. Participants with suitable business cases were ready to apply for neighbourhood battery capital funding, for individual buildings or in aggregate, in late 2024.

## Executive Summary

- We assessed the feasibility of neighbourhood batteries across 75 community housing apartment buildings, composing 2,832 households.
- Our goal was to identify sites where a shared battery was technically feasible and could be used to significantly reduce tenant bills.
- Two approaches were considered:
  - Solshare: Using the Allume Solshare technology, coupled with rooftop solar and a DC-coupled battery. This approach is treated as behind-the-meter with a straightforward delivery pathway, but with some limitations, including that the battery could only charge from on-site solar, not the grid.
  - Embedded Network: Where an embedded network is present, using an AC-coupled battery between the gate meter and apartment submeters to access low-cost daytime power (both from on-site solar and from the grid), and potentially provide a range of other market services.
- For existing buildings, physical site inspections were conducted by Arigo Engineering, who assessed the suitability based on available infrastructure, including switchboard configuration, and the capacity for on-site solar to charge a battery. For new (or under construction) buildings, drawings of electrical and mechanical services were examined.

- Site inspections by Arigo suggested 12 of the 48 *existing* properties were potentially suitable for a shared solar system and battery.
- Further assessment of available roof space ruled out another five properties, leaving 7 properties as candidates for a neighbourhood battery, all via a combined shared battery and solar system using the Solshare technology.
- CapEx for each Solshare site was estimated alongside modelling of bill savings in preparation for final business cases to be used in applications for grant-funded programs.
- Modelling showed average tenant bill savings are expected to be $306 per year. For some sites, electrification can be expected to increase these savings, but only modestly given hot water heating can be timed to coincide with solar, and cooktops only have a small contribution to household energy demand.
- Twenty-one *new build* properties were considered, which were in varying states of completion as part of the Victorian Government's Social Housing "Big Build". They were all-electric by design. Ten of these properties were unsuitable as they were freestanding or townhouses, better suited to standalone solar systems (with independent batteries later, as appropriate). Of the remaining , one was considered for a combined shared battery and solar system using the Solshare technology, and 8 for a shared battery within the embedded network.

# Introduction

BOOM! Power in collaboration with Arigo, Allume and Yarra Energy Foundation partnered with five Community Housing Organisations (CHOs) to create Neighbourhood Battery business cases across 75 candidate buildings, impacting 2,832 households. Modelling considered engineering feasibility, install costs, and benefits at the household level which drive the community benefit of the proposed shared battery infrastructure. The draft business cases also consider risks, and a plan for how batteries will be deployed and managed over time.

Project deliverables included:

Collection and collation of billing and interval data for communal areas and, wherever possible, individual tenancies to inform the validity of assumptions in the business case.

The creation of desktop business cases, with a focus on two approaches:

- Leveraging shared solar using Allume Solshare technology, coupled with rooftop solar and a DC-coupled battery. This approach is treated as behind-the-meter with a straightforward delivery pathway, but some limitations, including the inability to charge from the grid.

- Where an embedded network is present, use an AC-coupled battery between the gate meter and apartment submeters to access low-cost daytime power (both from on-site solar and from the grid), and potentially provide a range of other market services.

Physical site inspections undertaken by Arigo Engineering, a consultancy specialising in solar and battery systems, which has been involved in the rollout of 1,000s of renewable energy projects for Community Housing Organisations' buildings, including five of the seven CHOs involved.

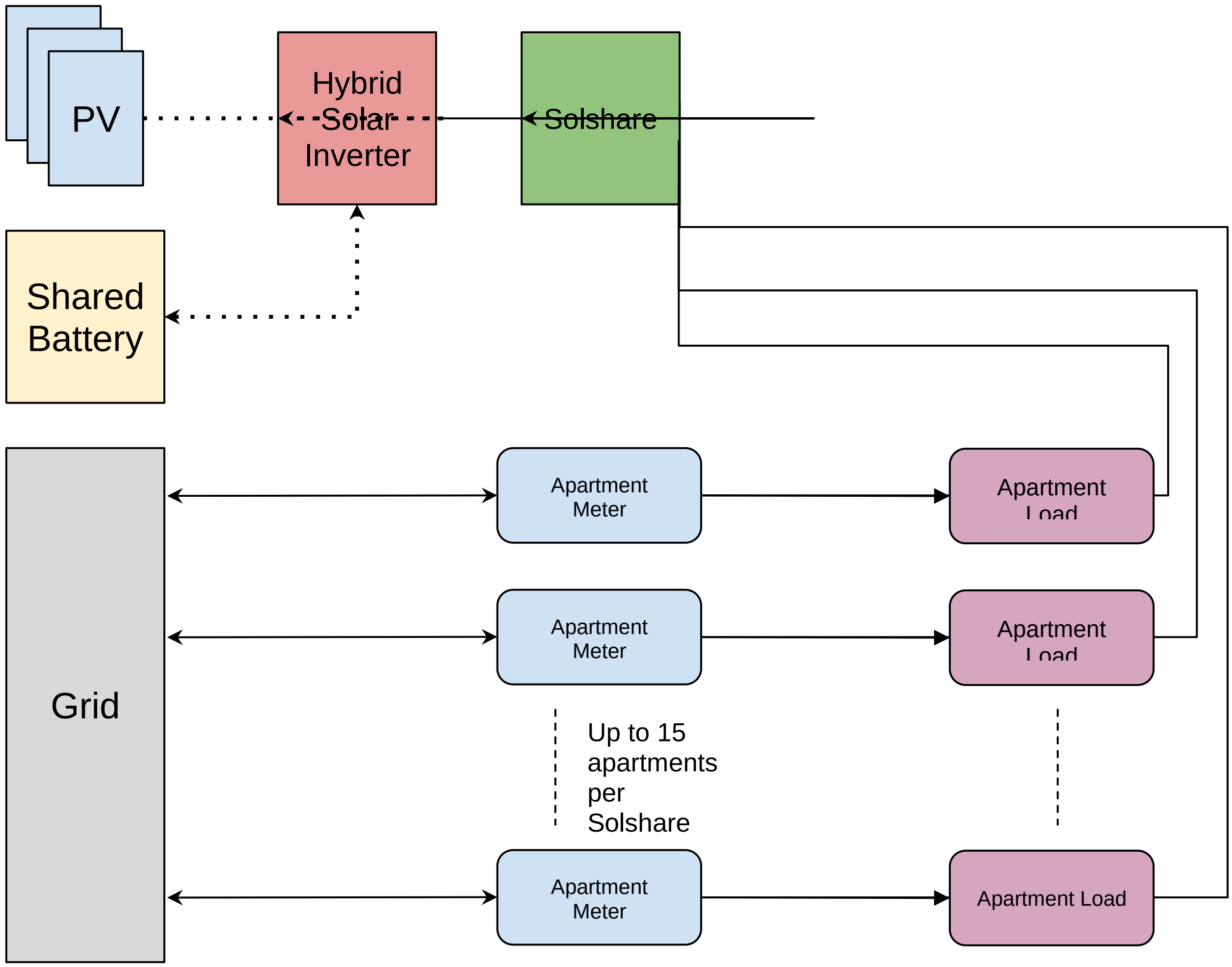
Finalisation of individual and aggregated business cases, including a peer review by Yarra Energy Foundation, ensuring the business cases are robust and realistic.

The following Project Summary outlines background on the technologies being considered, our modelling methodology and results, and a suggested approach for assessing the feasibility of neighbourhood batteries in other community housing apartment buildings.

# Shared Battery Technologies

## Solshare

We considered two approaches to providing shared battery infrastructure to the buildings. The first was using a shared solar system and DC coupled battery, using the Allume Solshare platform, developed in Victoria.




A typical arrangement would use a hybrid solar inverter, such as the Sungrow SH20T, with stacked battery modules which allow flexibility in battery sizing. This would be coupled to the Solshare, which monitors demand across each apartment, and switches the solar output to each apartment to maximise self-consumption, while ensuring a fair distribution of benefit across each. If the generation exceeds consumption across all apartments, the surplus would instead be directed into the battery bank, to be discharged later in the day. Each Solshare can support 15 single phase connections. For buildings with more than 15 apartments, multiple independent solar arrays, inverters, batteries and Solshares will be required.

This approach leverages a technology platform that's already widely deployed, following existing approval processes for solar and batteries with DNSPs, which reduces complexity and project timelines. The primary trade-off is the inability to charge the battery from the grid, as this energy would need to be sourced from individual apartments, incurring costs on their bills. At present, Solar Victoria funding guidelines prevent the Solshare being connected on the common area side. It may also raise regulatory challenges, as it means that imported energy from one household may ultimately be used to serve another. Nonetheless, it may be possible to find a solution to both barriers in the future, offering a more flexible solution.

| **Advantages** | **Disadvantages** |
|---|---|
| Freedom of choice for household energy retailer | Can only charge from on-site solar. The battery is unable to be charged from the grid. |
| Follows standardised approval process with DNSPs | Battery is unable to be used for VPPs (since it would span multiple retailers). |
| As it's treated as behind-the-meter, there's no dependence on special neighbourhood battery tariffs. | Unutilised battery capacity if there's insufficient solar generation (i.e. during winter). |
| Wide choice of installers. | |

## Embedded Network

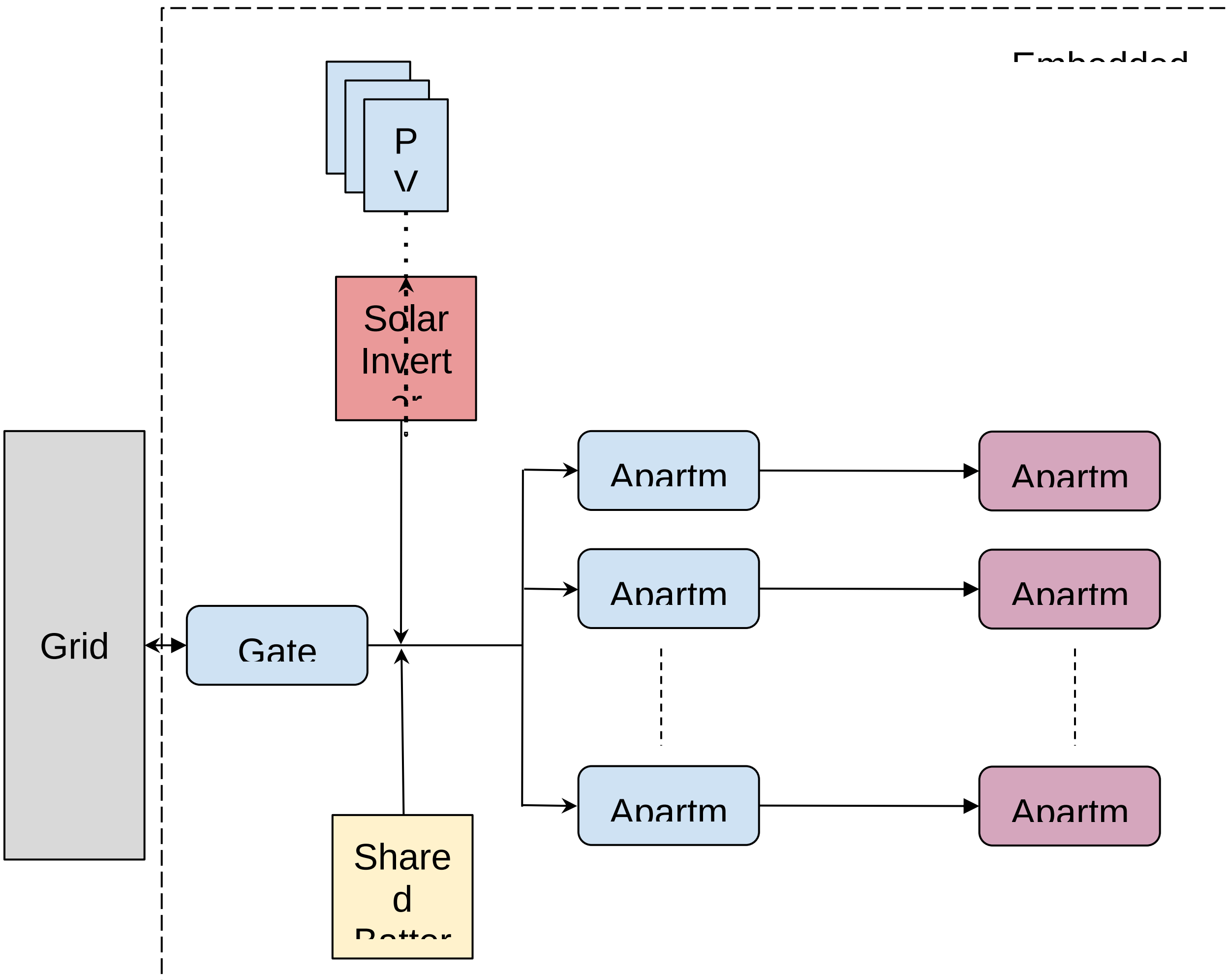
The second approach was applicable to embedded networks, where a standalone AC-coupled battery would be installed between the gate and submeters, allowing any excess on-site solar, as well as that from the surrounding area, to be stored for later use, as well as potentially providing other network and market services. In most sites, this would be installed in a basement carpark or plant room, coupled with the main switchboard (MSB).

A wide variety of C&I scale batteries are available on the market (expected to be in the range of 100-1000kWh), including those already deployed on other NBI projects. However, it's likely that even if CHOs were to be owner of this infrastructure, in practical terms that embedded network operator (ENO) would need to operate it, scheduling charge and discharge to maximise the wider range of revenue streams that may be applicable, with an undertaking to pass on a substantial portion of the benefit to tenants.

While these household benefits are likely to be material and meet the criteria of a grant-funded program, it's difficult to critically evaluate them against the benefits and risk profile taken on by the ENO, given the commercial sensitivity of such data. As such, modelling of these proposed installations was not undertaken. Instead, we propose to benchmark any proposed ENO offers against the Solshare scenarios, and current market VPP offers where a fixed annual benefit is provided, rather than the more volatile merchant approach of some VPPs (e.g. Amber Electric). The contribution of any grants, co-funding and finance costs would also be considered.

As an example, South Australia's VPP offer for community housing (developed with Tesla and Energy Locals), provides a fixed discount on the Default Market Offer of ~25%, with capital costs largely subsidised by government grants.

Two ENOs were approached for proposals.




| Advantages | Disadvantages |
|---|---|
| Flexible; can charge from on-site solar, as well as low-cost surplus solar from the grid. | Battery needs to be operated and tightly integrated with the embedded network operator to gain full benefits. |

| | |
|---|---|
| Can access a full range of value streams if operated by a retailer as part of a VPP, including wholesale arbitrage and FCAS, local network services and hedging. | Full value stack of the battery may not be transparent, as it depends on commercially-sensitive portfolio level revenue streams for the retailer. |
| | Less choice for households. They would lose any bill discounts/benefits upon opting out of the embedded network retailer. |

# Identifying Candidate Properties

In initial screening, site inspections by Arigo suggested 12 of the 48 existing properties were potentially suitable for a shared solar system and battery. This was based on an engineering assessment of switchboard condition, wiring configuration and available space for equipment. Further assessment of available roof space ruled out another five properties as the feasible solar capacity would be too low to justify a shared solar system with sufficient surplus generation for battery charging (typically these had <0.5 kW per apartment). Instead, these properties are likely suited for a solar system serving common area loads only. A further property was deemed unsuitable as there was a substantial distance between the MSB and a DB serving a small subset of apartments, requiring a substantial reconfiguration of the site infrastructure to ensure all apartments could access solar.

This left 7 properties as candidates for a neighbourhood battery, all via a combined shared battery and solar system using the Solshare technology.

Twenty-one new build properties were considered, which were in varying states of completion as part of the Victorian Government's Social Housing "Big Build". They were all-electric by design. Eleven of these properties were unsuitable as they were freestanding or townhouses, better suited to standalone solar systems (with independent batteries later, as appropriate). Of the remaining , one was considered for a combined shared battery and solar system using the Solshare technology, and 8 for a shared battery within the embedded network.

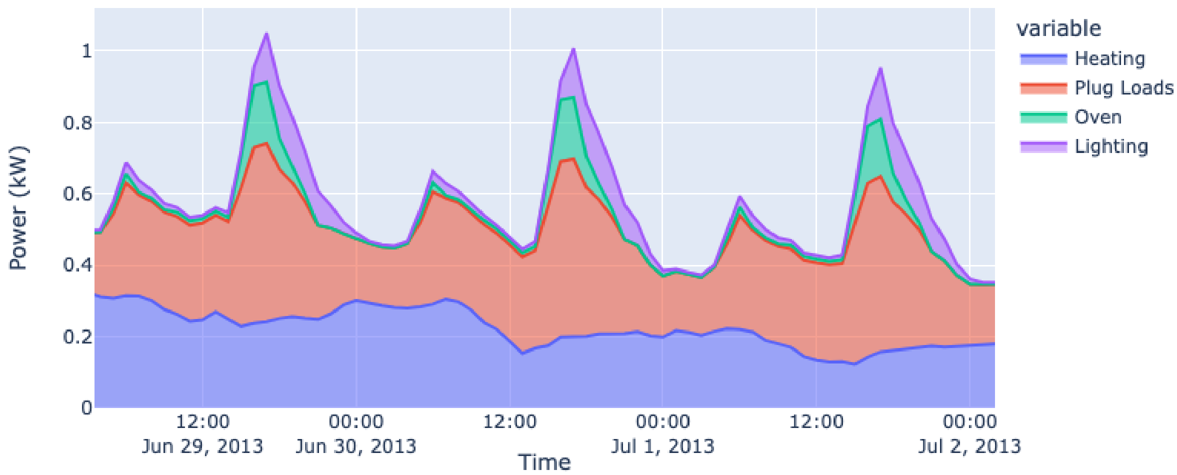
# Modelling Methodology

## Solshare

Five scenarios were considered, comparing how the addition of a shared battery can further reduce tenant energy bills from solar alone, both now, and as gas appliances are replaced.

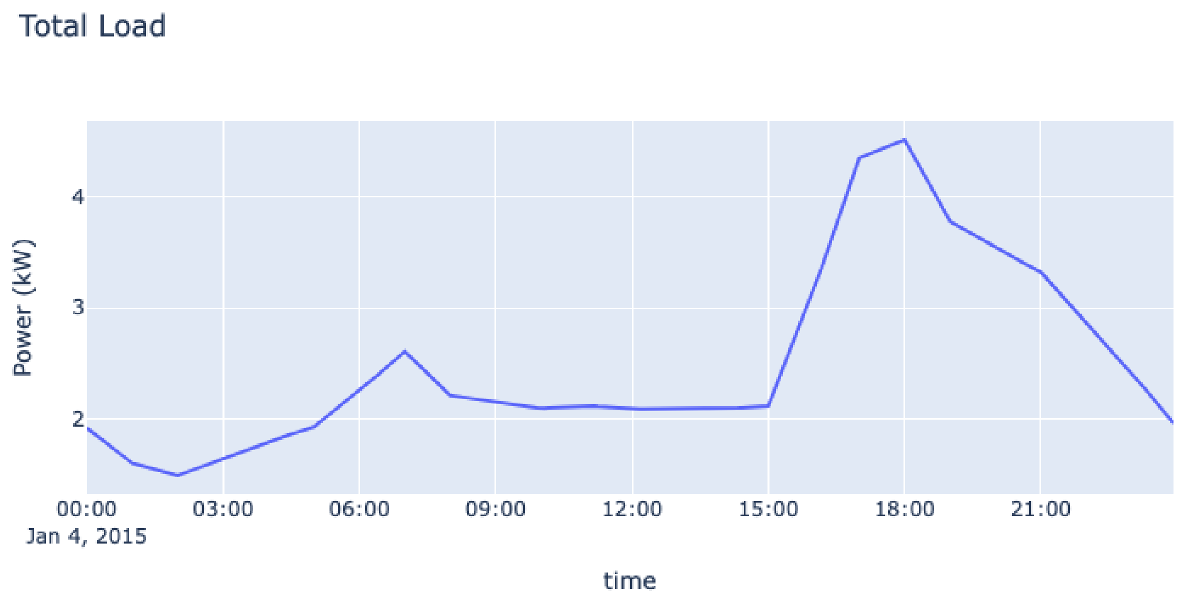
| **Scenario** | **Description** |
|---|---|
| BAU | Baseline energy demand and costs. |
| Solar | Applying Solshare with no battery. |
| Solar + 40kWh Battery | Solar, plus 40 kWh battery (per minimum requirements of 100NB program) |
| Solar + Larger Battery | As above, with a larger battery where there was room for more than 40 kW of solar (at 1kWh of battery capacity per kW of solar nameplate rating). |
| Solar + Electrification + 40kWh Battery | As per “Solar + 40kWh Battery”, but with an adjusted load-profile assuming gas appliances are replaced with electric alternatives. |
| Solar + Electrification + Larger Battery | As above, but again with a larger battery where applicable. |

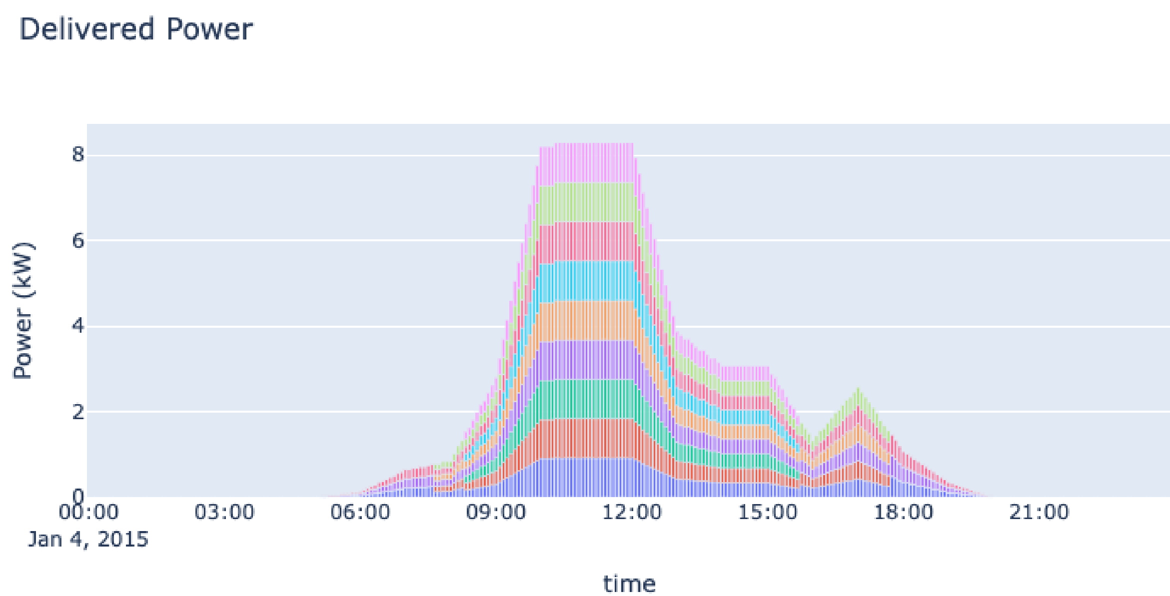
We started by developing a baseline electricity and gas demand profile, adapted from the NatHERS whole of home methodology and a thermal demand model built in EnergyPlus. The same approach, developed by BOOM! Power, is being used in the SEC Home Electrification Planner. In most cases, installed appliances could be identified from outside (e.g. storage gas water heaters) and CHO asset data, or otherwise assumed based on the age of the building and presence of a gas connection.




*Example of load profile simulation across three days for an apartment with electric heating and oven, but gas cooktop and hot water (not shown).*

Hourly load profiles were then fed into a cloud-based simulation of the Allume Solshare algorithm, along with a simulation of solar production for each site, both unsampled to five-minute time intervals. The simulation modelled how much energy was delivered to each apartment, switching to maximise overall self-consumption and ensure a fair balance of delivered energy between each apartment. The plot below shows the simulation output for a representative day. The modelled power delivery was subtracted from each load profile, and the annual bill savings calculated for each apartment and in aggregate. Details on modelling assumptions are included in the Appendix.




*Simulation output for a single day for a solar-only scenario, showing power delivered across 9 apartments. Note that when generation is sufficient, power is distributed across all apartments evenly. When generation is lower, power is shuffled between apartments, ensuring a fair distribution. In practice, switching will vary based on the second-by-second demands of each apartment. Solar demand exceeds consumption during the day, and without a battery, only limited generation is available during the evening peak.*

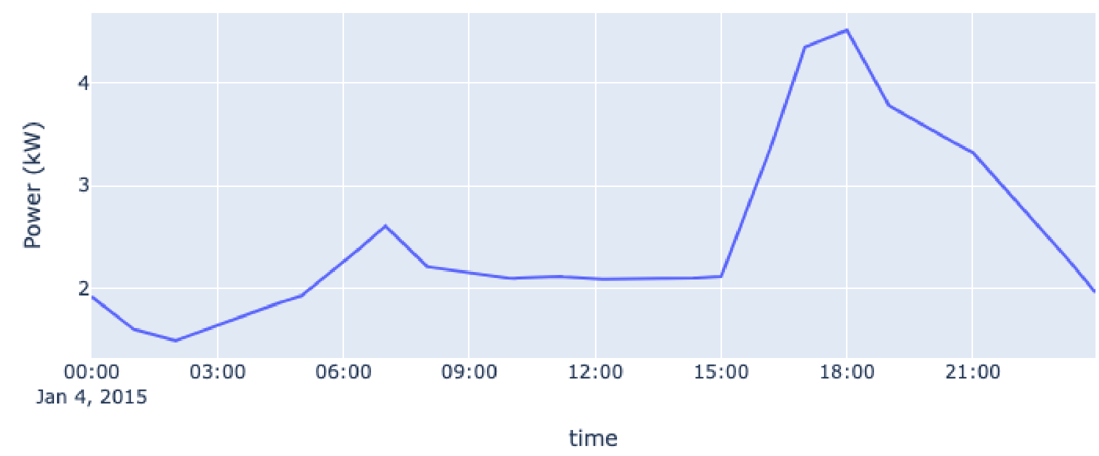
Battery scenarios were modelled by calculating overall surplus energy across the site, and using this to charge a battery DC coupled to the solar inverter, with the energy exported when solar generation ceases.

Electrification scenarios considered the future replacement of all gas appliances with electric alternatives. An exception was for sites with hot water provided by a shared plant, typically gas with a limited solar thermal contribution, which would instead be replaced with a centralised heat pump powered from the common area meter.

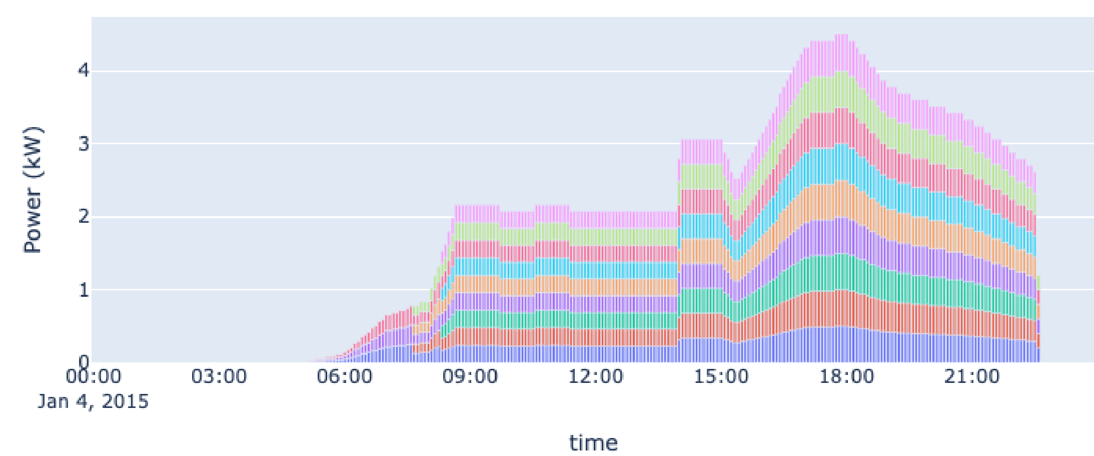
Total CapEx inclusive of both solar and battery (including STC rebates, but not any grant funding ) was estimated based on the system sizing, number of storeys, and number of Solshare devices required, using a model co-developed with Allume. For smaller sites, small differences in the number of apartments can produce large changes in CapEx, given each Solshare is limited to 15 outputs, i.e. a 16 apartment installation would cost ~$12k more than a 15 apartment one as a second Solshare would be required.

The aggregate apartment savings, CapEx and simple payback period were compared across sites and scenarios to identify the optimal configuration. Payback period here is indicative only, given there is no proposal to recover costs from tenants.

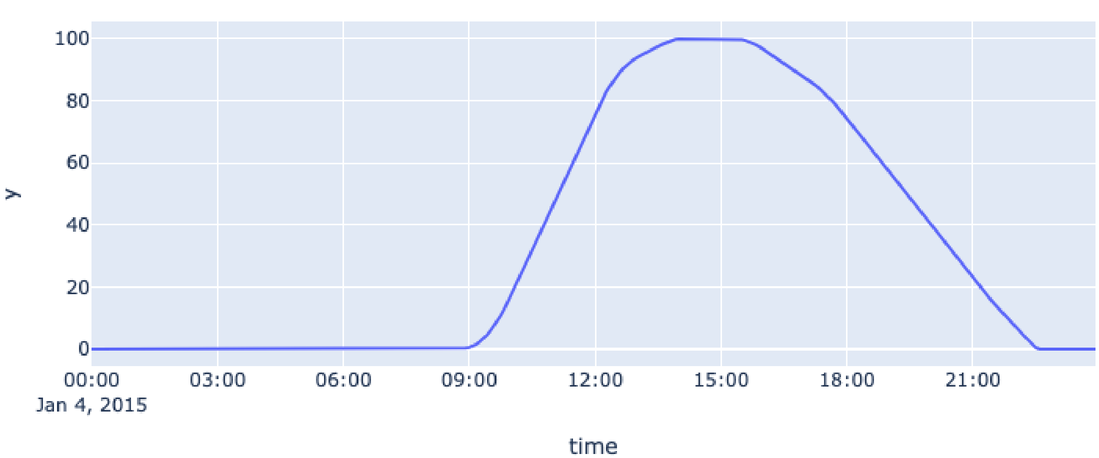
Total Load




Delivered Power




Battery State-of-Charge (%)



*Simulation output for the same day when a battery is added. The Total Load is unchanged, but the Delivered Power is now composed of the combined solar generation and battery charge/discharge. Generation that exceeds consumption is stored in the battery, reaching full charge by 2pm. The battery starts discharging later in the afternoon, largely eliminating evening peak demand.*

# Results

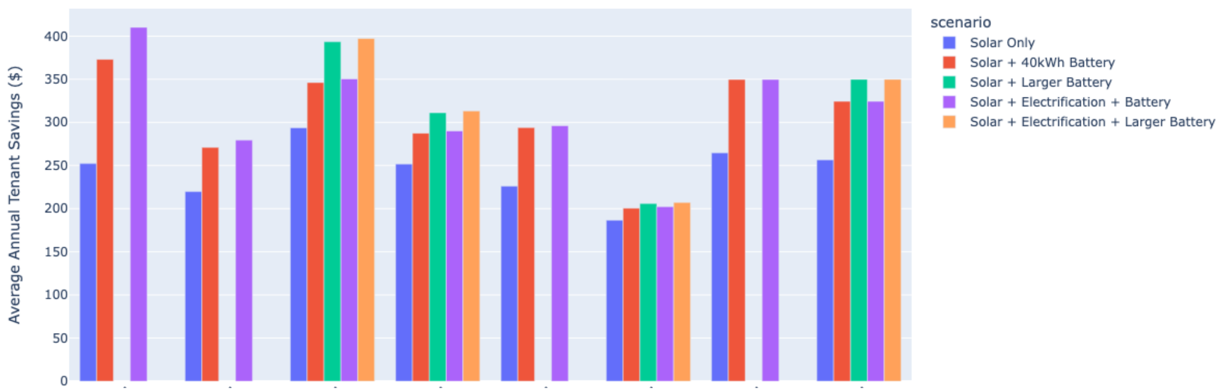
## Solshare

The tenant savings and payback period of each building, and in aggregate, are visualised in the following plots. On average, the addition of a battery to a shared solar system increased tenant savings by 25% (from $244 to $306 per year). The impact was negligible for one building, given it had a smaller amount of solar capacity available per apartment, with less surplus to charge a battery. The payback period tended to modestly increase with the addition of battery storage (1.3 years on average), however this difference could be easily overcome in the future if the difference between import and feed-in tariffs grows over time.

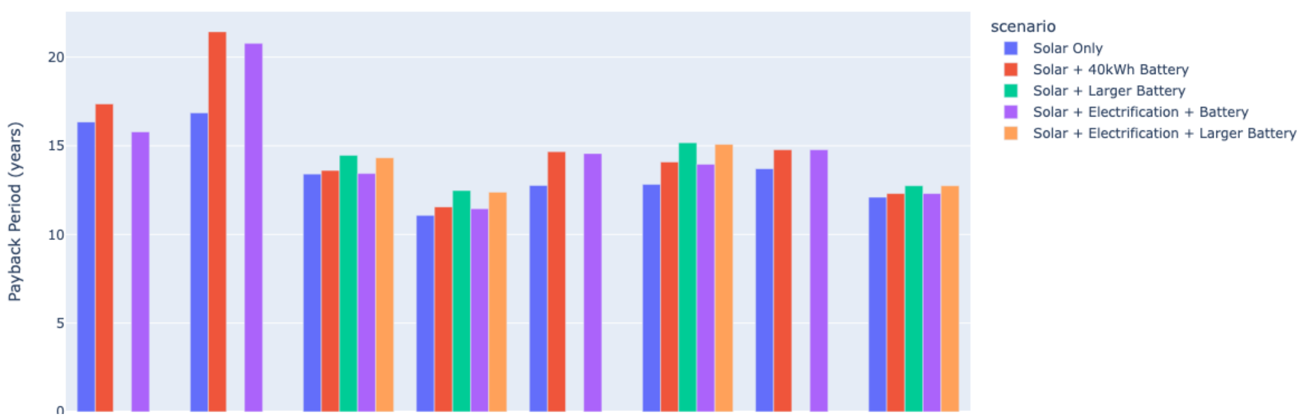
Further savings can be achieved for some sites with a battery larger than 40 kWh. Again, this modestly increases payback periods, but this is likely to be negligible once economies of scale are applied for these larger batteries.

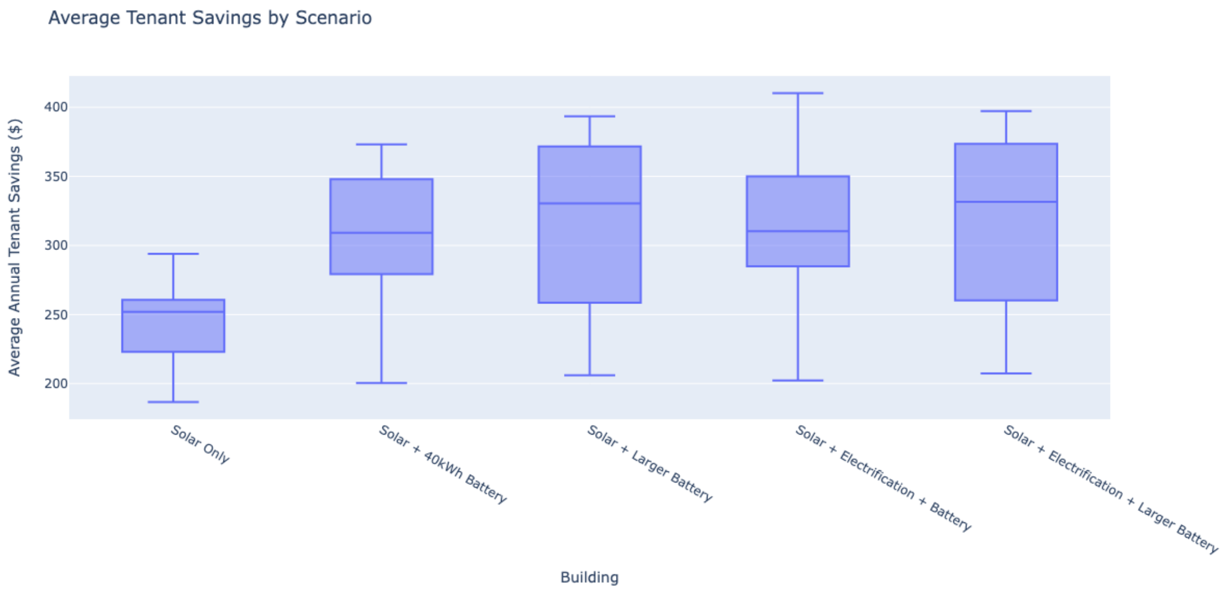
There was only a very small additional improvement in savings for properties that could be electrified. This was because no gas heating was present in the shortlisted properties, leaving only hot water and cooktop upgrades. We assumed heat pumps run on a daytime timer and so have little benefit from battery storage. Electric cooktops would benefit, but only make a small contribution to household energy demand. A broader benefit of batteries in this scenario would be the reduction in average peak demand following electrification. This is unlikely to be reflected under typical demand tariff structures, where a single billing interval per month sets the overall charge, as we can't rely on sufficient on-site solar generation to ensure the battery is adequately charged for peak shaving. That is, a peak might still occur on days of low solar production given grid charging is not possible. However, it could have material network benefits in aggregate.

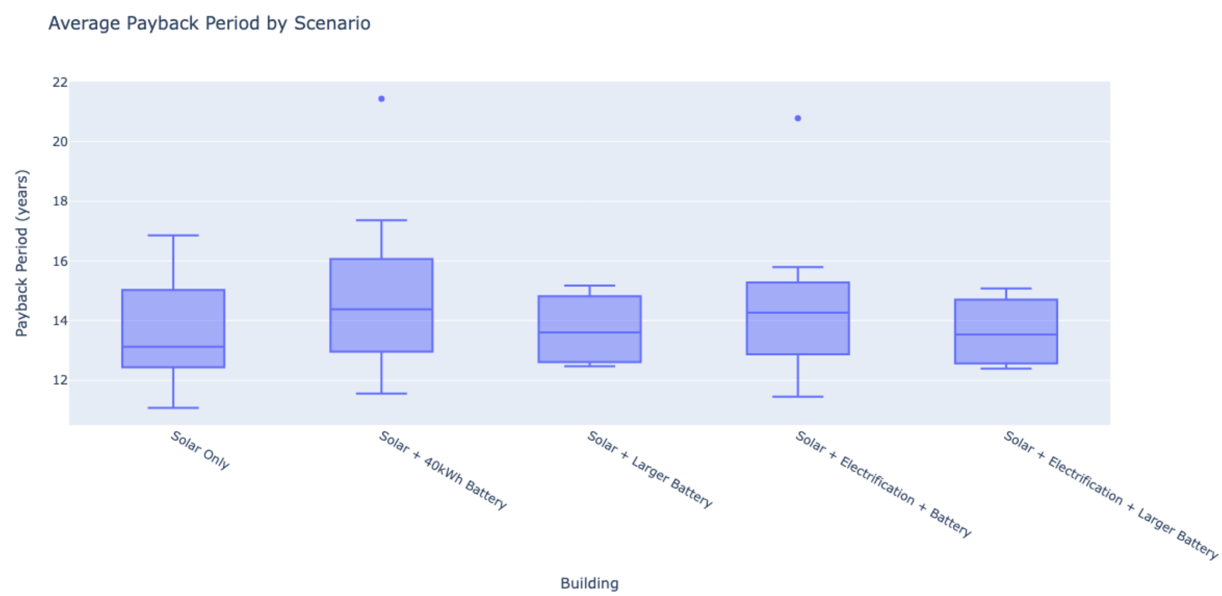
Average Tenant Savings by Scenario & Building




Payback Period by Scenario & Building

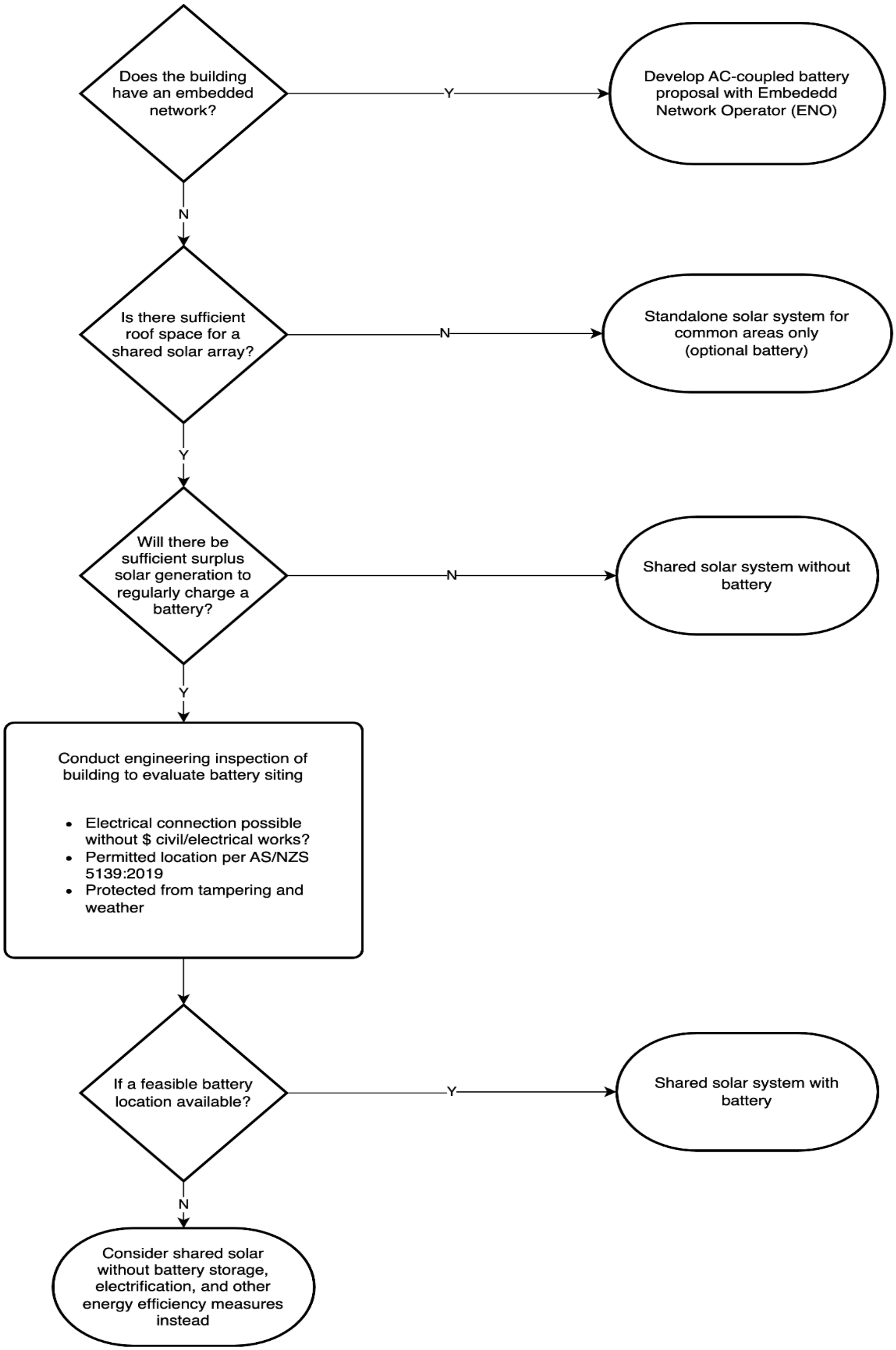





# Suggested Approach for Future Neighbourhood Battery Projects with CHOs

Based on the knowledge developed in this project, we've proposed the following high-level process to help CHOs determine which of their apartment blocks might be suitable for neighbourhood batteries. The software and algorithms developed by BOOM! Power can be applied to identify and prioritise buildings based on their load profile and solar potential.


Does the building have an embedded network?
Y
Develop AC-coupled battery proposal with Embededd Network Operator (ENO)
N
Is there sufficient roof space for a shared solar array?
N
Standalone solar system for common areas only (optional battery)
Y
Will there be sufficient surplus solar generation to regularly charge a battery?
N
Shared solar system without battery
Y
Conduct engineering inspection of building to evaluate battery siting
• Electrical connection possible without $ civil/electrical works?
• Permitted location per AS/NZS 5139:2019
• Protected from tampering and weather
If a feasible battery location available?
Y
Shared solar system with battery
N
Consider shared solar without battery storage, electrification, and other energy efficiency measures instead

## Ongoing Operations & Maintenance

It's expected that the selected products will have a manufacturer warranty of at least ten years, with minimal operations and maintenance budget required over this period. During procurement, proposals will be sought for ongoing maintenance and safety inspections, as well as live monitoring to ensure the systems are operating effectively. Subject to availability, proposals may also be sought for pre-paid extended warranty coverage for year ten onwards.

## Next Steps

In the final phase of this project, final business cases will be developed in preparation for 100NB applications, based on the model described in this report. This work is expected to include:

- Firm up expected CapEx, including more detailed assessment by Arigo of any major electrical upgrades required to facilitate the installation of neighbourhood batteries.
- Seek budgetary approval from CHOs for co-contribution amounts.
- Develop methodology for allocating CapEx to eligible activities according to 100NB guidelines (i.e. excluding any ineligible solar-only costs).
- Assess embedded network proposal from Origin for technical feasibility, tenant benefit, and compatibility with long-term energy strategy of CHOs.

# Appendix A: Modelling Assumptions

| Input | Assumptions |
|---|---|
| Rooftop solar capacity | Measured on measurements from aerial imagery, assume north facing at 10° tilt. |
| Tariffs | 28c/kWh variable rate, $1.20 daily charge, 3c/kWh feed-in tariff |
| CapEx | Model developed in collaboration with Allume, accounting for baseline solar $/W, plus allowances for additional cable runs, cranage, etc. based on number of storeys and apartments.<br><br>Battery component assumed at $1000/kWh. |
| Solar generation profile | Generated using NREL PVWatts, using NatHERS TMY weather data for the climate zone of each building. |
| Battery | DC-coupled, with charge/discharge rate limited to inverter capacity of 20 kW, and 95% round trip efficiency. |
| Load profile | Based on NatHERS whole-of-home methodology, using site inspection data on appliances (i.e. heating, cooking, hot water), and assuming 50m$^2$ per apartment.<br><br>Thermal NatHERS star ratings were assumed based on estimated building age:<br>1-2 years old: 7 star<br>2-5 years old: 6 star<br>>5 years old: 5 star |

# Appendix B: Risk Assessment

| **Description** | **Risk Level** | **Potential Controls** |
|---|---|---|
| Lack of suitable battery and solar location | Low | Site inspections and assessments by Arigo have largely mitigated this risk.<br><br>Further site inspections at the procurement and final design stage will eliminate this risk completely, with opportunity to adjust the design and selected buildings if needed. |
| Battery fire and chemical hazard | Low | Selected batteries on CEC approved product list and installed according to relevant standards including AS/NZS 5139:2019.<br>Risk assessment and updates to building emergency management plan as needed. |
| Refused or delayed connection from DNSP | Low | Complete DNSP pre-approval procedure.<br><br>Export limiting, if required, will have only a minor impact on tenant benefits for the Solshare approach.<br><br>However, it might be more severe for the embedded network approach where wholesale arbitrage and FCAS are significant opportunities. It's likely a more detailed connection agreement and feasibility assessment will be required for these sites to mitigate the risk. |
| Unexpected electrical or civil costs | Medium | Conduct more detailed engineering review of proposed sites, including the need for any major switchboard upgrades and extended wiring upgrades. |
| Lower than expected tenant savings | Medium | Shared nature of solar and battery system should provide resilience to variations in load profile (e.g. if some apartments consume more than others, or with different timing).<br><br>For larger sites with multiple batteries/solar systems, reconfiguration of solar and battery arrays may be possible to address any underused capacity. |

As a direct result of this project, final business cases were developed.

,

If the projects progress towards implementation, the next steps would include:

1. Installation of approximately 303kW of solar capacity and 263 kWh of battery capacity across four existing apartment buildings, and one new building currently planned for construction (located in Ballarat). Commissioning of all systems on existing buildings is intended to be by the end of 2025. Installation on the new building, with work fully contracted and paid, would be commissioned alongside construction. The timeline, dependent on the selected builder, is expected to be 18-24 months from the start of construction.
2. Installation of six batteries across new-build apartment blocks operated by one CHO within planned embedded networks. The overall capacity is expected to be 100-300 kWh per site.

# Appendix C: Comparison of Business Model Scenarios

The tenant savings and payback period of each building in aggregate are visualised in the following plots. On average, the addition of a battery to a shared solar system increased tenant savings by 25% (from $244 to $306 per year). The impact was negligible for one building (), given it had a smaller amount of solar capacity available per apartment, with less surplus to charge a battery. The payback period tended to modestly increase with the addition of battery storage (1.3 years on average), however this difference could be easily overcome in the future if the difference between import and feed-in tariffs grows over time.

Further savings can be achieved for some sites with a battery larger than 40 kWh . Again, this modestly increases payback periods, but this is likely to be negligible once economies of scale are applied for these larger batteries.

There was only a very small additional improvement in savings for properties that could be electrified. This was because no gas heating was present in the shortlisted properties, leaving only hot water and cooktop upgrades. We assumed heat pumps run on a daytime timer and so have little benefit from battery storage. Electric cooktops would benefit, but only make a small contribution to household energy demand.

In summary:

- The addition of battery storage increases tenant savings relative to the solar-only scenario, at a similar overall payback period. This is conditional upon sufficient excess solar capacity to charge the battery — some rooftops were too small to achieve the optimal solar capacity.
- Batteries larger than 40 kWh (the minimum for the 100NB program) created additional benefit for larger sites with more apartments, again at a similar payback period.
- The electrification scenario provided only minor additional benefits, given all buildings in this project already had electric (reverse cycle AC) heating. We'd

expect apartments with gas heating to benefit more strongly (especially in colder climates and where the thermal envelope is poor).