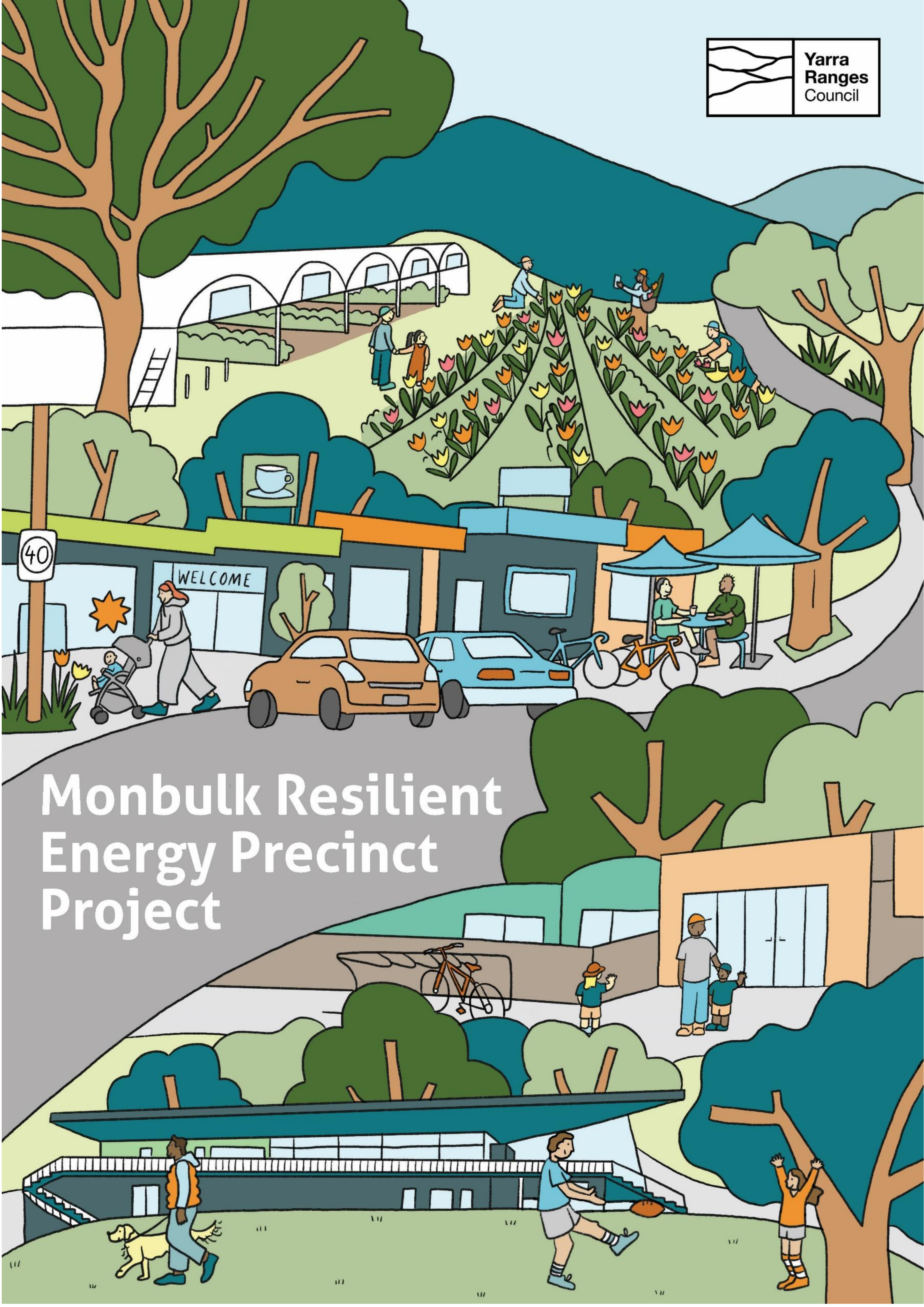
Yarra Ranges Council

Monbulk Resilient Energy Precinct Project



Acknowledgments

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Australian Government
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Yarra Ranges Council would like to acknowledge the project partners engaged to conduct the Resilient Energy Precinct Project, Monash University, n0de, and Birdwood Energy.

MONASH University

birdwood energy

nØde

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Amendment Notice

This documented was updated in July 2024 with the following edits:

- Tables 1 & 4 – Energy Resilience Performance of Local Energy System for Initial & Expanded Scenario, modelling figures corrected.
- Appendix Figure 2 – Illustration updated to include days of back-up power at Hub sites, rather than number of phones & electric vehicles charged.

Glossary of terms

Term	Definition
AEP	Active Energy Precinct
API	Application Programming Interface. It is a set of rules and protocols that allows different software applications to communicate and interact with each other.
BESS	Battery Energy Storage System. It is a system that stores electrical energy using rechargeable batteries and can release that energy when needed.
CapEx	Capital Expenditure. It refers to the funds invested in the acquisition or improvement of physical assets, such as equipment, buildings, or infrastructure, that are expected to have a long-term use and provide future benefits.
Cloud	In the context of computing, it refers to the delivery of computing services, including storage, processing power, and software applications, over the internet. Cloud computing allows users to access and utilise these resources remotely, without the need for local infrastructure or hardware.
Community Level Resilience	In the context of the Resilient Energy Precincts, Community level resilience refers to the energy capacity available to a community or local area to prepare for, respond to, and recover from disruptive events, such as storms or bush fires where electrical distribution or transmission networks are disrupted.
Curtailment	In the energy sector, it refers to the deliberate reduction or limitation of energy generation such as solar PV systems.
DER	Distributed Energy Resources. It refers to decentralised power generation and storage systems located near the point of consumption (normally behind the meter). DER includes technologies such as solar panels, wind turbines, energy storage systems, and small-scale generators.
DNSP	Distribution Network Service Provider. It is an entity responsible for operating and maintaining the electricity distribution network, which delivers power from transmission lines to end-users, including homes, businesses, and institutions.
Edge Device	In the context of the Internet of Things (IoT), it refers to a device located at the edge of a network, closer to where data is generated or collected. Edge devices often have processing capabilities and can perform data analytics and decision-making tasks locally, reducing the need for transmitting data to centralised servers.
Embedded Network	Is a privately owned and operated electricity distribution network within a building or complex, such as an apartment building or commercial complex. The embedded network allows for the independent supply and management of electricity to the connected premises.
FCAS	Frequency Control Ancillary Services. FCAS refers to a set of services provided by power system operators to maintain the frequency stability of the electricity grid. These services help ensure that the supply and demand of electricity are balanced and that the grid operates within a specified frequency range.
Grid/Network	Refers to the interconnected system of power generation, transmission, and distribution infrastructure that enables the supply of electricity from power plants to end-users. The grid/network encompasses power lines, substations, transformers, and other components that facilitate the flow of electricity.
Hub	In the context of Resilient Energy Precincts, it refers to a central location with facilities that are co-located or neighbouring and connected to the same distribution transformer on the network to enable islanding capability and will have energy (renewable) generation and storage deployment capability.

IRR	Internal Rate of Return. It is a financial metric used to evaluate the profitability of an investment. IRR calculates the annualised rate of return at which the net present value of cash flows from an investment equals zero.
Irradiance	In the context of solar energy, it is the amount of solar radiation incident on a surface (panel) per unit area.
LGC	Large-scale Generation Certificate. It is a tradeable certificate in the Australian Renewable Energy Target (RET) scheme. LGCs are issued to renewable energy generators based on the amount of eligible renewable energy they produce, providing proof of compliance with renewable energy obligations.
Local energy system (LES)	Is a system that generates and stores renewable electricity across a local area ('local Supply') and supplies and sells renewable electricity to individuals, businesses, and community services ('participants'). It integrates and optimises local supply with electricity from the grid ('network supply') and provides dynamic control of load, generation, and storage to benefit the community and individual participants ('market services').
Market services	In the energy sector, market services are the range of activities and functions that facilitate the buying, selling, and trading of energy or energy products such as FCAS and Demand Management.
Microgrid	A Microgrid is a system that efficiently controls and integrates the electricity supply and demand on behalf of locally interconnected users, either connected to the grid or as a stand-alone system.
NEM	National Electricity Market. It refers to the wholesale electricity market operating in the eastern and southern states of Australia. The NEM facilitates the buying and selling of electricity between generators and retailers, ensuring a reliable and competitive electricity supply across the participating regions.
Network Data	It refers to the information and data collected from electricity networks, including parameters such as voltage, current, power flow, and system performance. Network data is essential for monitoring and managing the power grid, optimising operations, and planning future infrastructure upgrades or conducting feasibility studies.
O&M	Operations and Maintenance. It encompasses the activities involved in the day-to-day operations, upkeep, and management of infrastructure, equipment, and systems. In the energy sector, O&M activities can include routine maintenance, repairs, asset management, and performance monitoring of power generation and distribution facilities.
OpEx	Operating Expenditure. It refers to the ongoing costs incurred in the regular operation and maintenance of a business or project. OpEx includes expenses such as salaries, utilities, maintenance, supplies, and other operational costs necessary to keep an operation running.
Participant	In the context of the Resilient Energy Precinct project and energy systems, a participant refers to an entity or organisation that actively engages in the system either as a buyer or seller of energy.
PV	Photovoltaic. It refers to the technology that converts sunlight directly into electricity using solar panels or solar cells. PV systems are commonly used for solar power generation and are a key component of renewable energy installations.
REP	Resilient Energy Precinct
Spoke	Refers to participants in the system that are outside the hub and can be residential, commercial, or industrial in nature. The participants are located within the same Precinct and owned, occupied, or operated by a participant in

	the Local Energy System. They can also be a source of renewable local electricity generation, storage, and demand response (energy services).
Tariffs	Refer to the pricing structures and rates set by energy suppliers and retailers for the supply of electricity to residential, commercial, and industrial consumers.
VPP	A Virtual Power Plant is a network of decentralised energy resources that are aggregated and coordinated to function as a unified power plant. It combines various distributed energy resources (DERs) such as solar panels, wind turbines, energy storage systems, and demand response programs, among others.

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Executive summary

The Yarra Ranges have been significantly impacted by extreme weather events in recent years, with subsequent widespread power outages. Yarra Ranges Council (YRC) has acknowledged the increased frequency and severity of these events, working to support community through initiatives guided by their Liveable Climate Plan 2020-2030.

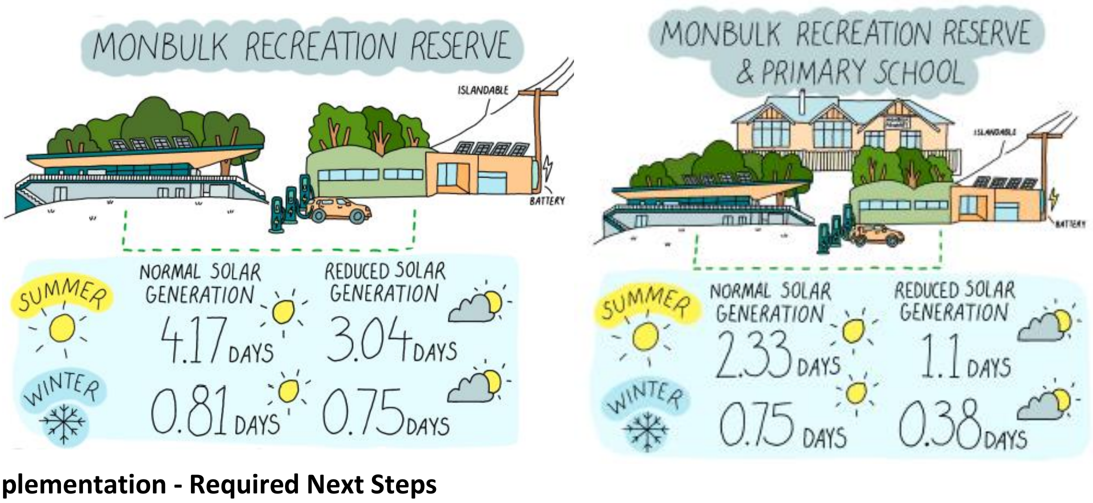
Partnering with Monash University, n0de, and Birdwood Energy, YRC has conducted the Resilient Energy Precincts (REP) project, focusing on Monbulk. The REP project is a feasibility study into how microgrids, or Local Energy Systems (LES), can deliver on local energy priorities of resilience, reducing costs, and minimising emissions. This project extends upon similar work conducted as part of the ‘Active Energy Precincts’ (AEP) Project, assessing the feasibility of LES for other towns including Healesville and Yarra Junction.

The LES design considered for Monbulk reflects upon the findings from other townships in the AEP project. A key finding in the AEP project was the significant level of effort required to bridge the gap between feasibility and investment readiness. The effort and coordination required to become investment ready, including addressing complex regulatory barriers, meant significant timescales before any implementation would allow benefits to be realised by the community. With that in mind, REP has extended the approach designed in AEP to one that is modular, potentially facilitating multiple implementation and funding pathways.

The community engagement process reinforced the value of place-based community resilience. The strong preference for community level resilience provided support for selecting the Monbulk Living and Learning Centre, the Monbulk Sporting Pavilion, and the Monbulk Primary School as ‘Hub’ sites in the REP modelling.

Resilience Module

The below graphic illustrations provide a high-level summary of the resilience duration that could be provided at the Initial Hub (Monbulk Sporting Pavilion and Monbulk Living & Learning Centre) and the Expanded Hub (Initial + Monbulk Primary School). These outcomes are modelled with reduced solar generation expected during extreme weather events.



Implementation - Required Next Steps

The modelling further reinforced the significant impact network tariffs have on the commercial value of Local Energy Systems identified in AEP. The ability to value resilience by the Distribution and Network Service Provider (DNSP) will have significant impact on the ability to fund systems and return benefits to communities. In lieu of this, in the current market, external funding such as grant funding is key to enabling communities progressing to investment readiness.

As identified in AEP, an opportunity exists in Victoria with a licence waiver available through the Essential Services Commission to trial projects that address some of the complexity identified. This option, whilst still providing significant challenges, is a pathway for realising a full LES implementation.

1. Project Methodology

1.1 Project overview

The Resilient Energy Precinct (REP) Project is funded by the Australian Government's Preparing Australian Communities Fund. The intended outcomes of this fund are to support communities to undertake disaster risk reduction and resilience initiatives that provide public benefit through reducing –

- The impact of future natural hazards on Australian communities, and
- The burden (cost and time) of recovery in communities following future disasters.

A project team comprising of representatives from Yarra Ranges Council, Monash University, n0de, and Birdwood Energy, was formed to conduct the feasibility study.

Yarra Ranges Council

The Yarra Ranges is home to over 150,000 people and covers approximately 2,500km^2. The municipality stretches from the densely populated outer suburbs of Melbourne, into the foothills, agricultural valleys, and forested areas of the Great Dividing Ranges, incorporating the Yarra Valley and Dandenong Ranges.

The region is at the forefront of 'resilience events', being significantly impacted by extreme weather events in recent years. Yarra Ranges Council endorsed their Liveable Climate Plan and associated actions in 2020, taking significant steps in addressing climate change and assisting local communities in their energy transition.

Monash University

Monash was the first Australian University to make the pledge to reach Net Zero carbon emissions by 2030, demonstrating strong leadership in climate action and paving the way for other universities and cities to achieve their Net Zero targets. In 2018, the University won the United Nations Momentum for Change Award in recognition of its sustainability efforts. With deep understanding in both implementation and research of Microgrids, with their own implementation at their Clayton Campus and the lead Victorian research institution in the Cooperative Research Centre (CRC) for Reliable Affordable Clean Energy (RACE) for 2030. The CRC is addresses one of Australia's major challenges – delivering reliable, affordable, and clean energy services for consumers and businesses.

n0de

n0de enables organisations to act on a credible path to Net Zero. A spinout company backed by Monash University, n0de's team of Net Zero experts are developing a software platform focused on turning an organisation's Net Zero ambition into action.

Birdwood Energy

At its core, Birdwood Energy is driven by an unwavering commitment to combating climate change through strategic investments in distributed energy and strategic assets. The organisation's philosophy is rooted in the belief that unlocking investment in these areas is crucial for immediate impact on climate mitigation efforts. Birdwood Energy's approach is holistic, targeting not just the financial aspects but also the technical and operational facets necessary for project success.

1.2 Project Objectives

The REP project objective is to refine the technical, financial, and commercial feasibility of a Localised Energy System (LES) in Monbulk, Victoria. This includes identifying options for local renewable energy generation and storage that supports the community during periods of grid outage. Building upon the AEP project, the REP objectives also aimed to extend on the following areas:

- Local capacity
  - To realise the potential community benefits of a LES, local capacity must be resourced to support overall engagement and project management. This was identified in AEP, resourcing Stakeholder Engagement Officers within each Local Government Area. This was expanded upon in REP, with an Energy Resilient Communities Officer funded via the project to contribute to overall project management and advocacy. This local capacity is now built into the Climate Action Team, with energy resilience and community collaborations a heightened priority.
- Energy literacy
  - As understood through AEP, the complexity of content matter coupled with accessibility to relatable material for the community is a key issue when communicating the energy concepts in this project. This understanding was utilised to frame community communications, engagement in workshops and critical artefacts that the community would be able to access beyond the project duration of REP.
- Pathways for community (groups) to access local energy system benefits
  - The longitudinal nature of implementing Local Energy Systems create a significant challenge for communities to overcome. The most significant impact relating to the time to realise benefits that a system could provide. It is with this in mind that the modular approach detailed in this feasibility study is proposed for consideration.

1.3 Design of the Local Energy System

As outlined above, the REP project is refining the model and approach carried out to assess the feasibility of a LES in other local townships in the AEP project. The REP project has utilised the same definitions of systems and terms to ensure consistency. As in AEP, the REP project utilises the concept of a '**Local Energy System'** to address community driven energy priorities across a local Precinct (Figure 1).

A **Precinct** is a geographic area that:

- Provides a range of critical services to local communities.
- Includes shared community facilities.
- Is capable of supporting communities during events that result in prolonged power outages ('**resilience events**')

A **Local Energy System** is a system for:

- generating and storing renewable electricity across a local area ('**local supply'**)
- supplying and selling renewable electricity to individuals, businesses, and community services ('**participants**')
- integrating and optimising local supply with electricity from the grid ('**network supply'**)
- providing dynamic control of load, generation, and storage to benefit the community and individual participants ('**market services'**).

These **Local Energy Systems** have two components, 'Hubs' and 'Spokes'. A **Hub** is defined as a collection of buildings or sites that are:

- geographically co-located;
- capable of islanding from the main grid during a resilience event (i.e. so that power can continue to be provided in an event when the broader grid is down); and
- will have solar and storage deployed capable of providing backup power during resilience events.

Spokes are defined as:

- individual sites, either commercial or residential;
- located within the same Precinct;
- owned, occupied, or operated by a participant in the Local Energy System; and
- a source of renewable local electricity generation, storage, and demand response ('**energy services'**)

Energy services include the supply of excess solar generation across the Precinct, shared use of storage, and/or provision of demand flexibility (controlling when energy is consumed). Spokes have no resilience service, that is individual resilience, outside of being able to use the community level resilience delivered at the Hub site. The services delivered to Spoke participants are aimed at increasing renewable consumption within the Precinct and reducing total system cost for participants.

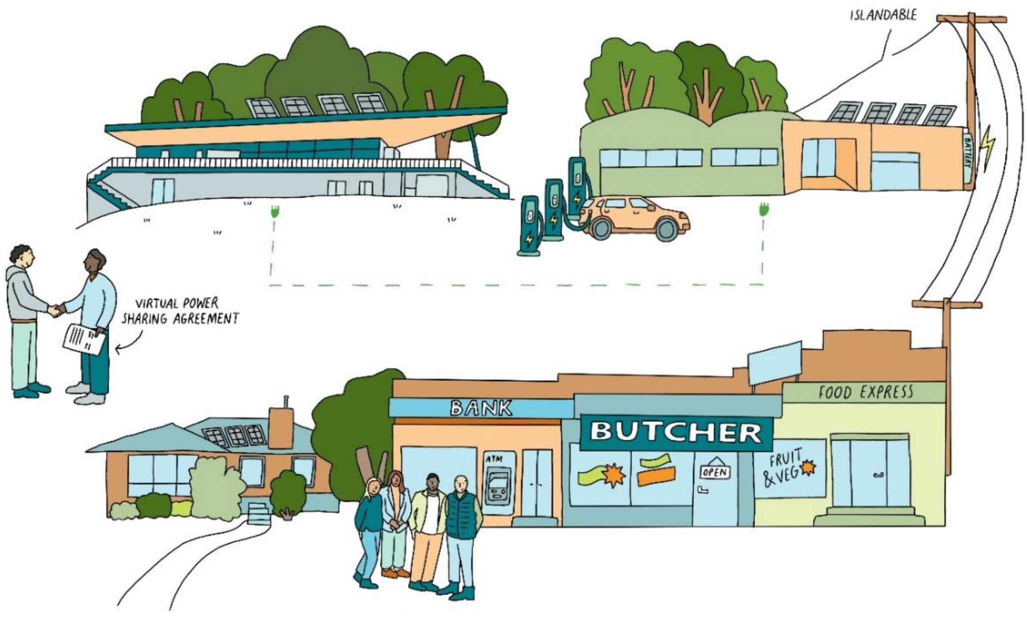


Figure 1. Components of a Local Energy System, including Hubs (e.g. pictured community facilities) and Spokes (e.g. pictured residential and commercial buildings).

Front of the Meter Assets are assets that can be located within or outside of the Precinct and provide renewable generation or storage to Local Energy System Participants that can't be sourced from within the Hub or Spokes. For example, Front of the Meter Assets could include a stand-alone solar farm. In the REP there are no identified Front of Meter Assets included in the analysis undertaken. However, the model does allow for the inclusion of any front of the meter assets that may become available in the future.

1.4 Modularising Local Energy Systems

The AEP project defined a number of configuration options that provided the REP project a clear baseline from which to build from. Leveraging this understanding, the REP project sought to understand how these configuration options could be modularised or produced in sequential steps. This approach has the potential to better meet community needs and enable more efficient paths for implementation.

This modular approach is based around the energy driver prioritised by the local community or Precinct. This approach allows for a potentially more efficient approach to implementing a LES whilst enabling communities to realise the benefits in much faster timeframes. The approach also facilitates the deeper community engagement that is necessary to progress the more complex components of the process.

As outlined above and in AEP, the three drivers being considered in the design of LES are resilience, emissions, and cost. A LES module can be associated with each driver, which when stacked provide greater benefits to the overall system. For the purpose of the REP project, these modules have been summarised under 'Resilience', 'Renewable Energy', and 'Local Energy System' Modules. This section will describe the modules, their interoperability and impacts to implementation and community engagement.

The Resilience Module

The resilience module is, as its name suggests, associated where Resilience has been identified as the priority driver for a community. A hub forms the basis for enabling a resilience site within a community (Figure 2). When resilience has been identified as the priority driver for a community the identification of potential hub sites should drive community engagement and any preliminary analysis. For example, critical inclusions in initial engagement for this module should include:

- Emergency Management/Response groups including Council teams, State Emergency Services, Emergency Services groups or similar.
- Local Community Groups that own or run community assets e.g. sports grounds.
- Local Energy Groups
- Distribution Network Service Providers (DNSP)

From an implementation perspective, the complexities are specific to the co-located sites that have been identified as potential hub locations. Whilst DNSP engagement is part of any new or upgrade to electrical infrastructure, where co-located sites are across more than one property title, a number of additional considerations would need to be considered.

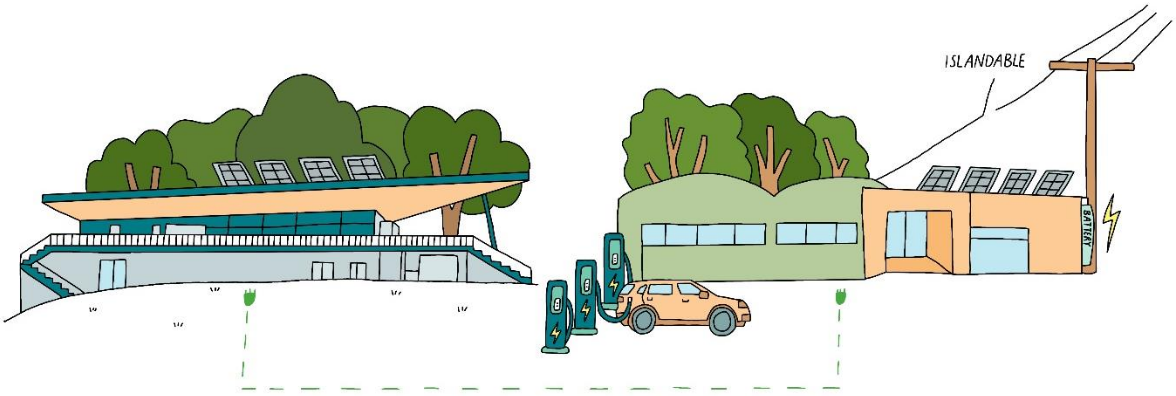


Figure 2. Illustrative example of 'Resilience Module', with key community buildings physically connected together and islandable from main grid.

The DNSP requirements will need to be allowed for in the design of the LES, including the capital costs associated with network upgrades to facilitate islanded operations (where a resilience module is across multiple property boundaries). These requirements will include switching and protection from an electrical network perspective. The details of the infrastructure considerations can be found in *Section 2c. Hub Resilience Mode Infrastructure Requirements (pg. 20) of the AEP Feasibility Report*. To identify the specific hardware and associated protection requirements, an engineering study including protection and load flow analysis needs to be carried out by DNSP engineers. This body of work will need to be conducted through the DNSP grid connection process.

There are regulatory considerations such as generation and distribution of electricity that will need to be addressed in the detailed design phase of implementing a resilience module. These considerations are significantly less where a resilience module does not cross property boundaries. The various regulatory considerations and potential waivers that are associated are detailed in the *Section 2d. Regulation and Licensing (pg. 22) of the AEP Feasibility Report.*

These lessons were considered when assessing potential hub sites for Monbulk. With the understanding of the technical and regulatory implications outlined above, a decision was made by Yarra Ranges Council to consolidate NMIs on adjacent hub sites to facilitate greater efficiencies in infrastructure and minimise barriers to realising hub benefits. The following provides an overview of steps to be taken at the Monbulk Hub which consists of multiple land parcels (across one title) with multiple NMIs supplying their corresponding site:

- Reviewing existing site arrangements and drawings where available
- Confirming property title information
- DNSP engagement to:
    - Understand the feasibility to consolidate NMIs.
    - Understand network arrangements and ability of supplying substation(s) to accommodate future DER infrastructure.
    - Obtain pre-approval for NMI consolidation works.
- Contractors engaged to conduct this process and would be similar for other sites include:
    - Design activities with appropriately authorised electrical contractor such electrical engineering services.
    - Land surveyors to address title requirements.
    - Solar & battery specialists to facilitate design requirements.

- Software vendors to understand energy management options.

The Renewable Module

This module enables participants from within the community/precinct to access:

- renewable energy that is generated locally
- potentially more attractive rates for their excess generation

This module enables participation from spokes within the community or precinct through contractual means leveraging a virtual power plant (VPP) arrangement (Figure 3). This approach ensures that there are no physical or network related constraints to members of the community that are interested in participating. This module incorporates some of the capabilities of an energy retailer and an approach to licensing requirements will need to be considered such as through an exemption or energy retail partner.

This module, if not already considered through the implementation of the Resilience Module, incorporates the generation of electricity for supply for sale to participants. This brings about the need to address distribution and retail license requirements, potential waivers that may be applicable or a strategy of implementation that involves delivery partners such as an energy retailer. The energy landscape is continuing to evolve, and retailers are offering VPP mechanisms that could facilitate a renewable energy module partnership that previously, during the AEP project, was not a readily available option. Whilst partnership options greatly reduce the regulatory burdens, and the associated risk, that must be met to operate there also can reduce the economic value that could be realised by participants. This trade-off is a consideration that should be considered as part of the strategic approach to implementing a LES and will impact the roles and responsibilities outlined in Section 3 – Feasibility Results.

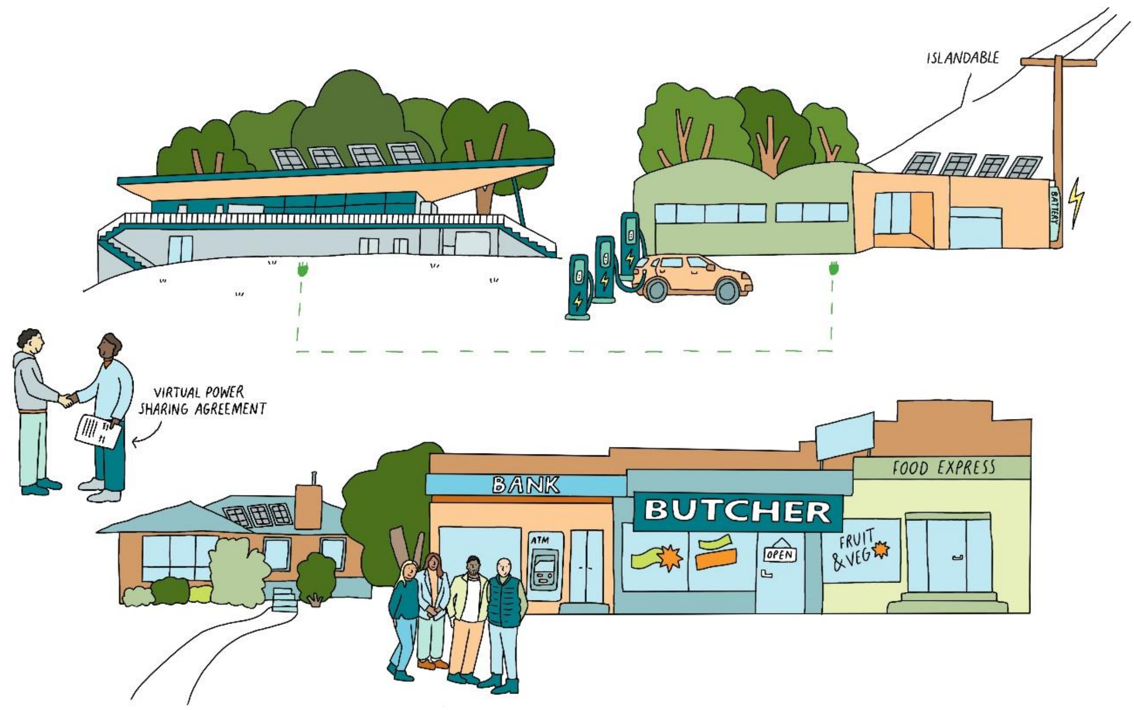


Figure 3. Illustrative example of 'Renewable Module, expanding to offer virtual power sharing agreements with the broader community.

The Local Energy System (LES) Module

This module extends the combination of Resilience and Renewable modules by incorporating both virtual and physical interactions between Hub(s), Spokes, and the energy market (Figure 4). This full stack of REP modules takes advantage of the capabilities of a LES to leverage local assets to maximise financial return, drive down costs, and increase use of local renewables. Ideally, this enables participants to realise value across all drivers. Where not already addressed in the implementation of the resilience and renewable modules, the LES module would need to address the full range of regulatory and licensing considerations outlined by the AEP project. There is the potential for significant synergies, achievable by incorporating these requirements early into the strategic approach of how a LES is implemented i.e. addressing some of these requirements through one process could facilitate considerable cost and time savings, however conversely there is a significant level of upfront engagement and decision making to achieve this.

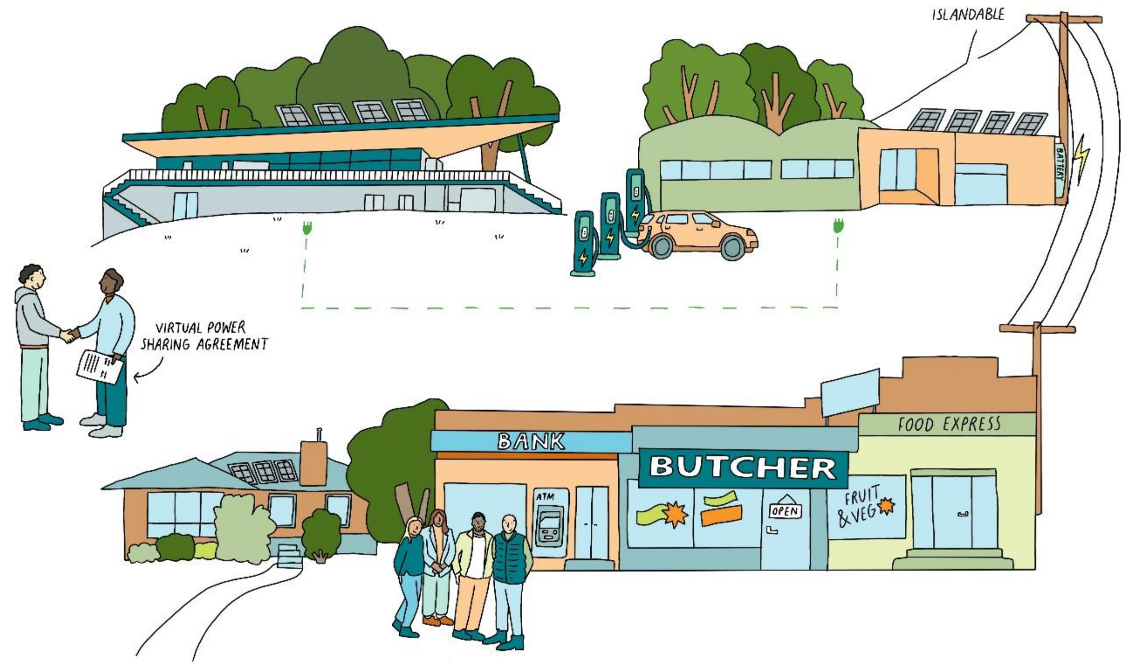


Figure 4. Illustrative example of 'Local Energy System Module', incorporating the full stack of LES modules to offer physical and virtual power sharing opportunities.

1.5 Modelling Approach

The Modelling Approach follows the methodology from the AEP project, involving four major steps as detailed in Figure 5.

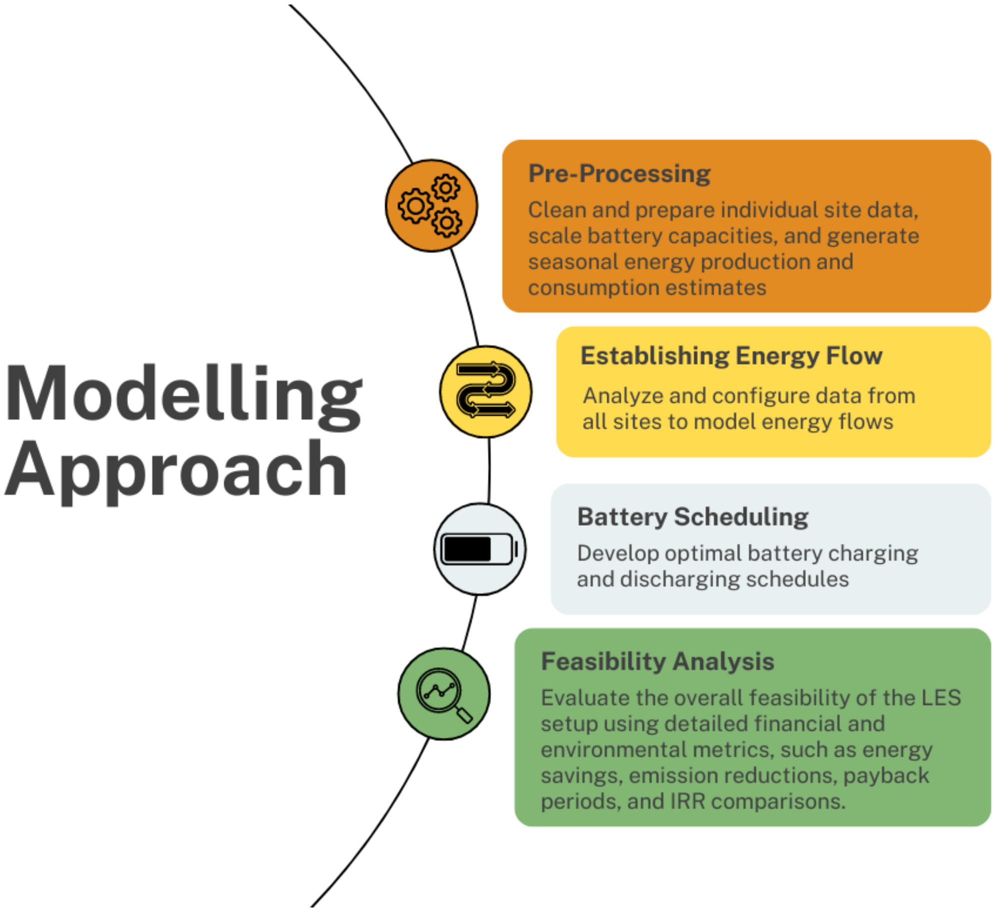


Figure 5. Four major steps of the modelling approach undertaken as part of the Resilient Energy Precinct project.

Pre-Processing Individual Site Data

The initial step involves the preparation of site-specific data to ensure its readiness for integration into the LES modelling. This process includes cleaning the data, reformulating grid imports and exports, generating seasonal estimates to inform additional PV requirements, and appropriately scaling battery capacities. This approach ensures that each site's unique energy profile is accurately captured and prepared for subsequent stages of analysis, laying a solid foundation for the feasibility assessment.

Energy Flow Analysis

Following individual site data preparation, the processed data is aggregated and analysed under two conditioned: standalone setup (No LES) and one with LES. This allows for the assessment of solar generation sharing potential and the new energy imports and exports from the grid. This step evaluates how energy distribution and sharing within the LES can enhance the overall efficiency and resilience of the system compared to the isolated operations of the sites.

Battery Scheduling Optimisation

Battery operation scheduling forms a core part of our methodology, where we aim to maximize financial returns and system resilience. By analysing tariff variations, battery capacity, and solar generation, we devise schedules that optimize battery charging and discharging cycles. This not only ensures that the battery supports the grid during peak times but also leverages excess solar generation for additional benefits, underpinning the system's economic and operational feasibility.

Comprehensive Feasibility Analysis

Our feasibility model synthesizes the data and insights gathered from the previous stages to offer a holistic view of the LES's performance. This comprehensive analysis encompasses total energy charges, system savings, emission reductions, and financial metrics such as payback periods and IRR. By comparing baseline operations to the proposed LES setup, we highlight the economic and environmental benefits, thus providing a robust foundation for decision-making regarding LES implementation.

1.6 Sensitivity Analysis

To build a robust and sustainable LES it is important to assess how variability in specific variables influence the system's performance and its viability. Sensitivity helps identify the drivers of the system behaviour and allows stakeholders to make informed decisions. These parameters include the uptake of spokes (participants in the LES), solar generation during resilience events, and network tariff rates.

Spoke Uptake

This segment of the analysis looks at how varying levels of spokes uptake impacts the flow of energy within the LES. The uptake of spokes can vary through community engagement and stronger uptake from residential loads. Increasing the uptake of spokes within the LES enhances the internal circulation of energy, thereby improving the system's financial viability. Notably, while the uptake of spokes boosts the energy exchange within the LES, its direct impact on resilience capacities remains neutral, as spokes do not play any role in the resilience.

Generation Sensitivity

Resilience events often coincide with environmental conditions that reduce solar irradiance, such as bushfire haze, increased cloud cover, and higher rainfall probabilities. Addressing these challenges, a scenario with irradiance reduced by 50% has been analysed to understand its impact on the Local Energy System's (LES) resilience capabilities during emergencies. The dates of the modelling period for Summer & Winter have been selected as the 25th of January and 25th of July respectively, anticipating higher likelihood of extreme weather and network constraints. The generation sensitivity provides a clearer picture of the LES's resilience under different solar generation scenarios, which allows us to make informed decision on the solar PV sizing.

Network Tariff Sensitivity

Network tariff sensitivity analysis highlights the financial implications for both the LES provider and users, driven by alterations in the LES's tariff structure. It's essential for optimizing the economic aspects of the LES, ensuring its sustainability and appealing value proposition to all stakeholders involved.

2. Outcomes of the feasibility

2.1. Community Engagement

The project's community led LES design meant that community and stakeholder engagement was a critical component. Various methods were utilised to reach different parts of the Monbulk community, as described below. Guidance from the International Association for Public Participation (IAP2) Public Participation Spectrum was considered in designing the community engagement plan.

This assisted with the selection of engagement methods that reflected the goals, timeframes, resources, and levels of concern in the decision-making process.

The collaboration from community groups was vital to this process, assisting the project in identifying key stakeholders and areas of concern that needed to be incorporated into the feasibility study. Specific support was provided by The Monbulk and District Community Working Group (MADCOW), elevating the profile of the project and advertising opportunities for local community members to have their say in various stages of the research.

Survey

A public survey was produced by the project team and shared via print and social media with the local Monbulk community. This survey aimed to develop a baseline indication into the energy priorities of local residents and businesses, with questions themed around energy resilience, energy cost, and renewable energy uptake. Survey respondents were also asked to participate in the feasibility study by providing their National Metre Identification number to allow the project team to model local residential energy usage. 46 responses were received from local residents and businesses, providing insight into local energy priories and interest for a community energy solution (Figure 6).

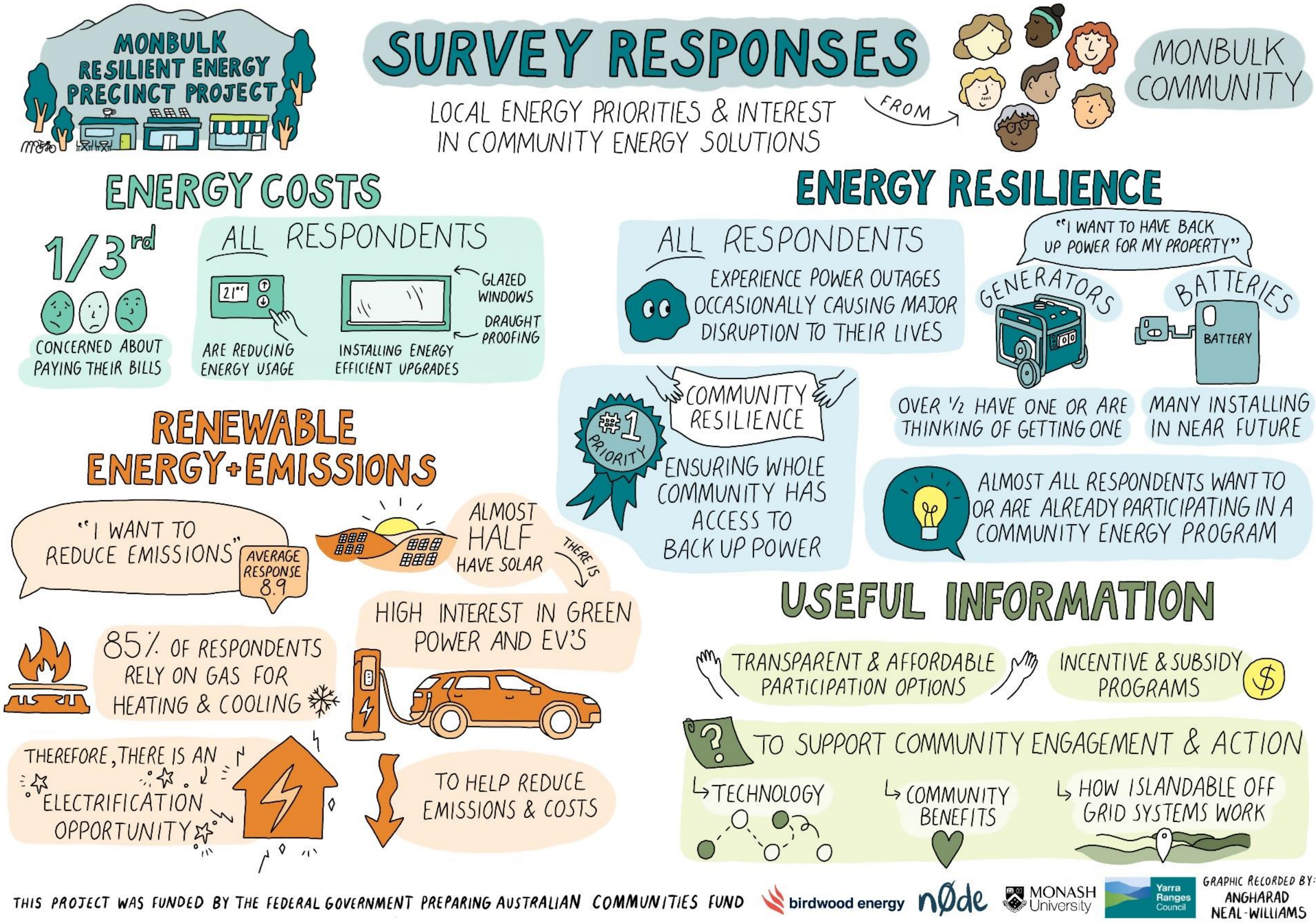


Figure 6. Summary of responses to local survey in Monbulk, May 2023, focused on energy priorities and interest in community energy solutions.

Community Workshop – May 2023

The first community workshop was held in May 2023, promoted to via newsletters, social media, event listings on webpages, and word-of-mouth via community groups. The aims of the first workshop were to provide an overview of the REP project objectives, providing lessons from other townships via the AEP project, and starting a collaborative discussion around local energy priorities.

The event was co-hosted by members from Yarra Ranges Council's Emergency Management and Climate Action teams, combined with an information session on the Monbulk Bushfire Management Plan. This increased the diversity of audience attendees and resulted in collaborative discussions between community stakeholders who focus on various aspects of community resilience and development. 17 community members attended, with a third of attendees identifying as representing a local business or community group.

Utilising an online polling system, workshop questions were themed around local energy priorities. Attendees shared their pre-defined understanding of a 'microgrid' or LES, with the top three responses including a LES having a community battery, supporting a resilient community, and facilitating the sharing of power with others. Initial assumptions around energy prices were tested, with attendees asked how cost would impact their interest in participating in a Local Energy System. 73% of attendees indicated that the cost needed to be similar to what they currently pay, with the remainder indicating that it could be more expensive if there were other benefits to participants.

With energy resilience being identified as a priority driver for attendees, the project team sought guidance on what key community buildings should be considered for the hub analysis. Feedback provided indicated that the following were key to building community resilience in the face of extreme weather and associated power outages –

- Community facilities, either owned by council or other entities, that were already utilised for events or could be adapted to support relief services.
    - Sporting Clubs
    - Libraries
    - Halls & Churches, such as the local RSL
    - Primary & Secondary Schools
- Essential services such as banks and ATMs, grocery stores, petrol stations, and medical centres
- Emergency services
- Telecommunication infrastructure

Community Workshop – November 2023

The second community workshop was held in November 2023, utilising external facilitators from GroupWork to host the conversations with support of Yarra Ranges Council's Climate Action Team. Graphic Illustrator Angharad Neal-Williams was contracted for the event to visually collate the feedback provided during the event (Figure 11). 17 local community members attended.

Activity - Energy Priorities

The first activity during the workshop aimed to encourage a collaborative discussion around energy priorities at a household and community scale. Participants moved to sides of the room depending on their preference. The following questions were asked, with responses collated -

"I'd prefer to have issues addressed at a household scale or for my community at hubs".

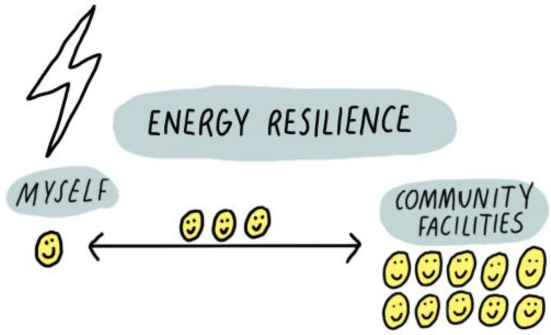


Figure 7 – Capture of workshop activity where attendees moved to different sides of the room depending on their answer to the question on 'Energy Resilience'.

Majority of attendees preferred immediate action to build energy resilience at their community facilities (Figure 7). Stories of recent experiences were shared, with the local RSL other community buildings providing relief services to residents who had no power or internet for weeks at a time.

"Energy costs are my priority above energy resilience and reducing emissions, or all three are equally equivalent".

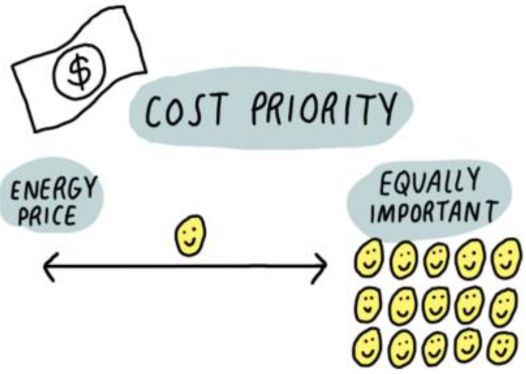


Figure 8 – Capture of workshop activity where attendees moved to different sides of the room depending on their answer to the question on 'Energy Costs'.

Majority of attendees indicated that all three energy drivers were equally important (Figure 8). Attendees shared that it was their understanding that transitioning to renewable energy and building energy resilience would be cost effective long-term.

"Reducing Greenhouse Gas emissions is my priority above resilience and cost, or all three are equally important".

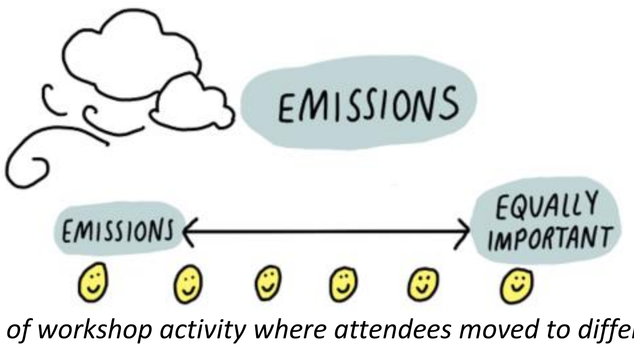


Figure 9 – Capture of workshop activity where attendees moved to different sides of the room depending on their answer to the question on 'Emissions'.

There was a wide range of responses to this inquiry (Figure 9). Multiple attendees noted the link between extreme weather and climate change, sharing that mitigating emissions was equally important to adapting to climate change and building energy resilience.

Activity – Delivery Partners

The second activity aimed to understand the types of delivery partners that would be most appropriate to take a LES feasibility study towards implementation. Attendees were asked what values they seek in a supplier of services, elaborating on how they knew these values were being actioned (Figure 10). Attendees shared concerns on suppliers having private interests, prioritising partnering with organisations and entities that could demonstrate a true interest in the local community. When asked to rate entities from 1 to 10 (least to most trustworthy), private retailers received the lowest average score (4.3), with Ausnet and similar service providers rated an average of 4.8. State and local governments were recognised for their influence in these projects (average scores of 5.2 and 6.5 respectively) but concerns around the 'influence of politics' and 'red tape' were shared. Community groups were rated at a 7.5 for trustworthiness, identified as being key players in building a social license for these projects to move towards implementation.

Figure 10. Words associated with the values workshop attendees would preference in selecting delivery partners for future associated LES implementation.

This workshop also reconfirmed significant issues related to place-based community resilience, with local attendees identifying secondary systems that had been impacted by recent power outages. These included the impact of extreme weather on telecommunications, road networks, alongside water and sewerage connections. Although beyond the scope of this initial feasibility study, these concerns were collated during the workshops and utilised to inform ongoing advocacy efforts.

Overall, community engagement throughout the REP project highlighted the need to consider local interest and capacity into the final overarching feasibility outcomes. Maintaining sustained community engagement is an ongoing challenge for related projects, with any future works related to LES implementation needing to consider how local capacity can be supported within key community groups.

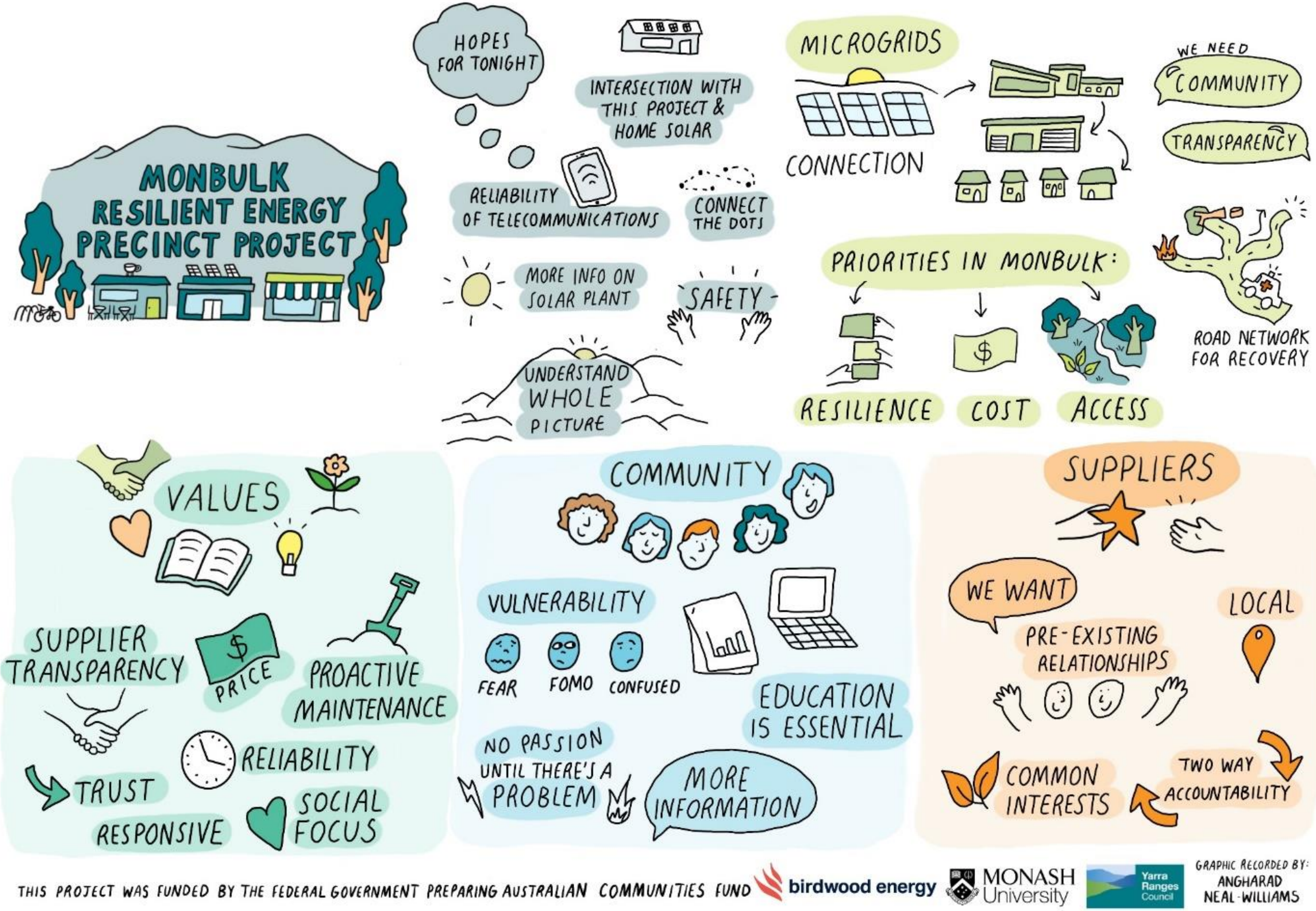


Figure 11. Graphic Illustration conducted during the November 2023 workshop, collating key themes from each of the workshop activities.

2.2 Modelling Outputs

This section provides a detailed analysis of the potential economic and technical performance of the LES under the various scenarios and uptake levels. By exploring different scenarios, the analysis aims to inform the stakeholders of the impact of different variables on key deliverables of the LES. Each scenario considers different combinations of hubs and their impact on the system's overall functionality and financial viability. The results aim to highlight how changes in system design and community engagement can influence the economic outcomes and energy resilience of the LES.

The modelling for the precinct's LES has been categorised into distinct scenarios based on the configuration of hubs and the level of residential uptake. Each scenario provides insights to potential benefits or limitations of the configuration. The hub configuration is categorised into two scenarios, initial hub setup (IH1) and expanded hub setup (IH2). The initial hub setup (IH1) includes the Monbulk Sporting Pavilion and Monbulk Living & Learning Centre as the central hubs with all other commercial sites and the spokes. Similarly, the expanded hub setup (IH2) expands the initial hub to include the Monbulk Primary School along with.

Under each of the hub configurations three unique uptake scenarios were analysed. Low uptake scenario where 150 households participated in the LES, Medium uptake scenario where 20% of the household or 300 households participated in the LES and a High uptake scenario where 50% of the households i.e. 750 households participated. These uptake scenarios address the community engagement and showcase the importance of community involvement in the LES.

Furthermore, consideration for reduced irradiance due to poor weather conditions (such as smoke from bushfires or cloudy skies during storms) have been made. Solar generation under these conditions have been modelled at a reduction of 50%. Detailed figures of the energy generation profiles can be found in Appendix 2.

Scenario Initial Hub (IH1 in analysis)

The IH1 scenario includes the Monbulk Sporting Pavilion and Monbulk Living & Learning Centre as central hubs with all other sites functioning as spokes (Figure 12). The Hub currently has 29.97kW of solar, with the modelling including a recommendation to add 80kW of solar and a 45kW/180kWh battery. When considering a full LES module, the existing solar present within the system increases with local uptake. The low, medium, and high uptake scenarios have 371.5kW, 941.5kW, and 1655kW of existing solar respectively.

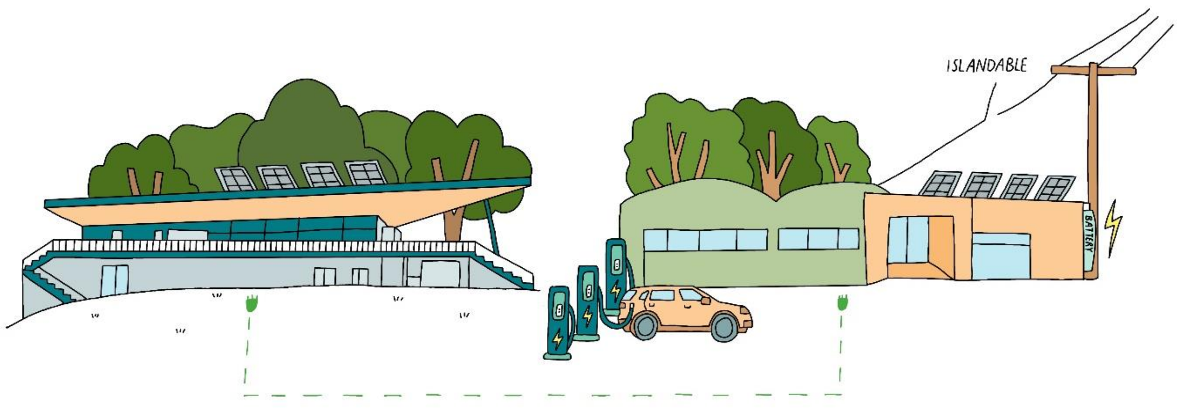


Figure 12. Graphic Illustration of Scenario Initial Hub, which includes the Monbulk Sporting Pavilion and the Monbulk Living & Learning Centre.

Resilience Analysis for IH1

The results of the REP modelling are displayed in Table 1 below. Resilience during summer is high, with days of back-up power reduced during winter and during periods of reduced solar generation. There are two primary drivers for the reduced capacity during winter; firstly, there is reduced solar generation due to the lower irradiance levels; and secondly the Hub uses more energy to maintain normal activities during winter due to additional requirements such as heating and hot water not required to the same extent during summer. Table 1 also displays the number of equivalent EVs or mobile phones that could be charged with the same energy as an alternative reference point.

Table 1. Energy Resilience Performance of the LES at Monbulk Recreational Reserve

Season	Scenario	Normal Hub Activities Supported by the System	Energy Required During a Resilience Event (3-days)	Percentage of Normal Operations Supported by System During a Resilient Event (3-days)	Equivalent Phones/EVS Charged During a Resilience Event (3-days)
	**Normal Generation**	4.17 days **OR** 659.5 kWh in 3-days	659.5 kWh	100%	43,967 phones **OR** 9 EVs
	Reduced Irradiance	3.04 days **OR** 659.5 kWh in 3-days	659.5 kWh	100%	43,967 phones **OR** 9 EVs
	**Normal Generation**	0.81 days **OR** 804.9 kWh in 3-days	1,331.9 kWh	60%	53,659 phones **OR** 11 EVs
	Reduced Irradiance	0.75 days **OR** 617.4 kWh in 3-days	1,331.9 kWh	46%	41,160 phones **OR** 9 EVs

Financial and Operational Metrics for IH1

The financial and operational metrics from the REP modelling for the Initial Hub (IH1) have been collated in Table 2. This compares the Hub only scenario (Monbulk Sporting Pavilion and Monbulk Living & Learning Centre) with increasing uptake scenarios. The Hub only scenario provides a baseline for comparison, however from the table we can notice that without sufficient uptake of households into the LES the financial advantages are not significant. Furthermore, the table highlights the need for reliable source of funding to make the LES more sustainable.

Table 2. Modelling results for Initial Monbulk Hub (Monbulk Sporting Pavilion and Monbulk Living & Learning Centre).

UPTAKE SCENARIO	IRR (NO FUNDING)	IRR (50% FUNDING)	CARBON EMISSION OFFSET (tCo2 p.a.)	PAYBACK	PAYBACK (50% GRANT FUNDING)	BUNDLED LOCALISED TARIFF (VS BAU)
HUB ONLY	5%	14%	90	14yrs	7yrs	Higher
LOW UPTAKE	0%	3%	586	30yrs	16yrs	Lower
MEDIUM UPTAKE	0%	7%	856	22yrs	11yrs	Lower
HIGH UPTAKE	3.5%	12%	1221	15yrs	8yrs	Similar

Local Network Tariff Sensitivity for IH1

The consideration of local network tariffs within the LES economic model significantly influences the cost-efficiency of energy distribution amongst its participants (Table 3). The model shows two distinct scenarios for evaluating energy transfer costs: one with a local network tariff reduced by 50% from the standard Business As Usual (BAU) rate, and another assuming no network tariff. These scenarios demonstrate that the financial viability of energy transactions within the LES varies notably under different tariff conditions. The "bundled tariff" integrates the comprehensive cost per MWh, encapsulating grid import charges, network fees, and environmental levies, illustrating how adjusted local network tariffs can either augment or mitigate the overall energy cost within the LES.

Table 3. Network tariff sensitivity results for initial Monbulk Hub (Monbulk Sporting Pavilion and Monbulk Living & Learning Centre) rounded to the nearest MWh.

	BAU – Bundled Tariff AUD/MWh	50% Network tariff – Bundled tariff AUD/MWh	0 Network tariff – Bundled tariff AUD/MWh
IH1 – Only hub	149	165	64
IH1 – Low uptake	200	136	36
IH1 – Med Uptake	191	158	57
IH1 – High Uptake	183	163	62

Scenario Expanded Hub (IH2 in analysis)

The IH2 scenario includes the Monbulk Sporting Pavilion, Monbulk Living Learning Centre, and Monbulk Primary School as central hubs with all other sites functioning as spokes (Figure 13). The Hub currently has 45kW of solar, with the modelling including a recommendation to add 90kW of solar and a 65kW/260kWh battery. When considering a full LES module, the existing solar present within the system increases with local uptake. The low, medium, and high uptake scenarios have 371.5kW, 941.5kW, and 1655kW of existing solar respectively.

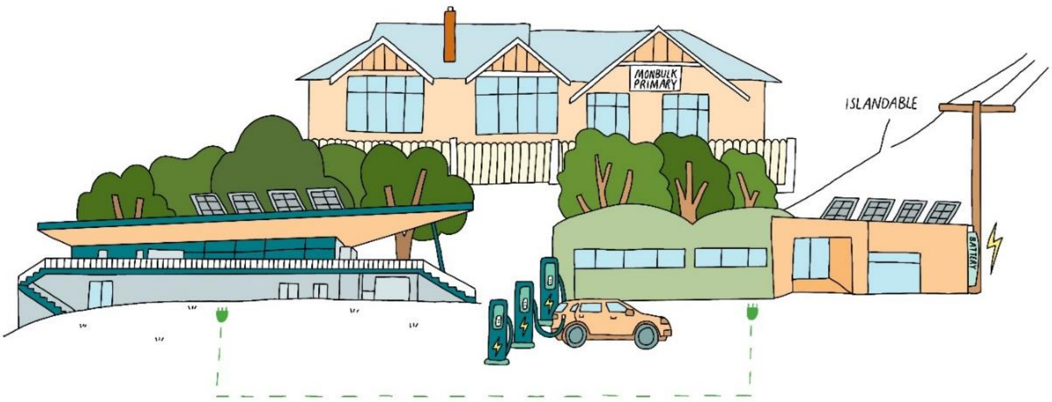


Figure 13. Graphic Illustration of Scenario Expanded Hub, which includes the Monbulk Sporting Pavilion, the Monbulk Living & Learning Centre, and the Monbulk Primary School.

Resilience Analysis for IH2 Scenario

The REP modelling results for Expanded Monbulk Hub are shown in Table 4. The duration of back-up power across both Summer and Winter are lower in comparison to the Initial Hub (Table 1) due to the higher energy consumed by the expanded hub. To allow for continuous energy resilience (supply) across a 72-hour period, energy usage (and subsequently normal activities) would need to be reduced. Detailed figures of the LES performance across these scenarios can be found in Appendix 3.

Table 4. Energy Resilience Performance of the LES at Expanded Monbulk Hub (Monbulk Sporting Pavilion, Monbulk Living & Learning Centre, and Monbulk Primary School).

Season	Scenario	Normal Hub Activities Supported by the System	Energy Required During a Resilience Event (3-days)	Percentage of Normal Operations Supported by System During a Resilient Event (3-days)	Equivalent Phones/EVS Charged During a Resilience Event (3-days)
	**Normal Generation**	2.33 days **OR** 1899.0 kWh in 3-days	2069.3 kWh	92%	126,601 phones **OR** 26 EVs
	Reduced Irradiance	1.1 days **OR** 1596.6 kWh in 3-days	2069.3 kWh	77%	106,441 phones OR 22 EVs
	**Normal Generation**	0.75 days **OR** 1558.1 kWh in 3-days	3200.0 kWh	49%	103,870 phones **OR** 21 EVs
	Reduced Irradiance	0.38 days **OR** 910.6 kWh in 3-days	3200.0 kWh	28%	60,709 phones **OR** 12 EVs

Financial and Operational Metrics for IH2

The financial and operational metrics from the REP modelling for the Expanded Hub (IH2) have been collated in Table 5. This compares the Hub only scenario (Monbulk Sporting Pavilion, Monbulk Living & Learning Centre, and Monbulk Primary School) with increasing uptake scenarios. The economic feasibility of the Expanded Hub and uptake levels are reduced, with an additional $500,000 allocated for network upgrades required to integrate the Monbulk Primary School into the Initial Hub. This upfront capital expenditure impacts the overall financial return, with or without external funding.

Table 5. Modelling results for Expanded Monbulk Hub (Monbulk Sporting Pavilion, Monbulk Living & Learning Centre, and Monbulk Primary School).

UPTAKE SCENARIO	IRR (NO FUNDING)	IRR (50% FUNDING)	CARBON EMISSION OFFSET (tCo2 p.a.)	PAYBACK	PAYBACK (50% GRANT FUNDING)	BUNDLED LOCALISED TARIFF (VS BAU)
HUB ONLY	0%	3%	136	29yrs	15yrs	Similar
LOW UPTAKE	0%	0%	601	38yrs	34yrs	Lower
MEDIUM UPTAKE	0%	0%	870	38yrs	26yrs	Lower
HIGH UPTAKE	0%	0%	1221	33yrs	19yrs	Lower

Local Network Tariff Sensitivity for IH2

The results of the varying network tariffs with the Expanded Hub are similar to that of the Initial Hub (Table 6).

Table 6. Network tariff sensitivity results for Expanded Monbulk Hub (Monbulk Sporting Pavilion, Monbulk Living & Learning Centre, and Monbulk Primary School) rounded to the nearest MWh.

	BAU – Bundled Tariff AUD/MWh	50% Network tariff – Bundled tariff AUD/MWh	0 Network tariff – Bundled tariff AUD/MWh
IH2 – Only hub	161	169	689
IH2 – Low uptake	200	143	43
IH2 – Med Uptake	191	159	59
IH2 – High Uptake	183	163	62

3. Feasibility Results

The REP project utilised a modular approach to assess the feasibility of a LES in Monbulk to meet community energy priorities, with various considerations made to understand the feasibility of each of scenario. Each module does not constitute a LES but when combined together, create an opportunity to access the full stack of LES technologies and therefore the associated benefits. Furthermore, this approach provides a pragmatic pathway to implementing an LES, addressing the various barriers that need to be overcome. This section of the report will detail the overarching feasibility considerations for LES scenarios, the immediate next steps for the 'Resilience Module', and the barriers that need to be addressed to progress towards implementation.

3.1 Feasibility Considerations

The overarching feasibility of each scenario have been critiqued against a range of considerations, including the modelling results, technical analysis, and risk assessments. These considerations have been summarised as follows.

Figure 14. Considerations for overarching feasibility of various LES scenarios, adapted from the AEP Feasibility Report.

This approach has been applied to the scenarios assessed in REP with a traffic light system applied against each consideration field resulting in Figure 15 below. This system indicates the following for each consideration:

- Green – provides positive outcomes against the consideration and indicates favourably towards becoming investment ready.
- Amber – potential for positive outcomes against the consideration however further work to overcome barriers exist to shift to a positive outcome.
- Red – indicates poor outcomes or the need for significant effort to overcome shortcomings against the consideration. Has a negative impact on becoming investment ready.

Scenario	Commercial Attractiveness	Value for Participants	Potential for Co-contribution	Technical Viability	Local Interest & Capacity	Resilience Value
IH1 - Hub Only	✓ (orange)	N/A	✓ (green)	✓ (green)	✓ (green)	✓ (green)
IH1 - Low Spoke Uptake (10% or 150 Households)	✓ (orange)	✓ (orange)	✓ (green)	✓ (green)	✓ (orange)	✓ (green)
IH1 - Medium Spoke Uptake (20% or 300 Households)	✓ (orange)	✓ (orange)	✓ (green)	✓ (green)	✓ (orange)	✓ (green)
IH1 - High Spoke Uptake (50% or 750 Households)	✓ (green)	✓ (green)	✓ (green)	✓ (green)	✓ (orange)	✓ (green)
IH2 - Hub Only	✓ (orange)	N/A	✓ (orange)	✓ (orange)	✓ (orange)	✓ (green)
IH2 - Low Spoke Uptake (10% or 150 Households)	✗ (red)	✗ (red)	✓ (orange)	✓ (orange)	✗ (red)	✓ (green)
IH2 - Medium Spoke Uptake (20% or 300 Households)	✗ (red)	✗ (red)	✓ (orange)	✓ (orange)	✗ (red)	✓ (green)
IH2 - High Spoke Uptake (50% or 750 Households)	✗ (red)	✗ (red)	✓ (orange)	✓ (orange)	✓ (orange)	✓ (green)

Figure 15. Feasibility Assessment of various LES scenarios against key criteria.

The initial work done by YRC to consolidate supply points and avoid cross-property distribution of energy greatly simplifies the regulatory and licensing considerations for implementation. By doing so the Initial Monbulk Hub (Monbulk Sporting Pavilion and Monbulk Living & Learning Centre) can achieve all resilience module outcomes without the need for waivers from regulatory bodies. The technical requirements and network considerations are within the bounds of what would be considered a "normal" network connection. These factors greatly increase attractiveness for co-contribution and local capacity required for implementation. The ability to scale, with community participation, and address commercial models when doing so also increases the commercial attractiveness of the implementation. The final assessment for IH1, in particular for the base and high uptake scenarios, is a commercially attractive one that provides value to participants, with a strong likelihood of being able to attract funding and local support to take them forward.

IH2 on the other hand, the extended hub scenario, is limited by the negative impact of both technical and regulatory requirements related to cross-property distribution. This impact driven by the increase in capital costs to address network infrastructure requirements and the coordination for the regulatory requirements, result in significant work being required to progress it to a position where it would be investment ready. As a result, the extended hub scenario is one that needs significant effort and coordination to become investment ready.

3.2 LES Modular Approach - Opportunities and Barriers

The solutions that LES can provide has garnered significant community support, both in AEP, and REP projects. The modular approach identified in REP provides an opportunity for communities to realise some of the immediate benefits whilst pursuing the deeper engagement required to facilitate the full stack of LES benefits.

This provides a pathway to address some of the barriers that have been identified not only through the AEP project but in many other LES studies as outlined in the recent study *Emergent opportunities and barriers on the feasibility of microgrids: Qualitative findings from an Australian funding program* published in Energy Research & Social Science, 2024. Barriers such as:

- The lack of regulatory framework for distributed energy solutions, particularly grid connected microgrid projects.
- Value to the distribution network that could be recognised via the DNSP through existing tariff mechanisms or in a new mechanism such as Resilience network payment.
- Ownership and governance structures and the legal requirements associated with establishing them.
- Investment pathways for communities
- Social barriers such as trust in energy institutions and energy literacy.

As identified in the AEP project, the licence waiver available through the Essential Services Commission for trial project(s) has the significant potential to reduce these barriers, particularly in relation to the regulatory requirements. However, reiterating the findings in the AEP project, meeting the requirements for a waiver is still a significant challenge.

The modular approach proposed in this report has the potential to simplify some of the steps that need to be navigated in the journey to investment readiness. As outlined the modules provides a mechanism to simplify some of the steps outlined below. The details of the next steps outlined in Figure 16 can be found in *Section 6. Recommended Next Steps (pg. 67) of the AEP Feasibility Report* and won't be repeated in detail here. This report will focus on the benefits the modularised approach could provide.

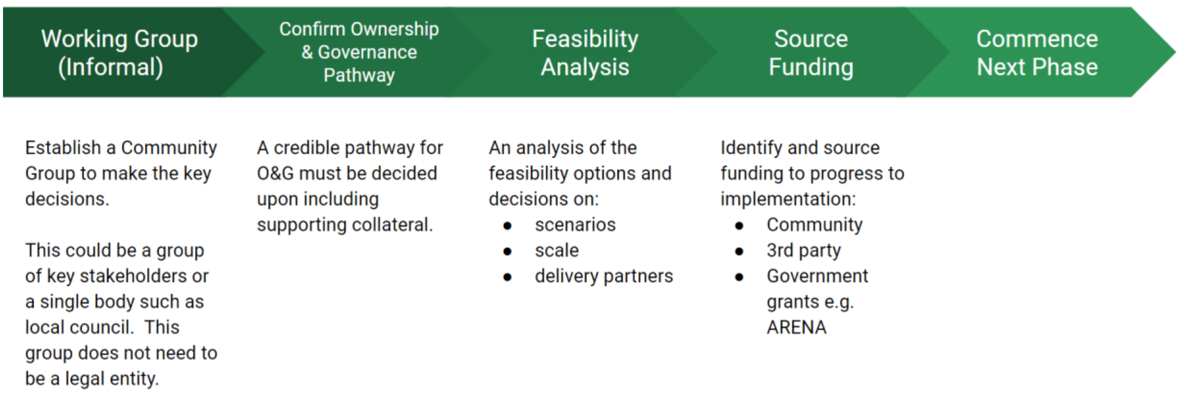


Figure 16: The next steps required to be undertaken for the REP modules, beyond the initial hub, to become investment ready. Adapted from the AEP Feasibility Report.

The resilience module has the potential to:

- Simplify working group and ownership, governance and DNSP requirements depending on the complexity of the hub's participants.
- Removes the immediate need to identify and engage participants.
- Has the potential for multiple funding sources given the narrower implementation focus.

Similarly, the renewable energy module has the potential to:

- Simplify working group and ownership and governance requirements depending on the energy ambitions of the community.
- Enable partnership considerations with an existing energy retailer, particularly with experience in facilitating the kind of transactions detailed in the Renewable energy module above.

Realising the full stack of benefits via a LES module through this modular approach would enable multiple implementation timelines for the various activities required to reach a fully functioning module. For example, deep community engagement, and timeframes for setting up the ownership and governance frameworks could occur in parallel to the, potentially, less complicated technical activities such as hub implementation. Similarly, this approach facilitates identifying new commercial models as the market matures which can be overlayed with established assets. This is reinforced by the time that the modular approach affords to overcome some of the social and value proposition barriers outlined above.

This also extends to sourcing funding – separate funding sources could be considered for implementing separate modules of a LES whilst progressing towards a fully functioning LES. This approach will need to be explored further, in particular, within the current opportunities where defined LES requirements exist. There is a high probability of an increase in administrative and governance burden that arises from multiple funding sources however this is counterbalanced by the ability to provide access to participants in much shorter timeframes.

The approach also provides a pathway for community groups who own assets to implement a module or begin the necessary coordination activities to support a module in an independent fashion. Ownership is a key requirement to facilitate implementation however for community groups that are not in an ownership position or have strong preferences for either Renewable or the full LES modules it provides an advocacy pathway through which these modules could be realised.

3.3 Overall Project Learnings

The learnings from REP have reinforced those identified through AEP, in particular the importance of local capacity to facilitate the necessary activities for LES. It was clear that the capacity built through AEP has resulted not only in the ability to conduct activities more efficiently, but equally critical, that the capability has become an integral part of the approach when considering resilience and energy systems.

Community Preferences

Of equal weight to local capacity was the ability to understand community preferences. Building on the approach in AEP enabled targeted engagement as outlined in section 2 of this report. Leveraging the strong knowledge bases of local community groups and early engagement of key stakeholder groups in the community such as emergency services, SMEs and similar reinforced the findings from AEP. This resulted in more efficient and practical outcomes with artefacts that can be accessed and reused for future engagements.

A key identification in the community engagements was that the support and understanding of LES benefits was strong. There was a strong desire to understand options for commercial models and partnerships whilst maintaining community oversight and benefits.

Data Gathering

The shift away from utilising hardware to facilitate data gathering, as was the approach in AEP, provided for significantly increased efficiencies. The ability to use existing energy billing data and proxies provided outcomes with the level of sensitivity required for the feasibility stage.

The lessons identified in AEP around regulatory barriers and valuing resilience remain. There has been progress in the market with vendors such as energy retailers providing options that could facilitate some of the roles that did not exist at the time of AEP. An indication of the market shifting to meet the demand for the benefits that LES can provide. As previously mentioned, the opportunity for trials through pathways such as the Essential Services Commission waiver would greatly support to understand the necessary changes to regulatory requirements to meet the shift in market services that is underway and ultimately enable benefits of LES technologies for communities.

Appendices

Appendix 1 – Key Assumptions

Proxies Considered

While modelling, if interval data for certain sites was not available estimates were utilised based on proxies specified in table below. The proxies were selected with sites having similar characteristics of which we have complete interval data. The similarity is typically based on the site's function (e.g. aquatic centres, schools, retail stores, etc.) this ensures that the site's energy usage pattern is similar to the proxies. Furthermore, we calculated a size factor to determine based on the physical size in square metres of both the actual site and proxy site. The factor is determined by dividing the size of the actual site with the proxy's site. This size factor is used as a multiple to manipulate the interval data to match the load profile of the site.

Site Name	Location size m2	Proxy name	Proxy size m2
Monbulk Aquatic Centre	1420	Similar Aquatic Centre	3483
Murphy's Mire 10	1503	Bakery	717
Open Door Church	155	Resident home	85
Monbulk Netball		Similar Sports club	
Monbulk Bowls Club	665	Similar Shopping Centre	5803
Monbulk Secondary College	20872	Similar Primary School	8179
Saint Pauls Primary School - Monbulk	5061	Similar Primary School	8179
Monbulk Scouts	123	Resident home	80
Woolworths	2481	Similar Shopping Centre	5803
Aldi	1661	Similar Shopping Centre	5803

Assumptions of Scenarios

Similar to the AEP model the REP model has assumptions that provide flexibility for the user to explore various configurations in the precincts. The following are set up based on:

Existing PV Size: The size of the PV system already installed in the precinct is considered in the base case scenario. This reflects the current renewable energy generation capacity of the site. The size of PV on the residential houses are based on 12 randomly selected residents in Healesville.

Additional PV Size: Additional PV systems are planned to be added to the precinct in the scenario. The size of the additional PV systems is determined based on the desired level of energy generation for resilience and financial viability.

Total PV Size: The total PV size is calculated by summing up the existing PV size and additional PV size. This represents the combined solar generation capacity of the precinct.

Storage Power: The power capacity of the battery storage system is determined based on the energy requirements and resilience goals of the site. It ensures that the battery can effectively support the load and charge from the excess PV generation during resilience events.

Storage Energy: The energy capacity of the battery storage system is determined to provide sufficient backup power during resilience events. It ensures that the battery can store enough energy to meet the resilience load requirements.

The following items provide flexibility to the user to explore various resilience scenarios:

Resilience Load %: The percentage of load to be supported during resilience mode is adjustable in the model. It allows the user to specify the level of energy backup required during resilience events, considering factors such as critical loads and duration of the event.

9pm to 6am Resilience Load %: The percentage of load to be supported between 9pm to 6am during a resilience event. It is assumed that this is lower than the actual load percentage and it is assumed only essential elements need to be supported during this time frame. This allows the battery to provide better resilience during the event.

Generation %: The percentage of energy demand to be met by on-site generation is adjustable in the model. It allows the user to determine the proportion of energy that should be supplied by the PV systems. This can be influenced by factors such as the availability of sunlight and the desired level of self-consumption.

Resilience Start Date: The date from which resilience mode is activated is set in the model. This determines when the resilience events occur, typically during periods of high demand or grid instability. It allows for the assessment of the system's performance and resilience capabilities under different scenarios. The SOC of the battery is set to 100% at the resilience start date. This is under the assumption that the resilience event is known beforehand, and the battery can charge and be ready.

Assumptions for Network Tariffs and Retail Tariffs in the feasibility report and model:

The following assumptions were made for Network Tariffs:

Peak: The tariff rate applicable during peak hours is considered. This rate is applied to energy consumption during periods of high demand.

Off-Peak: The tariff rate applicable during off-peak hours is considered. This rate is typically lower than the peak rate and applies to energy consumption during periods of lower demand.

All Other Times: The tariff rate applicable during all other times, excluding peak and off-peak hours, is considered. This rate is applied to energy consumption during non-peak and non-off-peak periods.

MLF (Marginal Load Factor): The metering load factor represents the ratio of the actual energy consumption to the peak demand. It is used to calculate the network charges based on the contracted capacity of the site. MLF and DLF are typically multiplied with the energy flow to get a more sensible result for the revenue.

DLF (Demand Load Factor): The demand load factor represents the ratio of the average demand to the peak demand. It is used to determine the demand charges based on the peak demand of the site. MLF and DLF are typically multiplied with the energy flow to get a more sensible result for the revenue.

Network Tariff Code: The network tariff code identifies the specific tariff structure and pricing applicable to the microgrid. It ensures consistency in the calculation of network charges.

The following assumptions were made for Retail Tariffs:

Peak: The tariff rate applicable during peak hours for retail energy consumption is considered. This rate is typically higher than off-peak rates and applies to energy consumed during periods of high demand.

Off-Peak: The tariff rate applicable during off-peak hours for retail energy consumption is considered. This rate is usually lower than the peak rate and applies to energy consumed during periods of lower demand.

All Other Times: The tariff rate applicable during all other times, excluding peak and off-peak hours, for retail energy consumption is considered. This rate applies to energy consumed during non-peak and non-off-peak periods.

Demand Charge: The demand charge represents the fee imposed based on the peak demand of the site. It is calculated separately from the energy charges and reflects the cost associated with the site's highest energy consumption during a billing period. It is assumed in the model that the battery and PV work together to reduce the peak demand and thus dropping the peak demand charge of the participants. The savings associated with the demand charge is considered as revenue to the LES operator.

Note: It is assumed that all participants within the microgrid have the same network tariff and retail tariff structure. This simplifies the modelling process and allows for consistent calculations of financial benefits. Individual tariff scenarios may be explored as part of future work.

Assumptions for Capital Expenditure (Capex) in the feasibility report and model:

PV Install Rate: The price at which the PV system will be installed. This determines the capex of PV system deployment and is usually dependent on market factors.

BESS Install Rate: The price at which the battery storage system will be installed. Similar to the PV install rate. This fluctuates highly based on availability of lithium and suppliers.

Total Capex: The total capital expenditure for the microgrid project, including the costs associated with PV installation, BESS installation, network upgrades, and other project-related expenses. This represents the overall investment required for the project.

BESS Capex: The capital expenditure specifically allocated for the battery storage system. This includes the costs associated with procuring and installing the battery system, including any necessary infrastructure and equipment.

PV Capex: The capital expenditure specifically allocated for the PV system. This includes the costs associated with procuring and installing the PV panels, inverters, mounting structures, and other components required for the PV system.

Network Upgrade Capex: The capital expenditure required for upgrading the network infrastructure to support the microgrid. This can include costs associated with grid interconnection, distribution system upgrades, and any necessary modifications to accommodate the integration of the microgrid.

This could be as simple as adding virtual monitoring to analyse what flows are used within the micro-grid system.

Other Capex: Any additional capital expenditures not directly attributed to PV installation, BESS installation, or network upgrades. These can include costs for site preparation, project management, permitting, and other miscellaneous expenses.

Grant Funding Capex: The portion of the capital expenditure covered by grant funding. This represents the financial support obtained from external sources, such as government programs or incentives, to offset a portion of the project costs.

Note: That these capital expenditure assumptions directly impact the project's payback period and internal rate of return (IRR). Adjusting these rates and costs allows for exploring different investment scenarios and evaluating the financial viability of the microgrid project.

Assumption for Local Network Tariff in the feasibility report and model:

This provides flexibility for the user to change the network tariff to see how it affects the model. The local network tariff directly correlates to the revenue to the local network tariff.

Local Network Tariff: The rate of the local network tariff charged for energy flows within the microgrid. This tariff is specific to the microgrid participants and is different from the standard network tariff charged by the utility company. In the feasibility study, it has been assumed that the local network tariff is set at 50% of the standard network tariff.

The local network tariff is applied to energy transactions within the microgrid. It is not applied to energy imports from the grid to the microgrid, energy exports from the microgrid to the grid. It only applies to energy transfers between different participants within the microgrid. By setting the local network tariff at a reduced rate compared to the standard tariff, it incentivizes local energy trading and promotes self-consumption within the microgrid.

The specific rates for the peak hours, off-peak hours, and all other times of the local network tariff are determined based on the BAU network tariff.

Note: The local network tariff directly impacts the financial calculations and revenue generation within the microgrid. The lower local network tariff rate encourages energy self-sufficiency within the microgrid and maximises the economic benefits for the microgrid participants.

Other Assumptions

Several key assumptions have been made in the analysis to ensure alignment with the specific requirements and constraints of the micro-grid system:

A generic solar profile is used for additional solar generation for each precinct, providing a practical and consistent basis for evaluating solar energy potential across all sites.

Winter months are defined as May through September, and summer months as December through March, reflecting the seasonal variations in energy demand and generation patterns.

In a microgrid scenario, all sites/participants interact with each other using the same weightage, i.e., no precedence is given to a certain site. This equitable approach ensures that if there is additional energy that can be consumed by a site, it is assumed that the site consumes the energy, enhancing overall system efficiency.

The Large-scale Generation Certificate (LGC) price is set to 0, ensuring no revenue from LGC as the benefit of going net zero is considered.

Retail prices are assumed to be the same as one of the major hub sites for the entire micro-grid, as extracted from the electricity bill of the site. This simplification allows for a uniform pricing structure across the micro-grid, facilitating feasibility calculations.

Network tariffs are assumed to be the same as one of the major hub sites for the entire micro-grid, as extracted from the network tariff code. This assumption provides a consistent basis for evaluating network costs and potential savings across all sites.

The emission factor is set to 0.85 tonnes CO2 per kWh, based on the Clean Energy Regulator. This assumption ensures that the evaluation of emission reductions aligns with current industry standards and regulations.

The average energy utilized by an iPhone 11 Pro Max is 0.015 kWh.[1] This value is used to estimate the amount of resilience provided by the Local Energy System (LES) in terms of mobile phone usage.

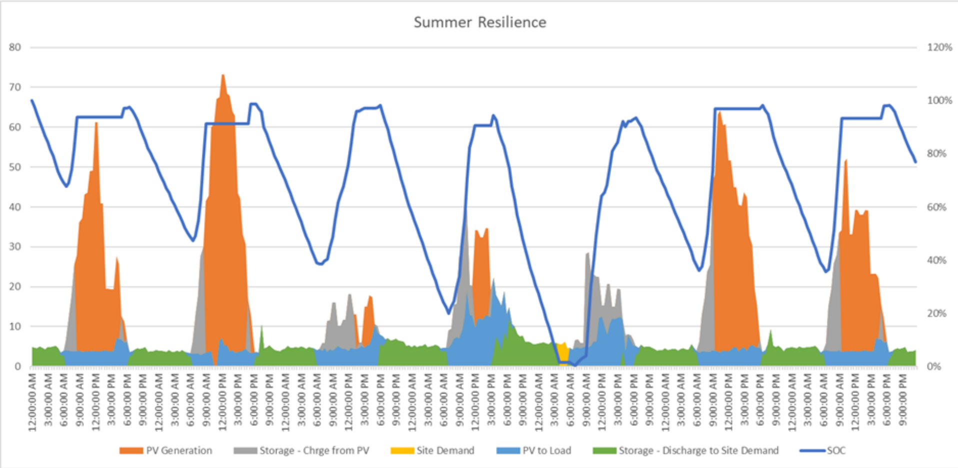
The average usable battery capacity of a Tesla Model 3 Long range dual motor is considered to be 72kWh, this is used as the average energy required to charge an EV.[2]

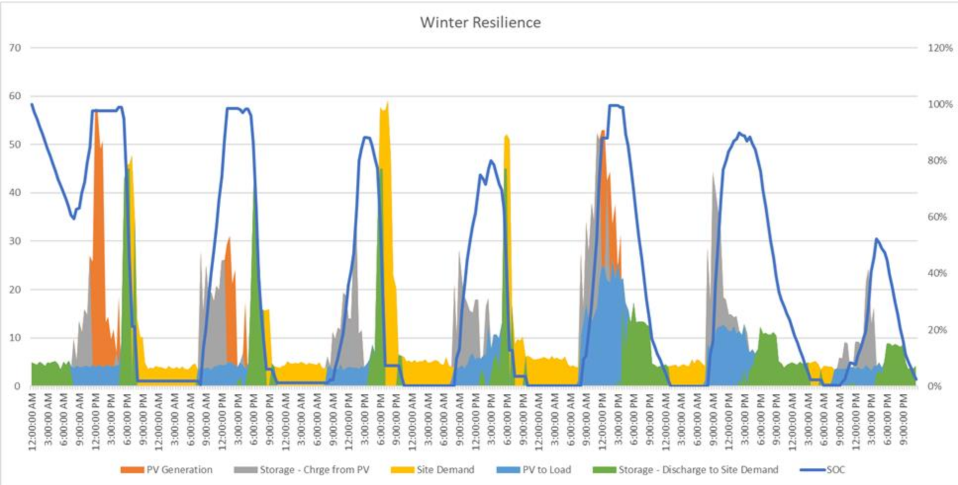
[1] Jary, S. (2024, February 15). *iPhone batteries compared: Capacity and watt hours for every model*. Macworld. https://www.macworld.com/article/678413/iphone-battery-capacities-compared-all-iphones-battery-life-in-mah-and-wh.html

[2] *Tesla Model 3 Long Range Dual Motor*. (n.d.). EV Database. https://ev-database.org/car/1321/Tesla-Model-3-Long-Range-Dual-Motor

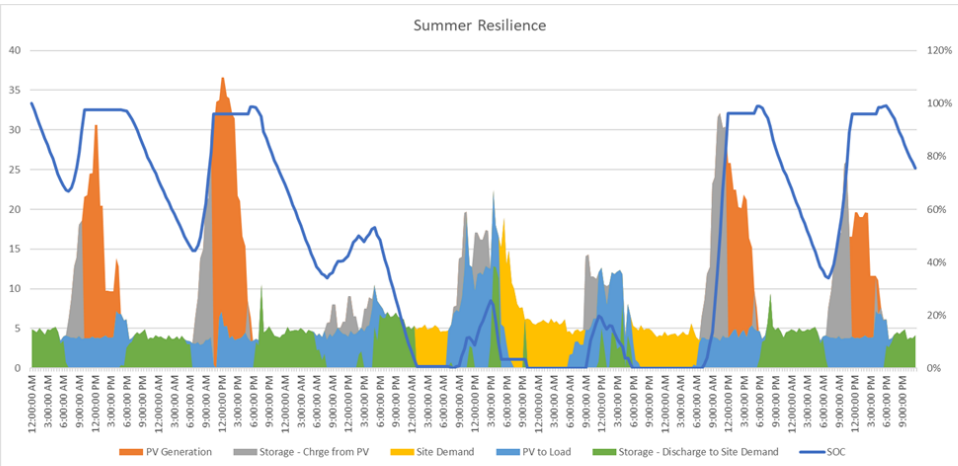
Appendix 3 – Modelling outputs

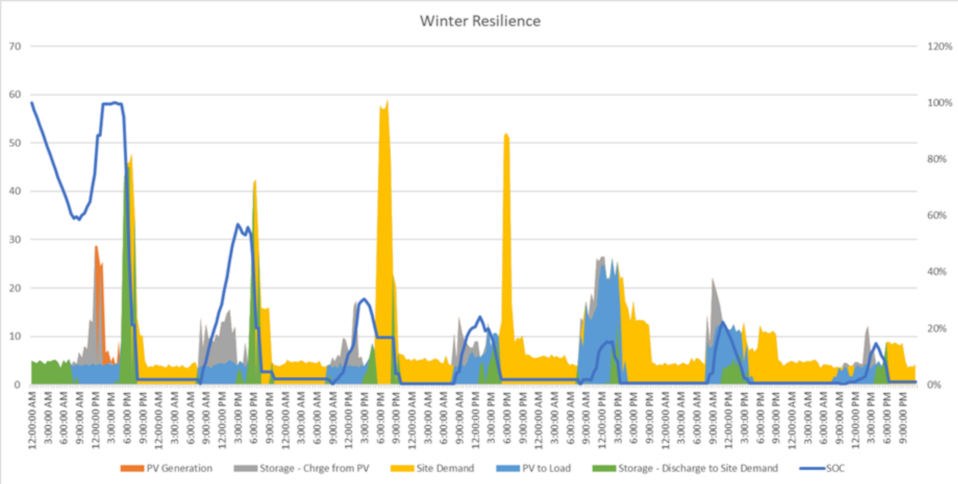
Normal Generation IH1



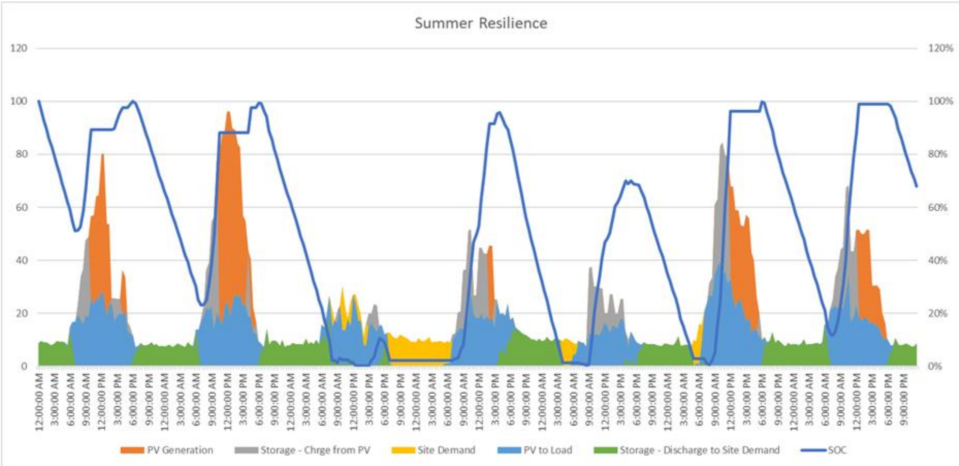


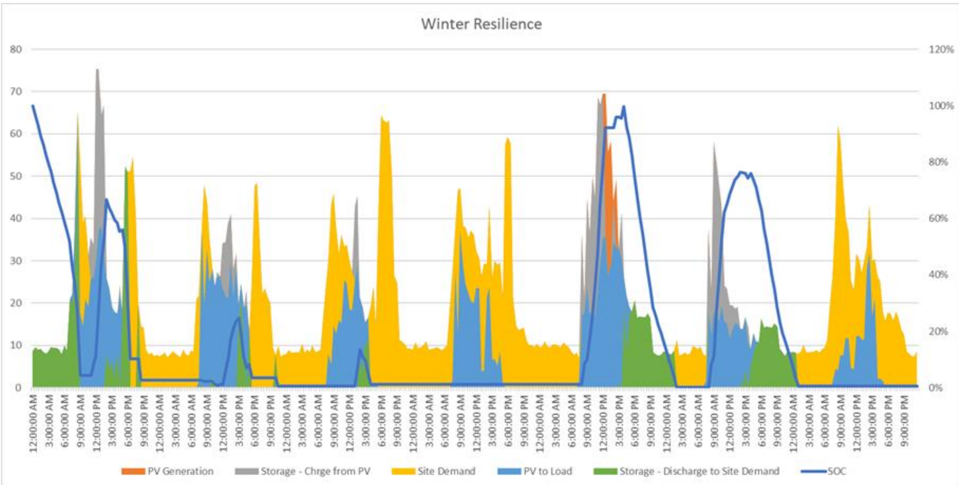
Reduced Irradiance IH1



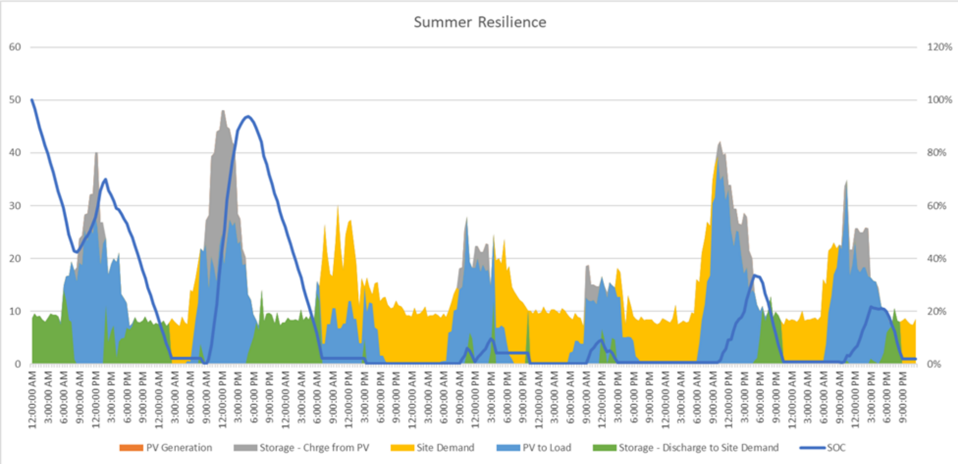


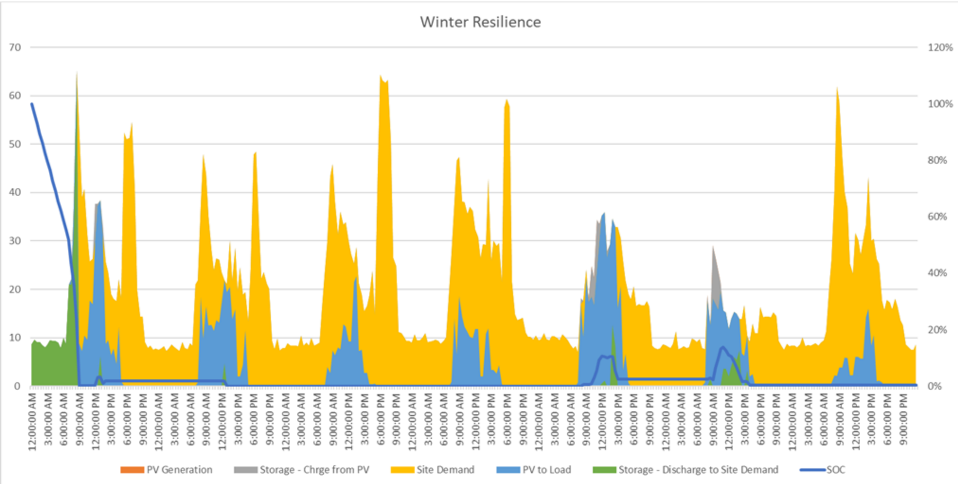
Normal Generation IH2



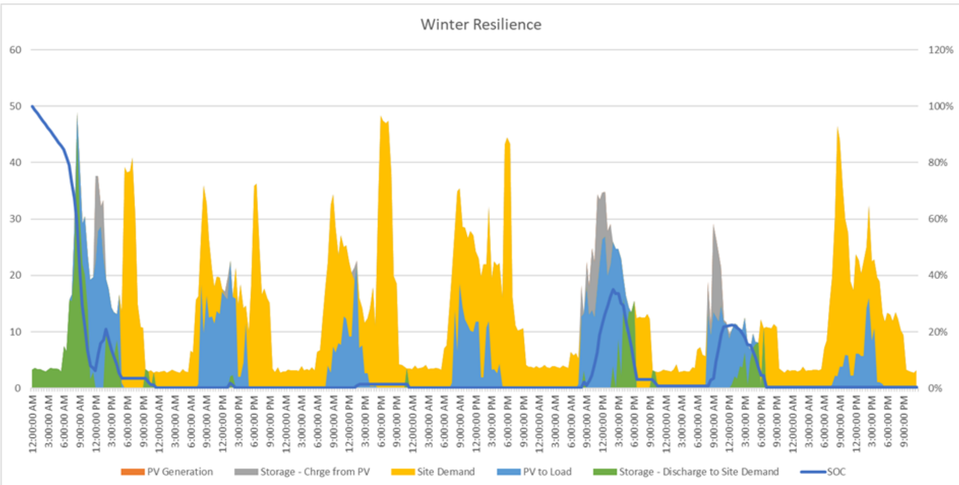


Reduced generation IH2





50% reduction in nighttime load and 25% reduction in daytime load



Appendix 4 – Survey Questions

The following questions were asked to local residents and business owners in Monbulk as part of a survey in May 2023.

Resilient Energy Precincts – Yarra Ranges

The Resilient Energy Precincts project team are undertaking a feasibility study for a microgrid solution that can be implemented in your local community. The feasibility study will look at solutions that help address the priorities in the community across resilience, energy costs and achieving Net Zero.

The project team is keen to understand what you value in relation to energy, as well as your future plans and ambition. This initial input will help shape the solutions that may be viable for your community - you can always change your mind as the project progresses!

As you would be aware, energy resilience has always been a high consideration for communities in the Yarra Ranges. Extreme weather events over recent years have reinforced the need to design systems to supply energy during widespread power outages which many of you have experienced first-hand. Simultaneously, there is also the necessary and ongoing push towards Net Zero emissions for businesses and residents in the region, whilst exploring ways to minimise the impacts of rising energy costs.

The Resilient Energy Precincts Project aims to explore these resilience, cost, and net zero considerations, to develop a feasibility study for a microgrid system centred around the Monbulk community. It also reflects similar action documented in Council's Liveable Climate Plan, an action plan detailing how we will respond to the threat of climate change in the Yarra Ranges. The Liveable Climate Plan can be found at this following link: https://tinyurl.com/Yarra-Ranges

Email –

Participation Request -

Monash University in partnership with Birdwood Energy and Yarra Ranges Council would like to invite the communities of Monbulk to participate in the Resilient Energy Precincts feasibility study for the Yarra Ranges Shire.

What does this mean for you? By participating, your input and energy data or energy use will be feed into microgrid system design. The designs or solutions that are produced as part of this study will then be presented to the community for review and potential implementation pathways. You will always have the ability to opt out of the study at any time by contacting the project team at Monash University netzero@monash.edu.au

Will you participate in shaping the energy solutions in your community? You can opt out at any time.

Yes, I'd like to participate by completing the survey and providing my energy data for use in the feasibility study.

Not at this time, but I am happy to complete the survey.

Participation Details –

I consent to the personal information that I provide in this survey being used by Monash University for the purposes of microgrid feasibility studies as part of the Resilient Energy Precincts project.

You authorise the Resilient Energy Precincts project team to act as a Customer Authorised Representative on your behalf to access your NMI meter data from Ausnet.

Yes, I authorise the Resilient Energy Precincts project team to act as a Customer Authorised Representative on my behalf to access my NMI meter data from Ausnet.

No, I'd prefer not to participate in the project.

Would you like to provide your personal details now or have a project member contact you at a later date?

I'll do it now.

I'd rather a project member contact me and will provide my email address.

Privacy Statement

Monash University values the privacy of every individual's personal information and is committed to the protection of that information from unauthorised use and disclosure except where permitted by law. For information about the handling of your personal information please see the Monash University Research Data Protection and Privacy Collection Statement (https://www.monash.edu/__data/assets/pdf_file/0010/1595269/Research-Data-Management-and-Privacy-Collection-Statement.pdf).

For more information about Data Protection and Privacy at Monash University please see our Data Protection and Privacy Procedure (https://www.monash.edu/__data/assets/pdf_file/0003/790086/Privacy.pdf).

If you have any questions about how Monash University is collecting and handling your personal information, please contact our Data Protection and Privacy Office at dataprotectionofficer@monash.edu.

What is the property type at your address?

Residential

Small Business/Commercial

Community Facility

Other:

If the property is a residence, how many people on average live there?

If the property is used for commercial/community purposes, how many people on average (per day) use the property?

Does the property have solar panels installed?

Yes

No

If yes, how big (kilowatts or number of panels) is your Solar system?

Do you have an app that shows your solar production? If so, which one?

If you have heating, what sort is it?

Gas
Electric
Wood Heating
None

Do you have air conditioning?

Yes
No

What sort of cooktop/oven do you have?

Gas
Electric
Gas Cooktop & Electric Oven
Not sure

What sort of how water system do you have?

Gas
Electric
Solar hot water
Heat pump
Not sure

Do you have any other large energy intensive equipment at this property? For example, a pool, commercial fridge/freezers or similar

How many passenger vehicles are owned/located at this address?

0
1
2
3 or more

Do you have an electric vehicle?

Yes
No

If you have an EV how often do you charge it at this property?

Only during the day
Only overnight
Whenever I need to

Do you have an EV charger installed?

Yes
No

Are you an owner/occupier or renter?

Owner/occupier
Renter
Prefer not to say?

What is the cost of your average energy bill?

Close to $0

Less than $100/month
$100-200/month
$300-$400/month
Greater than $400/month
Prefer not to say

Do you have any concerns paying your energy bills?

Yes
No
Prefer not to say

How often do you experience power outages? An outage is defined as a loss of power supply for more than 3 (continuous) minutes.

Never
Occasionally (for example, once every 3 months or less)
Frequently (for example, once every month or more)

What impact do power outages have on you?

No impact
Minor inconvenience
Major disruption

Do you have a generator on your property in case of an outage?

Yes
No
No, but I'm thinking of getting one

If you own a generator, how old is it?

Less than 2 years old
Between 2 and 5 years old
Greater than 5 years old
Not sure

If you own a generator, how large is it?

Less than 2.5 kW
Between 2.6kW and 5kW
Between 5kW and 10kW
Greater than 10kW

On a scale of 1-5, where 1 is very little and 5 is fully confident, how would you rate your understanding of new energy technologies such as microgrids, virtual power plants (VPPs) or green power?

Are you involved in any community groups? If so, which ones?

Are you interested in a Community owned energy solution for Monbulk?

Yes
No
I would need more information to decide

What matters to you? Please rate each of the following statements based on their importance to you, from 1 (not important to me at all) to 10 (this is my highest priority that I would like to address)

I want to reduce my energy bills

I want to reduce emissions from my energy use

I want to have backup power for my property during outages and emergency events (storms/bushfires)

I want to ensure the community has access to backup power at key facilities during power outages and emergency events (storms/bushfires)

Do you have any plans (or have already completed) to undertake any of the following activities? Please select all answers that apply. Options include – Completed, In Progress, Planned, Interested, Not Interested.

- Renovation
- Energy efficiency upgrade e.g. replacing windows, insulation, draught proofing
- Installing a solar system
- Install a battery system
- Adding to existing rooftop solar
- Purchase green power
- Buy an electric vehicle
- Replace hot water system
- Participate in community energy program
- Change my behaviours around energy use e.g. turning down thermostat, using appliances at non-peak times

- Renovation
- Energy efficiency upgrade e.g. replacing windows, insulation, draught proofing
- Installing a solar system
- Install a battery system
- Adding to existing rooftop solar
- Purchase green power
- Buy an electric vehicle
- Replace hot water system
- Participate in community energy program
- Change my behaviours around energy use e.g. turning down thermostat, using appliances at non-peak times

What further information would be useful to you around energy?

What to expect?

Thanks for participating in the Resilient Energy Precincts survey. We greatly appreciate your time and input into shaping your community’s future energy solutions. You can expect further correspondence from the project team and the Yarra Ranges Council in the coming months. If you are participating in the study the project team will be in touch and confirm your involvement.

Some of the upcoming events include community workshops centred around microgrid themes. Look out for updates via your local newsletters and by reading more about Yarra Ranges Council's microgrid projects here.

Appendix 5 – Additional Graphic Illustrations

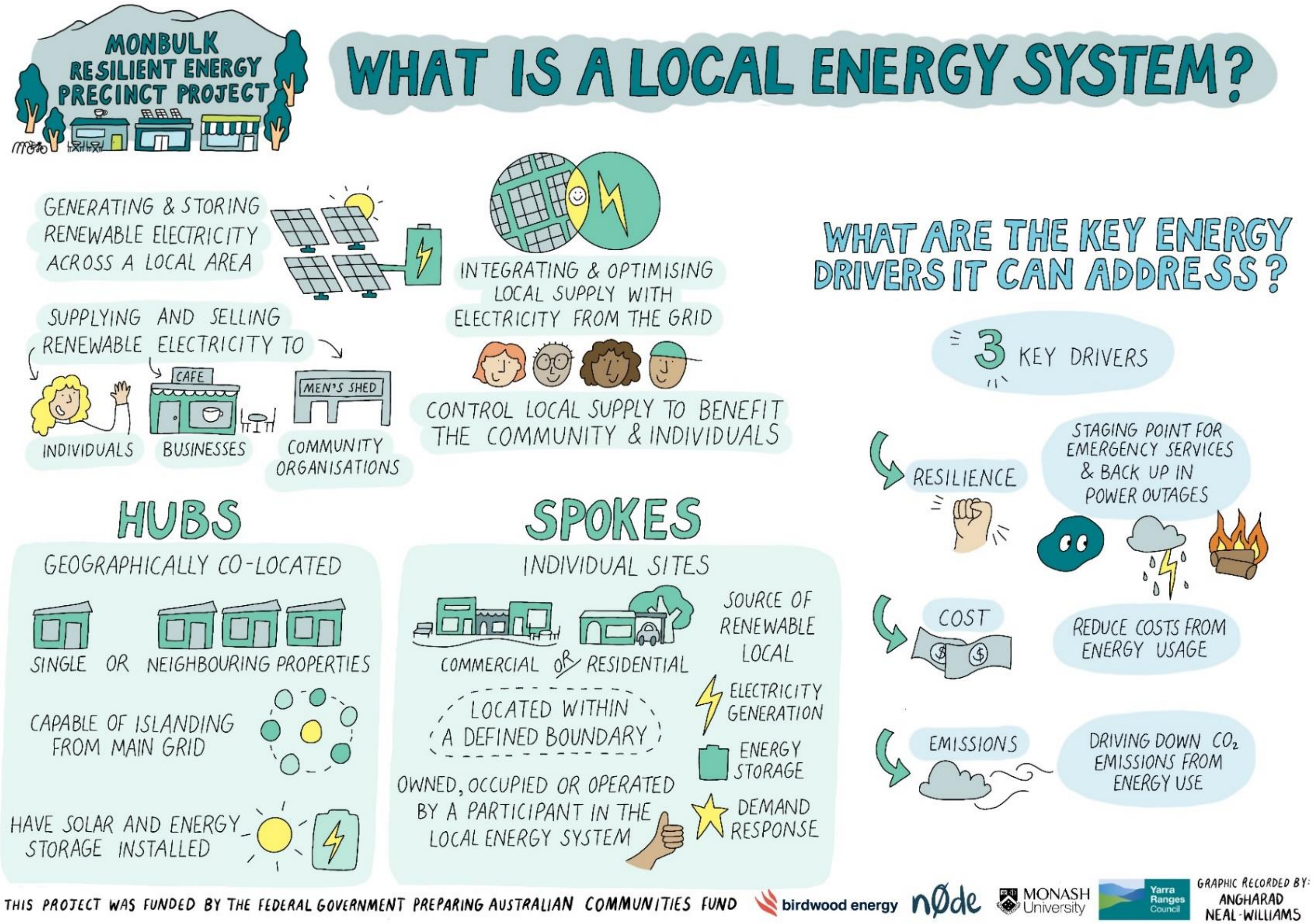


Figure 1. Graphic Illustration of 'What is a Local Energy System?', produced as an artefact of the REP project to support the communication of results and future community engagement.

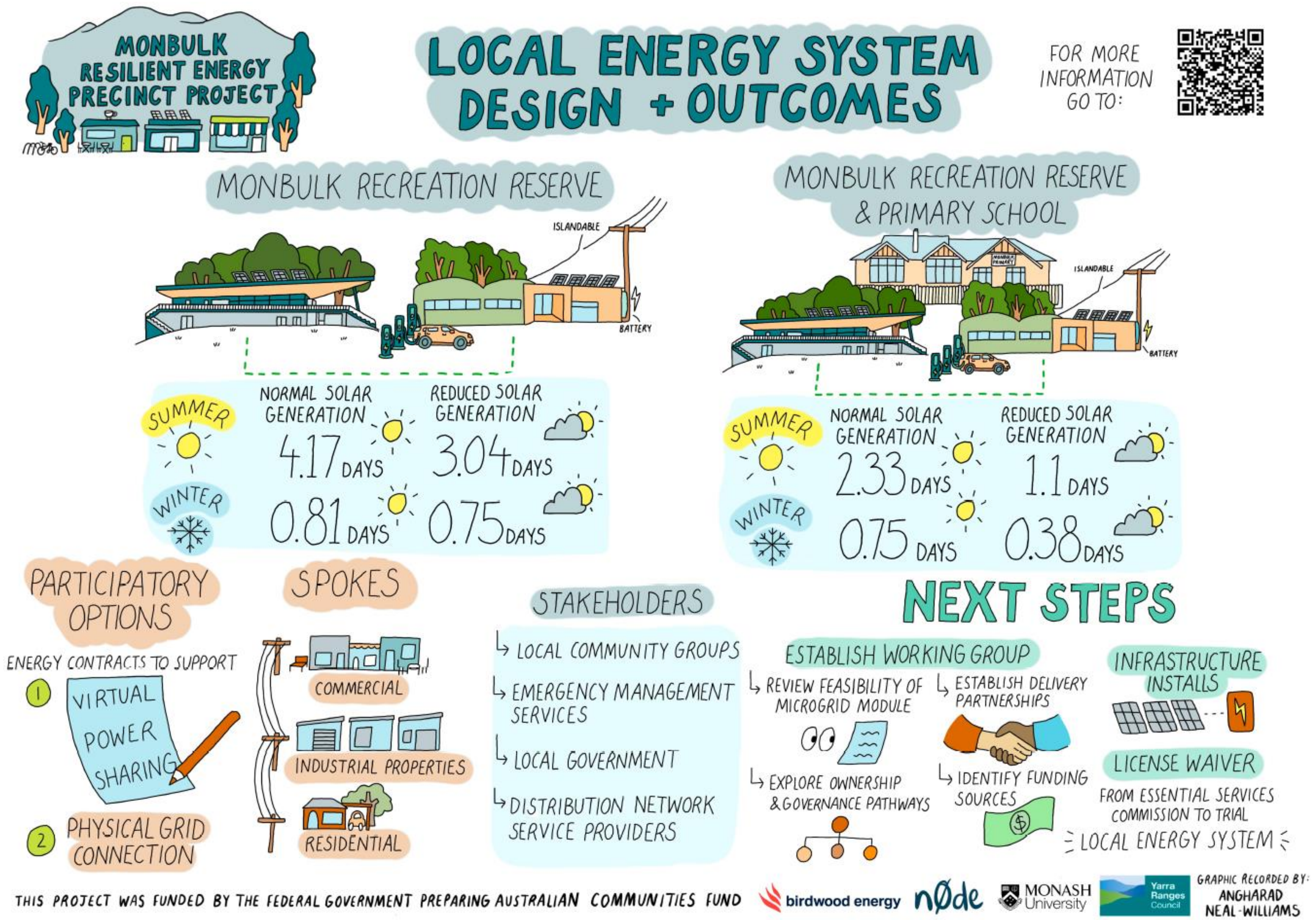


Figure 2: Graphic Illustration of the LES design and outcomes for REP, produced as an artefact of the REP project to support the communication of results and future community engagement.

Appendix 6 – Risk Assessment

Australian Government
Australian Renewable Energy Agency

ARENA

Risk Management Plan

Note: Table 1 is used to document key risks except for work health and safety (WHS) risks in the proposed Project or Measure; Table 2 is used to document key WHS risks in the proposed Project or Measure. Applicants are asked to either complete their risk management plan using Tables 1 and 2 for the Projector Measure outlined in their funding application, or else provide an alternative, equivalent risk management plan. Project Funding Applicants are encouraged to build on the Risk Management Plan submitted at EOI stage. Please refer to the Notes at the bottom of this document when completing the plans.

Table 1: Risk Management Plan – All Risks Except Work Health and Safety (WHS) Risks	
Project name	Resilient Energy Precincts - Local Energy System Implementation

Risk #	**Risk (except WHS risks)**	**Impact**	**Initial risk rating** (Before treatment strategies in place)	**Risk treatment strategies**		**Residual risk** (Once treatment strategies in place)
				Action	Risk owner and timeframe	
1	Risk: Technology delivery partners are not able to deliver functional requirements. Source: Delivery	• Financial - Loss of Revenue • Legal - Breach of contract both vendor and participant	Consequence: Major Likelihood: Moderate Risk rating: High	Apply strong procurement processes to ensure technology delivery partners have proven delivery capability.		Consequence: Major Likelihood: Unlikely Risk rating: Medium

Risk #	Risk (except WHS risks)	Impact	Initial risk rating (Before treatment strategies in place)	Risk treatment strategies		Residual risk (Once treatment strategies in place)
				Action	Risk owner and timeframe	
		• Reputation - Participant attrition				
2	Risk: Edge device support Source: Delivery	• Financial - increased support required from technology partners	Consequence: Minor Likelihood: High Risk rating: Medium	Apply strong procurement processes to ensure technology delivery partners have proven delivery capability.		Consequence: Minor Likelihood: Unlikely Risk rating: Low
3	Risk: Technology Contracts Specification Source: Contractual	• Financial - additional costs to access system owned data or integrate new services	Consequence: Major Likelihood: Possible Risk Rating: High	Utilise independent SME to define technology scope for procurement. Ensure contractual considerations are given for data ownership and future services with new service providers.		Consequence: Major Likelihood: Unlikely Risk Rating: Medium
4	Risk: Supply Chain Shortages Source: Procurement	• Objective - Delays in meeting milestone	Consequence: Moderate Likelihood: Likely Risk Rating: High	Equipment specification allows flexibility if specific equipment types have supply chain issues. Ensuring procurement processes are robust and have timeliness factors incorporated.		Consequence: Moderate Likelihood: Unlikely Risk Rating: Medium

Risk #	Risk (except WHS risks)	Impact	Initial risk rating (Before treatment strategies in place)	Risk treatment strategies		Residual risk (Once treatment strategies in place)
				Action	Risk owner and timeframe	
5	Risk: DNSP - Grid Connection Approvals Source: Delivery	• Objective - Delays in meeting milestone	Consequence: Moderate Likelihood: Likely Risk Rating: High	Grid connections processes are initiated as early as possible in project processes. Equipment specifications have been reviewed against DNSP pre-approvals and DNSP proactively engaged in processes.		Consequence: Moderate Likelihood: Possible Risk Rating: Medium
6	Risk: DNSP - Islanding Works Source: Delivery	• Objective - Islanding works are protracted or not possible due to DNSP acceptance	Consequence: Major Likelihood: Possible Risk Rating: High	Islanding application and engagement with DNSP has occurred as part of detailed design and prior to any grid connection approvals. Ensure DNSP buy-in prior to proceeding to construction.		Consequence: Major Likelihood: Unlikely Risk Rating: Medium
7	Risk: DNSP - Network Benefits Source: Delivery	• Financial - increased payback period and lower community returns. DNSP do not accept network benefits or do not provide alternative	Consequence: Moderate Likelihood: Likely Risk Rating: High	Early-stage engagement with DNSPs to enable agreement on tariffs/network services to ensure financial modelling is adjusted for DNSP position.		Consequence: Moderate Likelihood: Possible Risk Rating: Medium

Risk #	Risk (except WHS risks)	Impact	Initial risk rating (Before treatment strategies in place)	Risk treatment strategies		Residual risk (Once treatment strategies in place)
				Action	Risk owner and timeframe	
		tariffs for minimising use of the network/resilience services.				
8	Risk: Community Participation Source: Community	• Objective - community uptake is protracted impacting on achieving milestones.	Consequence: Moderate Likelihood: Possible Risk Rating: Medium	Community participation options are accessible i.e. simple to understand and support services/resources available for the community.		Consequence: Moderate Likelihood: Unlikely Risk Rating: Medium
9	Risk: Modular Funding Sourcing Source: Delivery	• Financial – ability to access funding sources that do not allow for a modular approach.	Consequence: Moderate Likelihood: Possible Risk Rating: Medium	Early-stage engagement with funding bodies to gain guidance and facilitate maximum opportunity to qualify for funding.		Consequence: Moderate Likelihood: Unlikely Risk Rating: Medium

Approved by --

Signed --

[Insert name, title, date of approval]

NOTES

Table 1 – Risk Management Plan Except WHS Risks

To complete the Plan:

1. In the ‘Risk’ column, identify the key risks to the project and, for each risk identified, list the main sources of this risk.
2. In the ‘Impact’ column, identify the possible adverse impacts to the project arising from this risk.
3. Identify what the ‘Initial risk rating’ would be for each key risk, were the risk to remain untreated. To determine this risk rating, applicants should assess the consequence and likelihood of the risks identified, in light of the scale and sensitivity of the project proposed. Detailed guidance on how to rate various project consequences and risks is provided below.
4. In the ‘Risk treatment strategies’ column, under ‘Action’, detail the actions you will undertake to manage and reduce these risks and assign a risk owner, who will be responsible within the proposal consortium for management of the relevant risk, and timeframe.
5. In the ‘Residual risk’ column, identify what the residual risk rating for the project is once the treatment strategy is in place. Again, to determine this risk rating, applicants should assess the consequence and likelihood of the risks identified, in light of the scale and sensitivity of the project proposed. Detailed guidance on how to rate various project consequences and risks is provided below.

Risk rating assessment guidance

Consequences of risks

Applicants should consider the relative significance of a risk eventuating, by ranking the consequence of the risk in accordance with the guidelines provided in Table 3 below.

Table 3: Guidelines on Consequences of Risks

Potential Risk Categories	Insignificant	Minor	Moderate	Major	Severe
Objective	- Negligible impact on delivering project	- Minor Milestone delays.	- Milestone moderately delayed - Objective delayed by less than 20% of original timeframe.	- Objective delayed by more than 20% of original timeframe. - Milestone significantly delayed or not achieved.	- Project Objective not able to be achieved.

Table 3: Guidelines on Consequences of Risks

Potential Risk Categories	Insignificant	Minor	Moderate	Major	Severe
Reputation	- Internal impact only. - No adverse publicity. - No stakeholder conflicts.	- Some adverse publicity. - Internal review of existing policies and practices instigated. - Minor loss of stakeholder confidence.	- External scrutiny / criticism. - Substantial adverse publicity or loss of some stakeholder confidence. - Risk event requires public ARENA response.	- Serious loss of stakeholder confidence. - Adverse national media reports on failings, inefficiency, or inadequacy, causing serious embarrassment to ARENA and Government. - Breach of Commonwealth law and regulations (including standards).	- Complete loss of stakeholder confidence. - Intense public, political and media scrutiny/criticism evidenced by front-page headlines, adverse international media reports and/or sustained television coverage. - Major breach of proposed funding agreement with ARENA.
Financial	- <1% impact on budget.	- Between 1% and 2.5% impact on budget.	- Between 2.5% and 10% impact on budget.	- Between 10% and 20% impact on budget.	- Greater than 20% impact on budget.
WHS	- Staff member sustains minor cuts or abrasions requiring first aid treatment.	- Staff members sustain minor injury requiring medical attention - Staff absences increase sufficiently to cause delay.	- Skilled staff shortages lead to significant additional costs or delays. - Work accident leads to staff/client hospitalisation.	- Unable to attract any skilled staff. - Work accident leads to extensive or serious staff/client injury or temporary disablement.	- Death or serious permanent disablement of staff or clients.

Table 3: Guidelines on Consequences of Risks

Potential Risk Categories	Insignificant	Minor	Moderate	Major	Severe
Environmental	- Minor and reversible effect on physical environment	- Moderate short-term effects on project environment. - No impacts on ecosystem services	- Serious medium term environmental impacts.	- Serious long-term impairment of the environment and surrounding ecosystem functions.	- Very serious long-term impairment of the environment and surrounding ecosystem functions.
Legal		- Minor non-compliance with funding agreement and breaches of regulation. - Breach of Applicant protocols.	- Serious breach of regulation involving investigation by or reporting to authority with prosecution powers - Potential for moderate fine - Breach of funding agreements terms and conditions.	- Major breach of funding agreement or relevant legislation/regulations.	- Breach incurring significant prosecution, with potential for significant fines.

Likelihood of risks

Applicants should consider the likelihood of a risk arising using Table 4 below.

Table 4: Likelihood of risks

Category	Example of Qualitative Measures
Almost Certain	The event is expected to occur in most circumstances
Likely	The event will probably occur in most circumstances
Possible	The event might occur at some time
Unlikely	The event is not expected to occur in most circumstances
Rare	The event will only occur in exceptional circumstances

Risk rating

The hazard/risk rating can be found by assessing consequence and likelihood using Table 5 below. This table can be used to determine a hazard/risk rating for each of the hazards/risks listed, for both before and after the proposed risk treatment strategies are applied.

Table 5: Risk rating

		Consequence				
		Insignificant	Minor	Moderate	Major	Severe
Likelihood	Almost Certain	Medium	High	High	Extreme	Extreme
	Likely	Medium	Medium	High	High	Extreme
	Possible	Low	Medium	Medium	High	High
	Unlikely	Low	Low	Medium	Medium	High
	Rare	Low	Low	Low	Medium	Medium