C4NET

RRCRF Microgrid Feasibility Study – Donald & Tarnagulla

Final report[1]

---

[1] Written by C4NET with the assistance of Dean Lombard and Sangeetha Chandrashekeran from the University of Melbourne, drawing on material from all project reports and the CET Forum held in June 2023. This report embodies the project's microgrids feasibility report.

Centre for New Energy Technologies Ltd | E: info@c4net.com | C4NET.com.au

1.0 Introduction

1.1 Executive Summary

The Donald and Tarnagulla Microgrid Feasibility Study ("the project") was part of the *Regional and Remote Communities Reliability Fund Microgrids Program* funded by the Commonwealth Department of Industry, Science, Energy and Resources to support feasibility studies looking at microgrid technologies to replace, upgrade or supplement existing electricity supply arrangements in off-grid and fringe-of grid communities located in regional and remote areas. Neither Donald (classified as "outer regional") nor Tarnagulla (classified as "inner regional") were off-grid nor fringe-of-grid (see ABS 2021), and were limited cases for the program because they tested feasibility in two well connected network sites with communities seeking new energy futures. This yielded insights on factors that can drive cost-effectiveness of microgrids beyond remoteness and cost of connection/augmentation, such as reliability challenges."

1.2 Overall Outcomes

The study determined that establishing the entire Donald or Tarnagulla communities as microgrids is unlikely to be economically feasible at present under existing technical, commercial, and regulatory arrangements. Nonetheless, it was identified that strategic deployment of new energy technologies can deliver community benefits in line with many of the communities' values and ambitions regarding their energy supply; and:

- Installation of a community battery in Donald is currently being considered; and
- Upgrades to feeder performance (and thus improved reliability) and solar hosting capacity in Donald have been completed.

The project generated a significant amount of data and insights to inform future microgrid, energy solutions, and regional planning and implementation projects. The project team also engaged deeply with community energy proponents from across the state, sharing tools, techniques and resources with community members to help them progress their projects.

The project illustrated how islandable microgrids may improve energy security and reliability for regional communities experiencing reliability issues, and how various energy solutions might be deployed to support community-scale energy agency in regional areas. Many of these benefits can be achieved without establishing a microgrid but by using energy technologies that are common components of microgrids.

The project explored the financial, regulatory, market, community, and logistical barriers to microgrids and started developing a reform agenda.

- Barriers include regulatory opaqueness; technology costs (especially batteries); the economic dynamics of distribution networks (that obscure potential locational value when smearing costs across all customers); and path-dependent industry structure (the traditional model of large retailers and centralised generation).

- A key reform recommendation was to undertake a regulatory frameworks review. This would include consideration of how recent regulatory changes with respect to embedded networks and stand-alone power systems (SAPS) might apply. This would help to clarify how the existing regulatory framework could apply specifically to microgrids, and consider opportunities for regulatory adaptation and innovation rather than wholesale reform such as rule changes.

The project also highlighted the need to invest in stakeholder engagement and community capacity building. Deep and broad engagement with communities around energy projects including microgrids is necessary to develop trust, and to design projects that can meet community needs and aspirations as well as supporting the energy system as it adapts to the new environment. This project reveals that there can be opportunities for win-win outcomes, but the process is complex and resource-intensive, requiring specific expertise. There are a range of supports that communities need to build their capacity to engage in community energy decision making. Some potential supports include access to independent advice from relevant not-for profit groups like Community Power Agency and universities, and access to industry advice to understand the potential development from a systems perspective early on.

The project produced an *Energy Literacy Community Toolkit* aimed at the general community to explain how the energy system works and how community energy initiatives such as microgrids fit into the broader network and grid infrastructure. It also held a *Community Energy Transformers Forum* that brought together community energy leaders, local and state governments and other key community energy stakeholders to share project findings and provide resources to facilitate community energy project design and development. Observing the challenge communities were having assessing their own needs and potential solutions to them, C4NET developed and published both a "*Community Energy Canvas*" and "*Stakeholder Engagement Analysis Template*" as tools to facilitate the process. Exploring solutions can be expensive and therefore benefits from being stepwise and data informed. The Canvas was used in facilitated discussion with community groups exploring energy solutions at the Forum to strong feedback. While the groups using the tool were split by their stage of development in exploring solutions, the tool was informed by the feasibility study and served as an aid to the discussion. It helped frame the key issues that needed to be addressed by community proponents should they wish to pursue such a solution.

1.3 Key Findings

- Clearly defining microgrids is critical to distinguish them from other types of sub-networks.
- A clear regulatory definition of microgrids is also needed.
- Communities wanted greater reliability and more self-reliance.
- The community experiences and understands the nature and value of reliability differently from the DNSP and regulators. As such, the community may value the integration of additional renewables and DER more than network operators.
- Historically, Distribution Network Service Providers (DNSPs) have had an obligation to provide reliable, secure, and affordable energy supply. However, the role of helping communities evaluate their energy needs is not currently within this scope and there are commercial barriers to DNSPs investing resources into investigating such outcomes. To develop community-scale microgrids that meet the needs of individual communities, DNSPs would

need to engage with commercial and community/consumer concerns and aspirations in new and nuanced ways. If this is sought then the regulated entity frameworks would need to better align interests to incentivise such engagement and solutions.

- The existence of significant reliability problems is a key indicator that a microgrid might yield a net benefit to a community.
- Communities also wanted to be able to prioritise critical loads when supply was limited.
- Deeper and wider community engagement is needed to build a better understanding of community goals and values.
- A microgrid could help stabilise local grid voltage, deliver lower energy costs through direct wholesale purchasing, earn revenue from wholesale market arbitrage and provision of ancillary services, reduce peak demand and increase minimum demand, reduce network costs, and increase reliability and resilience. The more revenue streams that can be accessed the more favourable the business model for ownership.
- Further exploration of innovative community ownership and operating models for microgrids may be beneficial. Under current settings, there are significant hurdles for communities seeking to develop sustainable governance structures to manage risk, investment, and operational complexities of microgrid assets. More research may inform community benefit energy providers and social enterprise models and feasible means of addressing the associated complexity of ownership and operation.
- A fully islandable microgrid requires significant upfront investment that requires significant revenue to recoup the capital cost – but the magnitude of this depends on the degree of islandability and the ability to access available value streams.
- A microgrid is not an economically feasible solution for Donald or Tarnagulla at the current time. However:
    - Smaller scale community energy projects are likely to help address some of the communities' objectives; and
    - Microgrids are likely to be a more viable option in some regional communities, with similar characteristics to Donald and Tarnagulla, in the medium term (10+ years).

1.4 Other Findings

- Microgrids are place-based technical infrastructure that activate local communities in ways that centralised energy solutions generally do not. There could be benefit to greater clarity and precedents around the role of communities in DER developments.
- DER projects are fundamentally social *and* technical undertakings, where it is not possible to decouple the social dimensions from the technical, nor vice versa. What is technically feasible must also align with social objectives to be sustainable and effective.
- There is an inherent risk in picking broad-based technology winners, and a potentially more sustainable approach would be to exploring the problem(s) that energy technologies can address, and tailoring technology solutions accordingly.

- Local institutions and entities, particularly local government, have a very important role to play in facilitating discussions and enabling microgrids. Other state institutions and agencies can play an important role in de-risking community energy projects and enabling the development of appropriate ownership and operation model.

1.5 Project Synopsis

The C4NET Donald and Tarnagulla Microgrid Feasibility Study (The Project) was a three-year, collaborative research project designed to understand the opportunities and barriers to implementing microgrids in regional and remote communities. The Centre for New Energy Technologies Ltd (C4NET) partnered with academic researchers from Deakin, Monash, Swinburne, Melbourne, RMIT, and Federation Universities to conduct deep technical, operational, market and stakeholder research. C4NET also worked closely with the Distribution Network Service Provider (DNSP) for the towns, Powercor, to understand and assess several scenarios for implementation of microgrid operations. Additional industry collaboration was provided by GWMWater, the local water utility which had both a community and commercial interest in the project. The project team also worked closely with the Central Victorian Greenhouse Alliance (CVGA) to assist with community engagement.

The towns of Donald and Tarnagulla were chosen as test beds for feasibility studies based on their engaged communities and locations along existing network infrastructure. Donald is located along a long feeder that supplies regional communities both before and after the town (mid-feeder) and Tarnagulla is located at the end of a long feeder as part of a ring main. These two scenarios represent reasonable templates for many regional communities within Victoria, allowing the results of the feasibility study to be applied for use in other early-stage energy solutions assessments across regional and remote communities. According to the Australian Bureau of Statistics 2021 Remoteness Structure Donald is classified as "outer regional" and Tarnagulla as "inner regional". The five remoteness classes are: Major Cities, Inner Regional, Outer Regional, Remote and Very Remote.

Many in the communities of Donald and Tarnagulla were highly engaged and had broad objectives associated with the project that extended beyond the remit of reliability electricity supply. For example, some within the community sought to use microgrid development as a source of interest for the town to facility and attract industry and other regional investment.

Learnings from the project extended beyond standard techno-economic assessments of assets which are traditionally included in microgrid operations. The project generated significant insights for stakeholders and consumers, regulators, DNSPs, retailers, and local, state and federal policy makers on the current state of the energy transition, the evolved expectations of consumers on the role of the delivery of electricity supply and the opportunities for policy to meaningfully impact regional communities.

For this project C4NET defined a microgrid as a specific set of assets that can be fully isolated from the electricity network while meeting the reliability and resiliency needs of a particular geographic area. Making this distinction was important to scoping the cost and operational requirements that are unique to microgrids as opposed to other energy solutions for communities. A formal definition of microgrids will be required moving forward to avoid confusion and advance regulatory and market frameworks to ensure that microgrid operators are able to fully realise relevant value streams. Further meaningful conversations about employing microgrids require clear distinctions on the commercial, technical, and geographic parameters that are at play.

It is important to note that the purpose of this study was not to assess the value of microgrids broadly as there are several existing scenarios where fully islandable asset clusters are commercially viable. This project was focused on the feasibility of existing and near-term commercialised technologies for use by regional and remote communities within Victoria when considering their reliability and resiliency requirements.

While this project has assessed the financial and economic viability of a microgrid in terms of the current regulatory and market frameworks for energy supply – where all costs are ultimately passed on to customers through their energy bills – an alternative approach with a focus on green industry and regional development could provide an alternative framework for microgrid development by intrinsically valuing local economies, environmental benefits, and industry support and generation should a community-first lens be applied. Such an approach would also more neatly encompass community benefit energy providers with a social enterprise orientation.

-

Table of Contents

2.0 The Regional and Remote Communities Reliability Fund Microgrids Program

The Donald and Tarnagulla Microgrid Feasibility Study was part of the *Regional and Remote Communities Reliability Fund Microgrids Program* funded by the Commonwealth Department of Industry, Science, Energy and Resources

The objective of this federal government program was to support feasibility studies looking at microgrid technologies to replace, upgrade or supplement existing electricity supply arrangements in off-grid and fringe-of grid communities located in regional and remote areas. The intended outcomes were to facilitate viable projects that:

- improved regional business, community services and emergency resilience through innovative microgrid solutions.
- scaled-up and improved microgrid systems in regional and remote communities.
- increased human capital (skills/knowledge) in the design and deployment of microgrids.
- demonstrated commerciality and/or reliability and security benefits of deploying and upgrading microgrids
- reduced barriers to microgrid uptake in remote and regional communities
- increased dissemination of technology and/or project knowledge regarding the deployment and upgrading of microgrids.

2.1 Meeting the program objective

To support regional and remote communities to investigate whether establishing a microgrid or upgrading existing off-grid and fringe-of-grid supply with new energy technologies would be cost-effective.

The Donald and Tarnagulla Microgrid Feasibility Study determined that establishing the entire Donald or Tarnagulla communities as microgrids is unlikely to be cost-effective at the present time under existing technical, commercial, and regulatory arrangements. Nonetheless, strategic deployment of new energy technologies can deliver community benefits in line with many of the communities' values and ambitions with regard to their energy supply. The project also shed light on the technical and financial barriers to cost-effectiveness, indicating which future technological and price changes and design choices might facilitate not only microgrid viability, but also broader energy solutions for community groups. (Refer to the 3.25 Economic and technical opportunities section on page 21.)

The project highlighted a range of community aspirations that are sought from new energy technology and infrastructure development. The project revealed both the challenges of and opportunities for involving communities in energy projects, and the project partners gained a better understanding of how to effectively engage with communities in future energy projects. (refer to the section on 5.0 Communities and microgrids, below)

2.2 Delivering on the intended program outcomes

Viable projects attract funding to support scale-up / implementation of microgrid systems in regional and remote communities.

The project determined that a microgrid was not viable for Donald or Tarnagulla, but that a community battery in Donald's industrial precinct might be a cost-effective in improving energy security and availability for the precinct. Further development is underway. (Refer to 3.212 GWMWater site assessment on page 27 below.) the project also identified opportunities to improve feeder performance (and thus reliability) and increase solar hosting capacity in Donald. This work was completed.

Additionally, the 5.8 The Community Energy Transformers (CET) Forum (see page 42 below) enabled the project team to engage deeply with community energy proponents from across the state and included sharing tools, techniques and resources with community members to help them progress their projects.

Increased human capital (skills/knowledge) in the design and deployment of microgrids.

The project generated a considerable amount of data and insights to inform future microgrid, energy solutions, and regional planning and implementation projects. We note enhanced skills and knowledge for the DNSP, the community, university researchers, and C4NET and their project funders. The project has also engaged a range of stakeholders and market/regulatory agencies to consult and translate research findings. Some key learnings include:

- identifying potential grid-based value streams and the barriers and opportunities for accessing them (see 3.211 Economic and risk assessment on page 26 and 3.212 GWMWater site assessment on page 27);
- the impact of islanding on network voltage, and how to mitigate it (see 3.210 Microgrid impact study on page 25); and
- techniques and approaches to improve the effectiveness of community engagement in energy projects (see 5.0 Communities and microgrids on page 38).

Demonstrated commerciality and/or reliability and security benefits of deploying and upgrading microgrids.

Both towns have lower reliability than average for Powercor's network, as shown in the table below where SAIFI (System Average Interruption Frequency Index) is the average frequency of outages per customer per year, and SAIDI (System Average Interruption Duration Index) is the average number of minutes spent off supply per customer per year.

	SAIFI (outages p.a.)	SAIDI (minutes off supply p.a.)
Powercor as a whole[2]	≅1.3	100
Donald[3]	10.55	53.21
Tarnagulla[4]	84.92	1360.85

The project demonstrated not only how islandable microgrids can improve energy security (e.g. voltage management within and around the microgrid) and reliability (e.g. reducing outages) for regional communities experiencing reliability issues, but also how various energy solutions might be deployed to support energy agency in regional areas. Importantly, many of these benefits can be achieved to various extents without establishing a microgrid by using similar energy technologies to those used in microgrids (such as community batteries, local generation, demand management, etc.). It also identified the aspects of microgrids that most determine whether they are cost effective, and identified value streams they can access to increase their financial viability. (Refer to 3.25 Economic and technical opportunities on page 21 and 4.2 The feasibility of microgrids on page 33.) The latter opportunities could be accessible for communities without establishing a microgrid through other collaborative energy projects that coordinate supply and demand within a community.

Reduced barriers to microgrid uptake in remote and regional communities

The project progressed understanding the barriers (financial, regulatory, market, community, and logistical) and started developing a reform agenda. Key barriers include:

- Some technologies – especially batteries – while rapidly decreasing, in the applications assessed were cost prohibitive at present.
- The economics of electricity grids creates cost barriers, especially around the way costs are smeared over entire networks. While this is done to advance locational equity – it is based on the economics of traditional one-way grids. The transition from centralised to decentralised energy resources – including both behind-the-meter and front-of-meter consumer or community owned generation and storage, as well as commercial distribution-connected resources – impacts these economics and could be considered further in future approaches to pricing network usage to continue delivering locational equity at efficient cost.
- Major regulatory change is not required to allow microgrids. However, clarity around how existing regulation should apply specifically to microgrids is needed. A regulatory frameworks review, including consideration of how recent regulatory changes with respect to embedded networks and stand-alone power systems (SAPS) might apply, would be useful. A regulatory definition of microgrids will be essential to facilitate this.
- The way energy markets are operated and can be accessed reflects the traditional model of large retailers and centralised generation. Changing the way markets work and retailers are regulated to allow participation of new types of energy providers with different types of

---

[2] Reliability Panel, *2022 Annual Market Performance Review*, Final report, 30 March 2023; AEMC, Sydney: pp. 100–101

[3] RMIT University, *Area Hosting Capacity Assessment: Final Report* (Donald and Tarnagulla Microgrid Feasibility Study), May 2021: p. 37

[4] *Ibid*: p. 38

customer relationships and new business models will make it easier for community-based microgrid projects to be developed and become viable.

- The project highlighted the need to invest in stakeholder engagement. Communication and understanding between project partners and people in the community can go awry without significant local investment in understanding the values and drivers endemic to the area, leading to misunderstandings and frustrated expectations. This is exacerbated by projects that are defined in terms of a proposed solution, rather than problem-solving – in this case, the project's purpose was to investigate the feasibility of a microgrid, rather than to understand the reliability concerns and other issues and devise solutions to those. In the course of this project, Powercor was able to improve feeder performance and increase solar hosting capacity – both addressing community concerns – but the lack of a microgrid outcome was still a disappointment for some. Deep and broad engagement with communities around energy projects including microgrids helps to develop trust, and to design projects that can meet community needs and aspirations as well as supporting the energy system as it adapts to the new environment. This includes taking a step back and embedding community and energy system needs and realities within broader societal contexts and principles.

Increased dissemination of technology and/or project knowledge regarding the deployment and upgrading of microgrids.

The project reports and the community energy forum have engaged a range of industry and community stakeholders and socialised the project findings.

As part of the community engagement related to the project, a series of energy literacy videos aimed at the general community were produced to form the *Energy Literacy Community Toolkit*. The *Toolkit* explains how the energy system works and how community energy initiatives such as microgrids fit into the broader network and grid infrastructure. It's available online, along with video documentation of a series of primary school workshops that delivered similar information designed for primary school aged children.

Toward the end of the project, the *Community Energy Transformers Forum* brought together community energy leaders, grant recipients, local and state government as well as other key stakeholders involved in developing community energy projects from across Victoria. We used the forum to share our findings with these community practitioners, and provided resources to facilitate community energy project design and development including a project development matrix (the Community Energy Canvas) outlining the different types of data, information, and relationships needed to design and implement a successful project. We also gathered information and feedback from these community practitioners, who shared what they had learned during their projects as well as rich insights into the different values and aspirations that drive community projects, how they had worked with and managed multiple priorities and differing objectives from different sections of the community, and – importantly – their experiences of helpful and at times unhelpful engagement with network businesses and other industry stakeholders. More detail on what we learned from the CET forum is in the 5.0 Communities and microgrids section on page 38 below.

3.0 The Donald and Tarnagulla Microgrid Feasibility Study

3.1 Project scope and description

The project purpose was to assess the feasibility of partial or full microgrids in two regional Victorian towns – Donald and Tarnagulla – by planning, designing and evaluating microgrids for each town and, informed by contrasting the impact of the town's different characteristics and needs, developing a tool to extrapolate the method for use by towns with a similar makeup. The towns were selected by the local distribution network, Powercor, as towns with edge of grid characteristics and engaged communities.

Engaging with the communities was recognised as critical to understanding the opportunities and impacts of concentrating distributed energy resources (DER) such as solar and battery in microgrid areas. Key objectives included:

- facilitating community participation in the project;
- determining the willingness of communities to coinvest or enter into alternative supply arrangements;
- increasing self-generation capability and understanding the impact of DER within the microgrid areas;
- finding the optimal balance between customer premises (behind-the-meter) and network side (front-of-meter) for battery installations; and
- exploring the ability to engage the towns' existing 185 solar systems in a microgrid
- determining the viability of a microgrid at different scales (whole of town, precinct etc)

All investment in community DER was to remain in place regardless of whether either microgrid proceeds to investment stage.

The latter point – factoring existing privately-owned DER into the microgrid modelling – emerged as a key consideration in microgrid design. Solar PV penetration in the communities was so high that it became apparent that there was limited value in additional microgrid solar generation without significant investment in new storage. This is particularly so when considering that a key driver of microgrid investment from a community standpoint is to reduce carbon emissions related to electricity consumption. Because storage is still relatively expensive, this became a limiting factor in microgrid viability.

3.11 The impact of COVID-19

Restrictions on movement and public gathering due to the COVID-19 pandemic delayed and constrained some of the community engagement aspects of the project, and in many ways the project more generally. The project was designed before the pandemic began, and its modular nature was more suited to the pre-pandemic world of travel and in-person meetings. By the time the project commenced during 2020, the pandemic and associated restrictions were well underway, but were expected to ease as we entered 2021. Restrictions continuing during most of that year meant that much engagement – both within the project, and between the project and the Donald and Tarnagulla communities – continued to be largely remote. Together, this limited engagement with the communities and constrained collaboration between the various project teams.

In April 2022, the community engagement team was able to interview 12 residents and business owners in-person: four in Tarnagulla, and eight in Donald; and in October 2022 they ran in-person energy literacy workshops in Tarnagulla Primary School. This helped offset some of the shortcomings of remote engagement. This was followed by a community energy meeting in Donald in February 2023 to report on key outcomes from the project and additional work on reliability being undertaken by Powercor.

Toward the end of the project it became apparent that there had been some misunderstandings between project proponents and some of the engaged community members in, leading to unmet expectations of project outcomes. Additionally, it was recognised that the group of community members who had been engaged with the project was not as broad or representative of the wider Donald and Tarnagulla communities as would have been desirable. It is probable that the constraints on in-person engagement earlier in the project due to impacts of COVID-19 was a factor in one or both of these issues.

3.2 Project outcomes

The proposed project outcomes are described below, with explanation of how they were pursued over the life of the project and the extent to which they were delivered.

The project was designed with 13 sections undertaken by different university and industry teams. This enabled deployment of specialist knowledge where most needed and deep interrogation of the relevant subject matter.

Key findings were included:

- **Clearly defining microgrids** is critical to distinguish them from other types of sub-networks (such as stand-alone power systems (SAPS) and embedded networks) and to establish a consistent nomenclature for regulatory, market, policy, and community groups to ensure that we create the right infrastructure and pathways for community energy agency while meeting the broader remit of network operations for regional communities.
- A **clear regulatory definition of microgrids** is also needed so that regulatory changes designed to better facilitate microgrids can be well targeted and effective.
- Community members surveyed wanted **greater reliability** and **more self-reliance –** such as sharing surplus solar within the community and having a sense of local ownership of their energy supply. They may be prepared to pay a little more for these benefits, but may not have been representative of the community as a whole. **Retail choice was less important** to them than getting these benefits.

- Community members also wanted to be able to **prioritise critical loads** – such as the hospital and aged care facilities, telecommunications equipment, grocery stores, petrol stations and other essential services and infrastructure, and vulnerable households – when supply was limited.
- **The community experiences and understands reliability differently from the DNSP**. One aspect of this is that DNSP reliability standards are based on averages across the network, so a town can have reliability issues despite the DNSP meeting reliability standards. Customers are compensated for reliability shortfalls, but still experience the outages.

- **Deeper and wider community engagement is needed** to build a better understanding of community goals and values, especially with respect to variance within and between communities, and prioritisation of values.
- Under the current regulatory framework, a microgrid could (to varying extents and depending on the ownership and governance model)[5]:
    - help stabilise local grid **voltage**.
    - deliver lower energy costs through **direct wholesale purchasing**.
    - earn revenue from **VPP participation**, **wholesale market arbitrage** and **provision of ancillary services**.
    - enable coordination of storage, loads and generation to **reduce peak demand** and prevent insufficient minimum demand.
    - **reduce network costs**.
    - significantly **increase reliability and resilience**.

- With regulatory changes, a microgrid could also earn revenue or reduce energy costs by providing **network services** to the DNSP.
- Improving reliability and resilience are key benefits of a microgrid and the existence of **significant reliability problems is a key indicator** that a microgrid might yield a net benefit to a community. The extent to which reliability and resilience are valued within the regulatory framework determines that threshold beyond which microgrids are viable.
- A fully islandable microgrid requires significant investment cost that needs to be recouped through energy revenues – but the magnitude of this depends on the **degree of islandability** (i.e., how long and at what capacity it can island), its **ability to access available value streams**, and potential additional benefits if further value streams are unlocked.
- The significantly greater cost for fully islandable town-sized microgrids makes it unlikely these could be DNSP-led grid-connected stand-alone power systems (SAPS) under the current regulatory system. This could change if **resilience is valued differently** in the regulatory framework, or if other regulatory changes can better reflect value unlocked by some microgrid-enabled functions or account for non-quantifiable community benefits in a way that

---

[5] These all bring tangible value but some can't directly offset costs without regulatory change, and others may be able to access additional value with regulatory change.

does not disadvantage community members who will not or cannot pay higher prices for these benefits.

- **An initial finding that a smaller concept microgrid might be viable** within Donald, focused around the water plant and industrial precinct, relied on funding support from the RAMPP[6] program which was designed to support regional microgrids. Changes to the RAMPP program's focus and eligibility criteria made the project ineligible and thus unviable. But the developmental work for this project has informed a new potential project for a **community battery** that meets some of the same objectives. This project is being pursued.

- The ultimate conclusion was that **a microgrid is not an economically feasible solution** for Donald or Tarnagulla at the current time. However:
    - Smaller scale community energy projects are likely to help address some of the communities' objectives; and
    - Microgrids are likely to be a more viable option in some remote communities in the medium term (10+ years).

Looking at the proposed outcomes and assessing the extent to which they were met requires looking in some detail at the outcomes sought and the findings of the sub-projects that addressed them.

3.21 Engaging with the communities

Support implementation of microgrid systems in regional and remote communities by:

- investigating the town's social and cultural values, as well as their priorities when it comes to electricity, through a range of forums, interviews, listening posts and responses to customer offers
- Understanding needs, drivers, variance across the population impacted, level of participation sought, trade-offs of existing supply, and key deliverables the microgrid must achieve through applying the findings above and hosting codesign workshops with customers and community opinion leaders
- Informing the merits of the options available for stakeholders to meet their needs
- Understanding and attempting to classify the value of community engagement for other sites contemplating a microgrid
- Identifying how much support is required within the community for different customer types to understand and/or participate in a trial.

Regional and remote communities are unique in their energy needs based on socio-economic, geographic, and infrastructure requirements. They often have limited access to broader services such as certain social programs, may lack regional economic investment, and populations that are, on average, of lower socioeconomic status than metropolitan communities. For example, Buloke Shire

---

[6] RAMPP = Regional Australia Microgrid Pilots Program, overseen by the Australian Renewable Energy Agency (ARENA).

(where Donald is located) ranks 24th among Victoria's 79 local government areas on the SEIFA Index of Relative Socio-Economic Disadvantage.[7]

The energy transition affords electricity consumers more discrete choice in how they can incorporate personal and community values into their purchasing decisions. It was clear during this project that when partnering with regional communities as living labs to assess the technological and economic opportunities for microgrids, there are broader considerations for the community than mere reliability and security of supply and how microgrid technologies might improve traditional DNSP responsibilities – and there are more types of solutions to the communities' goals and ambitions than the specific solution (in this case, a microgrid) a project might be focusing on, such as the potential of the Donald community battery instead of a microgrid reflects this.

3.22 Community engagement

The primary community engagement stream of the project was undertaken by Swinburne University and the Central Victorian Greenhouse Alliance (CVGA). It sought to understand the communities' energy needs, community priorities if supply was constrained (the relative merits of various trade-offs among energy needs, what changes to current supply could be accepted and what behavioural change could be expected), to inform the feasibility assessment and design of microgrid solutions and other work developed or proposed by the project. It also gave insight into challenges and opportunities engaging with communities on energy projects.

The project team worked particularly with two active community energy-focused groups, one in each town:

- the *Tarnagulla Alternative Energy Group Inc* (TAEG), a local council and community-based group that worked with the Department of Environment, Land, Water and Planning (DELWP) to develop the *Resilience Action Plan for the Tarnagulla Community* in June 2020; and
- *Donald 2000*, a local business-based group with a strong interest in encouraging sustainable economic development of Donald and the surrounding region, recognising that energy is a key element.

A mix of surveys, interviews, community meetings and information updates were used to engage with the communities'. A key engagement was one-on-one interviews with nine people, conducted by phone or videoconference; and in-person interviews with 11 more once pandemic restrictions eased. While more engagement was sought, the small sample size means limited value can be drawn from the engagement. Within this limitation though, the key findings from these included:

- Priorities are environmental sustainability, reliability, and lower cost.
- There's' a strong preference for more reliance on local energy resources (though not necessarily exclusively).
- People want to be able to share their surplus solar generation within the community.

---

[7] Buloke Shire Council, Annual Report 2021–22

- There's considerable concern about reliability, and enthusiasm to improve it. (While reliability in the towns is better than in many other Victorian regional and rural communities, it is below average for Powercor as a whole.)
- People were interested in prioritising supply for key services and groups – such as the hospital, aged care facilities, telecommunications equipment, grocery stores, petrol stations, and vulnerable people in the community – when supply was limited.
- Retail choice is not important. Whatever works!
- Cost reduction is important but not the most important. People were happy to pay a bit more for local benefits.

More detail on what the community would prioritise and would constraints they would accept if supply was constrained was not able to be informed due to limited engagement, but would be useful in future assessments.

Another key engagement was an online roundtable with community energy and microgrid project leaders and consultants, and advocates and researchers with particular interest in community energy projects. This identified a few key considerations and issues for community energy projects:

- TRUST as the basis for community engagement with industry;
- ENERGY LITERACY to support well-informed decision-making and project planning by community energy groups; and
- RESILIENCE of energy supply for the community as a key driver for community energy and microgrid projects in regional and rural towns. People are cognisant of the critical importance of their energy supply and its vulnerability in the face of extreme weather events and natural disasters.

In the final stage of the project, energy literacy training was delivered to the communities – via in-person workshops in Tarnagulla Primary School, and the *Energy Literacy Community Toolkit*, a series of informational videos that were shared with both communities and also made publicly available. The *Toolkit* is available on CVGA's website, along with video documentation of the in-school workshops.

The community engagement team also participated in a public meeting held by Powercor in early 2023. This event was a community information session on the learnings from the 3.212 GWMWater site assessment (see page 27 below). It was also an opportunity for Powercor to explain the recent work being done to increase the reliability of the feeder to the town and to give an opportunity for locals to ask questions about their network.

The engagement team noted that Donald and Tarnagulla are very different communities, and that their engagement in each town was similarly different – in Donald they mostly engaged with the business community, which is very focused on improving energy reliability and capacity and is eager for a project to commence; while in Tarnagulla the engagement was with passionate community members more focused on resilience and sustainability and more comfortable taking some time to develop a project that aligns with their values and aspirations. This led to the different approach taken in each community, with Tarnagulla being the main focus of the energy literacy workshops, while in Donald the focus became the smaller concept microgrid proposal in the industrial precinct, a proposed outcome of the *3.212 GWMWater site assessment* described on page 27 below (as discussed there, this was ultimately determined to not be viable and the proposed project shifted to a community battery in the industrial precinct that could meet some of the same objectives).

At the same time, it was recognised that engagement had occurred primarily with certain subgroups of each community, and that broader community engagement would be needed to better understand the wider communities' needs and values.

More detail is in the community engagement report.

3.23 Community Energy Transformers (CET) Forum

The *CET Forum* was held in Bendigo on 5 June 2023. Its purpose was to bring together people from community energy projects across Victoria in a full day event with researchers, policy-makers, regulators, network businesses, and local governments in order to:

- better understand community energy groups in terms of their composition, constituencies, knowledge base, skillsets, goals and objectives, values, and so on;
- better understand the perspectives of community energy groups – how they understand the energy industry and policy bodies and what they do, what they need (and don't need) from energy businesses and authorities that are trying to help them;
- understand how communities can be better supported and assisted in developing and implementing energy projects; and
- upskill people in community energy groups, and to provide them with tools, networks, and knowledge to help them take tangible actions in advancing their objectives.

More detail on the forum's outcomes can be found in 5.8 The Community Energy Transformers (CET) Forum section below.

3.24 Facilitating community uptake of distributed energy resources

Increase human capital (skills/knowledge) in the design and deployment of microgrids by:

- increased DER uptake in the communities, whether it be at homes, businesses or community organisations, including the investment commitment by the local councils and utilities to demonstrate leadership and support.
- leveraging of existing support schemes such as the Victorian Solar Homes Program incentives for solar and storage.
- a deeper understanding of how DER can be used to benefit the community as well as individual consumers.

This aspect of the project was led by the Central Victorian Greenhouse Alliance (CVGA) in partnership with the Loddon and Buloke Shire Councils. They sought to understand community energy supply and usage requirements, network constraints and opportunities, and assess the community appetite for subsidised solar and battery installations on commercial and residential premises. The project team leveraged Victorian Government solar and battery rebates and local councils' solar bulk-buy programs.

The already high rate of solar penetration in both towns limited the reach of the project.

3.25 Economic and technical opportunities

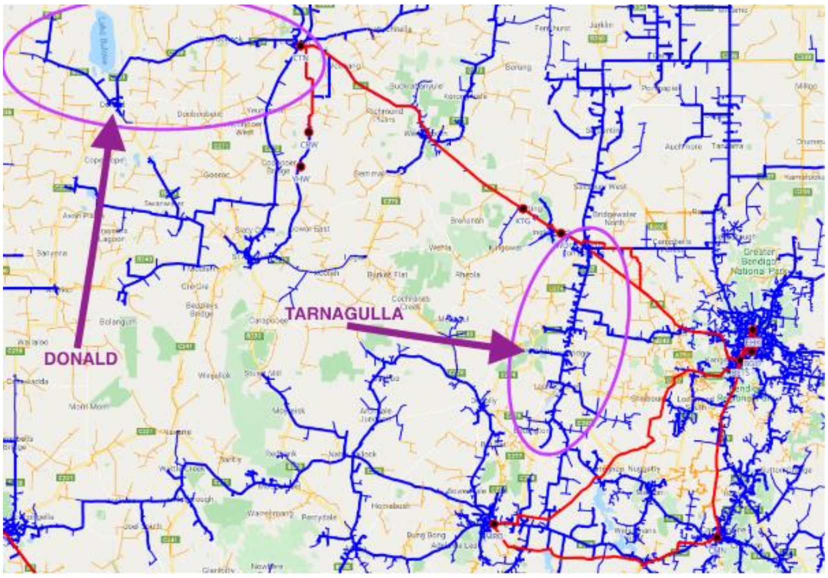
Demonstrate commerciality and/or reliability and security benefits of deploying and upgrading microgrids by:

- An implementable, well-informed investor-ready plan for each town.
- An explanation of the trade-offs and opportunities of various stakeholders from deep data analysis.
- Network implications for implementation.

This was a core focus of the project and was undertaken by a number of specialist teams focusing in different aspects of the work – starting with an initial network assessment of the two sites, assessing energy needs and hosting capacity, examining the options for islanding design, developing approaches to access and deliver different types of value, and understanding the interaction between the proposed microgrids and their surrounds.

3.26 Network assessment

Network assessment was undertaken by Powercor, the local DNSP for the two towns. The purpose of this work was to assess the current and forecast status of supply to Donald and Tarnagulla, including grid and customer characteristics, demand peak, volume, events impact, known constraints, and power quality analysis.



Both towns are in Central Victoria, with Donald 280 km and Tarnagulla 180 km from Melbourne. Both towns are located on long feeders (from substations that are both fed by Bendigo Terminal Station) and there is little capacity to transfer load to other feeders or stations as they are located on isolated assets or along the feeder which is critical to delivery of electricity supply to consumers further down the line. The map above[8] shows both towns in context with other towns, LV feeders, and distribution lines.

The energy and customer dynamics of each town are detailed in Appendix 2. Additional, non-public detail on customer demand and other relevant load characteristics was shared as necessary with researchers from other sub-projects as necessary to complete their assessments. Historically, maximum demand of both feeders has not exceeded their respective capacity ratings.[9] As such, there is no augmentation planned in the near future. Information on outages was shared with researchers to help provide detail on reliability issues. This summary table compares outage frequency and duration in the two towns with the average for Powercor's entire network.

	SAIFI (outages p.a.)	**SAIDI** (minutes off supply p.a.)
Powercor as a whole[10]	≅1.3	100
Donald[11]	10.55	53.21
Tarnagulla[12]	84.92	1360.85

More detail is in the Network Assessment Report.

3.27 Area hosting capacity assessment

This assessment sought to model (for each town) different connection and operational scenarios, each with different generation and storage capacity (using solar, diesel/gas gen-sets, batteries and demand response options) to meet energy needs while accounting for network constraints. Scenarios were *grid-connected* (with some backup capacity), *islanded* (stand-alone system with no grid connection and more storage and generation) and *virtual power plant* (grid-connected and islandable, with more generation and considerably more storage than the other scenarios, and forecasting both load and generation to optimise these resources).

The approach taken was to co-locate solar PV, battery storage, and backup gen-set at each distribution substation within each town – this approach offers more flexibility than centralised microgrid generation and storage, and also enables the resources to be used to support quality of power supply

---

[8] All diagrams in this section are from the relevant project reports.

[9] N rating: Donald's feeder CTN006 has an N rating of 9.2 MVA; Tarnagulla's feeder MRO007 has an N rating of 10.4 MVA

[10] Reliability Panel, *2022 Annual Market Performance Review*, Final report, 30 March 2023; AEMC, Sydney: pp. 100–101

[11] RMIT University, *Area Hosting Capacity Assessment: Final Report* (Donald and Tarnagulla Microgrid Feasibility Study), May 2021: p. 37

[12] *Ibid*: p. 38

(such as mitigating voltage fluctuations) in the LV network.13 This microgrid was then modelled in various scenarios.

The project found that:

- The *grid-connected* scenario is the most cost-effective.
- The *islanded* scenario has materially higher reliability – measured using SAIDI (System Average Interruption Duration Index = the sum of all customer interruption durations divided by the total number of customers), SAIFI (System Average Frequency Duration Index = the total number of customer interruptions divided by the total number of customers), and ENS (Energy Not Supplied = the total amount of energy on average not delivered to the system loads).
  - For Donald, SAIFI is 45% lower, SAIDI is 38% lower, and ENS is 38% lower in the islanded scenario than the grid connected scenario
  - For Tarnagulla, SAIFI is 80% lower, SAIDI is 94% lower, and ENS is 95% lower in the islanded scenario than the grid connected scenario
- The *virtual power plant* (VPP) scenario provides the most energy security and may be cost-effective[14] but has a high capital cost.
- Both towns have more consistent voltage when islanded due to voltage support from the back-up generators.
- Residential batteries are effective at absorbing surplus solar PV generation during the day for later use during peak times; while community batteries are most effective at the end of a feeder to help stabilise voltage when needed.

More detailed findings are in the Area Hosting Capacity Assessment Final Report.

3.28 Islanding design and cost analysis

This analysis sought to define the optimal islanding point and undertake cost-benefit analysis of the islanding design for each of the towns to operate autonomously. The project proceeded in three stages:

Stage 1: Develop a representative model for both (Donald and Tarnagulla) microgrid networks with associated external grid connections.

Stage 2: Study the network model for islanding design by considering the optimal location of islanding and the status and operation of the microgrid in the islanded mode.

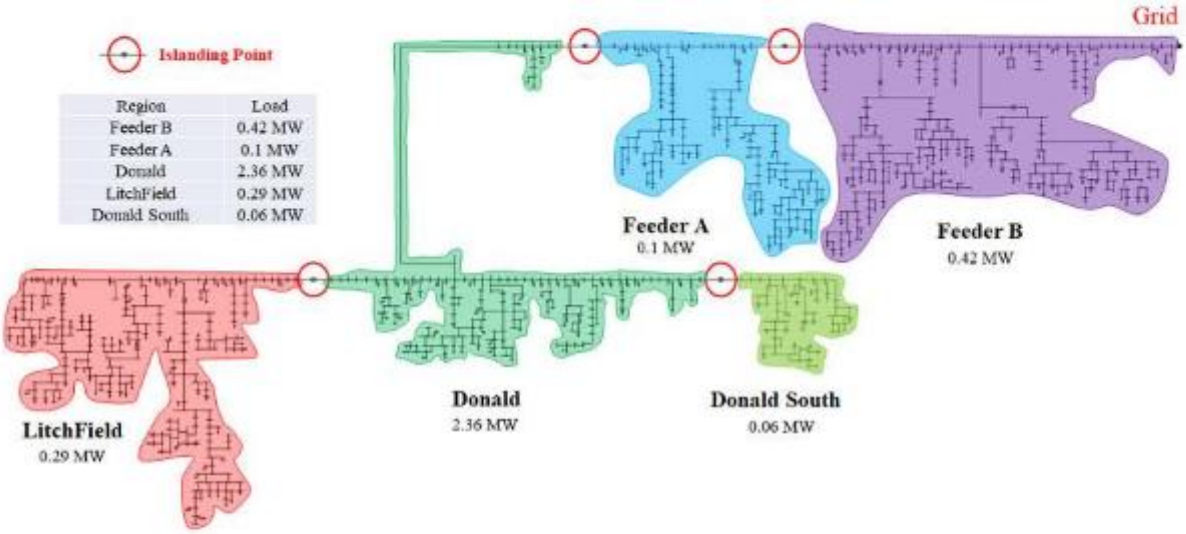
Stage 3: Undertake cost-benefit analysis of the islanding options and autonomous operation of the microgrid by highlighting different network events and scenarios.

---

[13] More detail on the merits of this approach is in J. Fernandopulle, Y. Fang, M. Datta, I. Nutkani, A. Vahidnia, Z. Csereklyei, A. Kallies, R. Yang, M. Gu, P. Dao, C. Liu, K. Wang and L. Meegahapola, 'Planning and operation of community microgrids: technical, economic, policy and regulatory aspects', RMIT University, Melbourne, Australia, 2023

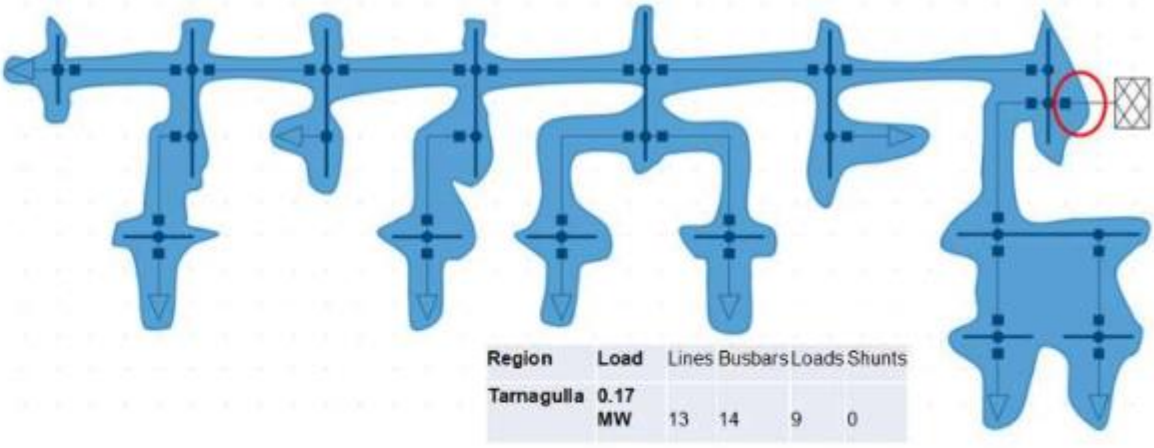
[14] This is an estimate which considers the additional capital cost of an intelligent control system and additional generation and storage to optimise operation as a VPP. The additional energy security is an assumption based on the having the additional energy resources when islanding.

The project determined five potential islanding points for Donald, and assessed the economics and performance of islanding in any possible combination.



Region	Load
Feeder B	0.42 MW
Feeder A	0.1 MW
Donald	2.36 MW
LitchField	0.29 MW
Donald South	0.06 MW

The modelling demonstrated that economies of scale meant the most cost-effective islanding point was at the grid connection, creating the largest possible microgrid. There is only one option for the islanding location for Tarnagulla, due to it being at the end of a short feeder.



Region	Load	Lines	Busbars	Loads	Shunts
Tarnagulla	0.17 MW	13	14	9	0

Main findings from this project included:

- Grid-connected operation is most cost-effective, but reliability is higher in islanded mode – the full report gives the full range of reliability indicators for 16 islanded and 16 grid-connected scenarios for Donald and one for Tarnagulla – all islanding scenarios improve reliability to different extent, with more costly scenarios having greater reliability.
- Islanded microgrids can meet the electric load demand reliably and continuously under different operation and investment scenarios.

- Islanding scenarios that fully eliminate grid-related reliability issues would require considerable investment and lead to up to five times more expensive electricity (considering investment, energy, and operating costs).
- Valuing reliability according to the *value of customer reliability* (VCR) for regional Victorian customers, some islanded scenarios produce a modest net benefit if reliability worsens.

These findings broadly aligned with those of the area hosting capacity assessment. More detail is in the Islanding Design and Cost Analysis Final Report.

3.29 Stakeholder impact investigation

This investigation sought to determine how the microgrids could operate in such a way to prioritise critical loads during times when energy supply is insufficient to meet all demand. To do so it undertook customer critical needs analysis and developed a trading model and simulated trading platform that used dynamic pricing to prioritise supply ranking when islanded.

- Based on the interviews conducted by the community engagement team and other literature on and experience with communities experiencing reliability issues or extended outages, community critical loads were determined to be:

    - medical centres, pharmacies, retirement villages and the hospital;
    - supermarkets, grocery stores, petrol stations and banks;
    - telecommunication stations and mobile phone towers;
    - public services and emergency services; and
    - homes with full-time care needs or life support systems.

- Most other loads were determined to have some flexibility, and a smaller number to have high flexibility. The flexibility of loads goes beyond the connection point – within a premise, some loads are more flexible than others.
- Load shedding or shifting of non-critical loads when islanded can improve security and cost when islanded.
- Dynamic pricing (based on the equilibrium point of available supply and demand) could be an effective mechanism for voluntary shedding or shifting of flexible loads to ensure critical loads can be served. But willingness to pay is not sufficient to identify all critical loads due to limited financial capacity of some critical load customers.
- Energy cost when islanded for an extended period is high but may be offset by savings from self-generation at other times.
- Regulatory changes will be required for microgrid operators to incentivise de-energisation of customers.

More detail is in the Stakeholder Impact Investigation Final Report .

3.210 Microgrid impact study

This project sought to assess the options, risks and benefits of specific microgrid control strategies in different circumstances. This was done in three stages:

Stage 1: Develop steady-state and dynamic operation simulation tools to enable techno-economic and reliability probabilistic assessment of microgrids;

Stage 2: Model the economic, reliability, and resilience impact of the Donald and Tarnagulla microgrids and broader networks, in grid-connected and off-grid modes and under different operating conditions; and

Stage 3: Provide an assessment of the options, risks, and benefits of specific control strategies for the microgrid to provide resilience against bushfires, including risk-based control strategies to mitigate the probability of unsafe operation and decrease the associated costs.

Key findings included:

+ Monitoring bushfire risks along transmission and sub-transmission lines and regular inspection of sub-transmission lines are the most effective strategies to avoid the need to run islanded for extended periods.
+ Looking ahead two days to ensure batteries can be at full capacity for emergency discharge is the most effective strategy for maintaining capacity when islanding due to a major event such as bushfire of storm.
+ Meeting the capacity adequacy requirement under the newly-implemented *Stand-Alone Power System (SAPS) Capacity Adequacy Rules*[15] requires more generation capacity than modelled in this project. This would be a consideration if a microgrid was established under the SAPS framework as it currently stands, but might be different under a microgrid-specific framework with different capacity adequacy requirements.
+ More diesel storage capacity is required to support islanded operation during bushfires, however it is important to note that this also to be likely when diesel supply may be constrained.
+ Islanding Donald led to overvoltage upstream and undervoltage downstream. Grid-forming converters and scheduled and real-time controls for inverters and transformers are needed to mitigate voltage issues which add to the cost to supply the broader network.
+ Forecasting errors are reduced when PV generation forecasts are based on estimated generation and demand rather than actual import/export signals from smart meter data.

More detail is in the Microgrid Impact Study Final Report.

3.211 Economic and risk assessment

This project sought to examine the techno-economic implications of the proposed microgrid, understanding the main benefits and costs to each stakeholder and whether a microgrid is commercially feasible for the different stakeholders – including identifying value potential created, investment required, alternatives (including network storage etc.) and community effects (impact on all grid-users) and risks.

---

[15] National Electricity Amendment (Regulated stand-alone power systems) Rule 2022, Clause 5.10.2. Available: https://www.aemc.gov.au/sites/default/files/2022-02/SAPS%20NER%20amending%20rule%20final%202022.pdf

This project built on the previous projects by including the MV (medium voltage) network of each town in its modelling, comparing normal operation with operation during extreme weather events, examining costs and value at a more granular level, considering external value streams while grid-connected, including credible major bushfire events when analysing the investment model, and treating the microgrid as a single entity when calculating possible value.

Key findings included:

- Community-scale solar PV is unlikely to be of high value for normal operation because privately owned PV is already meeting most energy needs during solar hours.
- Future reductions in the capital cost of batteries will reduce the need for diesel generators and enable storage of additional solar PV instead.
- Significant economic benefits can emerge from purchasing energy wholesale, DER wholesale market arbitrage, and DER participation in contingency FCAS.
- Increased reliability and resilience are other tangible benefits, but not directly monetizable.
- Peak demand reduction and provision of network services can also be delivered but need regulatory change to capture value in the community.

More detail is in the part 1 report and the part 2 report.

Additional modelling and analysis was done as part of *Project 11 – Recommendations to regulators* to estimate the value of regulatory change that would simplify or open up access to a wider range of opportunities. It found that actively coordinating supply and demand across the microgrid (combining retail activities with centralised microgrid DER operation), trading directly with the wholesale market instead of via NEM retailers, using local cost-reflective network tariffs within the microgrid and at the connection point with the wider grid, and selling network services to the DNSP could all bring materially additional revenue to the microgrid operator and improve total benefits. This is discussed in more detail in the Recommendations to Regulators on Microgrids report.

3.212 GWMWater site assessment

This assessment was undertaken by Powercor and ENEA Consulting. It sought to identify potential microgrid sites within the Powercor network, evaluate them to determine which could yield a net benefit, and assess the potential of a Donald microgrid using the same approach. An aspect of the design of the potential Donald microgrid was to benefit the GWMWater plant in the town and the adjacent industrial precinct.

The techno-economic assessment used in the project considered a range of value streams accessible to and benefits realisable by grid-connected microgrids including:

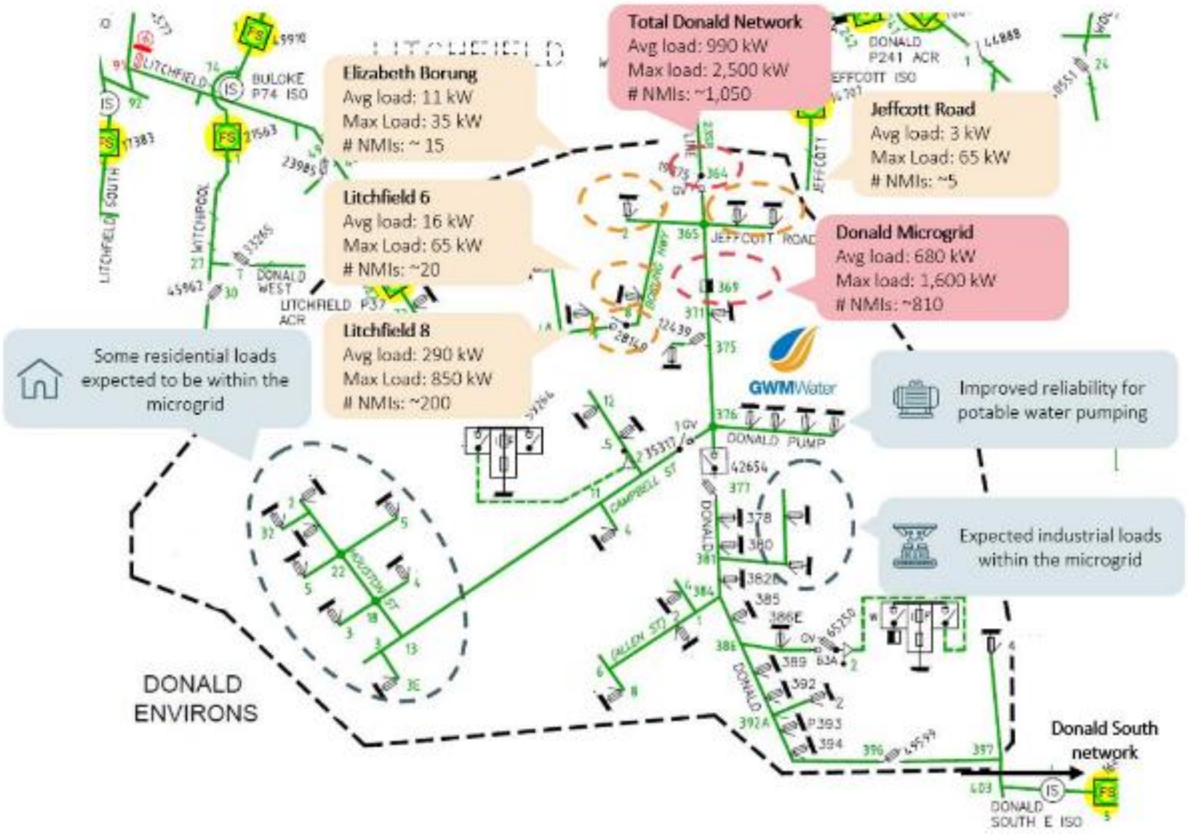
- frequency control ancillary services (FCAS) revenue and energy arbitrage (accessible by non-DNSP operators of community DER);
- reduced line losses and network capital expenditure (CAPEX) deferral (realisable by Powercor); and
- bushfire risk reduction and reliability (beneficial to community and Powercor).

Additional benefits identified for the potential Donald microgrid included:

- improving resilience and reliability;
- decarbonisation and contributing to the Victorian emissions reduction target;
- maintaining water supply during power outages and natural disasters; and
- encouraging economic development in Donald.

55 sites in Powercor's network were identified as potential microgrid sites. 12 of these yielded a net benefit. Donald was the 11th when these sites were ranked from highest to lowest net benefit.

Two potential microgrids were modelled for Donald: a 2 MW microgrid encompassing the whole town, and a smaller 1.6 MW microgrid that still encompassed an important section of the town, including the GWMWater plant and the industrial precinct.



If funding from the Australian Renewable Energy Agency's (ARENA) RAMPP (Regional Australia Microgrids Pilot Program) could be secured, the 1.6 MW microgrid would yield a modest net benefit. The 2 MW microgrid would not yield a net benefit.

Significant findings included:

- Reliability issues on the network appear as the key driver of the net benefit. CAPEX deferral is not significant.
- Battery costs are also a key factor in limiting potential benefits – diesel fuel cost is not.
- A decrease in battery costs or increase in reliability benefits leads to significant improvement in net benefit.

- Sites with lower net benefit (including Donald) only yield that benefit if ARENA RAMPP funding is used and if the additional costs for resolving major reliability events are considered (that is, non-STPIS[16] events that are not covered by the network's revenue allowance that is recovered through approved network charges).

It should be noted that the economic analysis in this project is indicative and that some benefits (e.g., non-financial community benefits) and costs (e.g. installation costs) are not included. More specifically, additional financial modelling of the 1.6 MW Donald microgrid cost and benefits would be required to gain a more detailed understanding of its financial viability.

The project identified some next steps for further action:

- Undertake feasibility assessments and detailed financial modelling of the 1.6 MW concept microgrid for Donald, including identifying potential factors that might improve the business case (some of this has already been done by other projects in the broader study).
- Investigate the marginally viable or unviable sites further to determine whether there are non-financial benefits that may attract funding from RAMPP or similar programs.
- Engage with Powercor's regulatory team to consider the strategic value of microgrids.
- Explore the impacts and frequency of extreme weather events and any resilience or reliability benefits microgrids could bring.

Further detail can be found in the Microgrid opportunities identification report.

Subsequent to the publication of the *GWMWater site assessment* report, it became clear that RAMPP funding could not be secured due to a shift in focus and thus eligibility criteria of the program. Consequently, Powercor redirected its attention to assessing the viability of a community battery in the industrial precinct of Donald to meet some of the objectives the concept microgrid was designed for. This development work is still ongoing.

Additionally, while undertaking this work Powercor did some additional analysis of the network capacity issues in and around Donald, and undertook some cost-effective upgrade work on the feeder and LV network to increase the performance of the feeder and the solar hosting capacity within Donald.

3.213 Policy and regulatory issues

Reduce barriers to microgrid uptake in remote and regional communities by:

- Determining whether rule or regulatory changes are required to facilitate microgrids that are currently considered non-network solutions.
- Informing regulators to help their decision making when it comes to DER-related proposals by network businesses.

---

[16] Service target performance incentive scheme

- Influencing future regulation, policy and programs developed by governments to encourage investment in these new energy solutions in a way that balances the needs of all stakeholders.
- Highlighting the impacts of different design forms possible within microgrids such as the investment landscape for network-side batteries compared to customer side with differing levels of control to maximise the value to all stakeholders.

3.214 Recommendations to regulators

The project sought to identify regulatory and market barriers to microgrids, articulate the regulatory changes that might be needed to best facilitate microgrids, and recommend what changes to pursue, and how to pursue them. This was done in four stages:

Stage 1: Reviewing the current regulatory framework, market rules, and market behaviours to identify aspects that prevent or constrain microgrids from being established or reaching their full potential;

Stage 2: Review the findings of the other projects to identify where they are impacted or constrained by those regulatory or market barriers;

Stage 3: Consult with key stakeholders to interrogate the issues and clarify understandings and recommendations; and

Stage 4: Document findings and recommend for action to best facilitate microgrid development where viable.

As part of stage 3, the University of Melbourne's power systems team used the microgrid operational model developed in *Project 8 – Economic and risk assessment* to undertake additional modelling to estimate the possible scope of accessing value streams that were limited or constrained by current regulatory settings. This work indicated that considerable additional value may be available.

A key issue identified was that, without regulatory adjustments, the market-based model of the energy system puts some constraints on the design possibilities of and the value streams accessible to microgrids due to its rigidity, its narrower frame of objectives, and the role of energy regulation as, essentially, a form of consumer protection against otherwise unfettered corporations. A regulatory framework that facilitates microgrids operating as coordinated entities in the wider market, that fully values resilience investment, and that provides appropriate oversight for community benefit social enterprise energy providers with an appropriate governance structure could overcome many of these constraints.

An alternative approach with a focus on green industry and regional development could provide a more appropriate framework for microgrid development by intrinsically valuing local economics, environmental benefits, and industry support and generation. Such an approach would also more neatly encompass community benefit energy providers with a social enterprise orientation.

Key findings and recommendations included:

- A clear regulatory definition of microgrids is needed, to support regulatory change.
- Adjustments to the DNSP-led SAPS framework and the embedded networks framework that accommodate the distinctive characteristics of microgrids are needed to fully account for (respectively) DNSP-owned and third party-owned microgrids. These frameworks need to ensure that appropriate consumer protections are delivered, and that microgrids are capable of accessing the value streams required to enable them to be viable.
- A framework for accrediting and overseeing community-benefit energy providers in microgrids may be useful.
- A transition plan is needed to enable predictable regulatory change towards more cost-reflective network pricing when distributed generation, storage, and demand response are more ubiquitous and widely distributed.
- Regulatory reforms for distribution networks are required to properly value what microgrids can offer with respect to resilience, reliability, and delivering network services.

Significantly, the project concluded that “regulatory change at the level of a rule change is [probably not] required. Rather, a framework review to determine how best to enable microgrids to be appropriately governed and regulated, and reach their full potential.”[17]

More detail can be found in the Recommendations to Regulators on Microgrids report.

Additionally, the 3.29 Stakeholder impact investigation (on page 25 above) recommended that regulatory changes to allow microgrid operators to incentivise and operationalise customer de-energisation in order to prioritise critical loads when islanding due to extreme weather events are needed, with the appropriate safeguards in place.

3.215 Assessing the suitability of microgrids

Increase dissemination of technology and/or project knowledge regarding the deployment and upgrading of microgrids by developing a tool for use by towns of a similar makeup to assess their suitability for a microgrid. The tool will recognise any barriers to successfully building and implementing a microgrid in a community, and also be adaptable for differing drivers between the community, the electrical infrastructure already in place and the financial cost/benefit so the potential for value creation can be factored in.

A Microgrid Assessment Tool was developed by *Project 12 – Microgrid Assessment Tool Development*. Additionally, the *Community Energy Transformers Forum* shared several tools and resources with community energy proponents.

---

[17] Recommendations to Regulators on Microgrids report, p. 47

3.216 Microgrid Assessment Tool Development

This project sought to develop a web-based microgrid assessment tool to enable communities to better understand if a microgrid is right for them. It's designed to help project proponents answer a number of key decision-making questions including:

- What does local energy demand look like? How does historical energy demand compare with current and forecasted future demand?
- Would a microgrid suit the community's energy needs? And what would be the potential impacts?
- What are the costs and risks involved?
- What are the available microgrid options? What are the trade-offs including economic, environmental, and expectations?
- What would a microgrid mean for critical energy needs during different types of major reliability events?

The tool was developed using the technical analysis done in previous sub-projects as key inputs, and includes material from the *Energy Literacy Community Toolkit* developed as part of *Project 2 – Community engagement*. The website that hosts the tool may also be used as a central repository for other resources of use to community energy groups developing projects.

Additionally, the *Community Energy Transformers Forum* introduced a number of other resources (in addition to the Microgrid Assessment Tool) to community energy proponents from around the state, including information about the Australian Energy Regulator's Energy Innovation Toolkit, guidance on how to access DNSPs' network usage data, and so on. This is discussed more fully in the section on 5.8 The Community Energy Transformers (CET) Forum on page 42.

4.0 Key findings

The various workstreams (summarised in the 3.2 Project outcomes section above) yielded deep and detailed information on the specific aspects of the microgrids that they examined. We recommend reading the more detailed workstream reports (available here) to fully interrogate their findings and conclusions.

Altogether, the project's findings helped answer or at least address many of the bigger picture questions relating to the feasibility, design and implementation of microgrids for Donald and Tarnagulla, and – by extension – for other regional and remote towns and communities.

4.1 Defining microgrids

A number of the sub-projects noted that microgrids are not clearly defined in energy literature or regulation. These projects referred to various definitions in Australian and international literature in order to clarify their own assumptions. *Project 11 – Recommendations to regulators* developed a definition based on a review of the literature and engagement with key stakeholders:

- a distinct interconnected local energy system that is also connected to the wider grid and acts as a single controllable entity with respect to the grid;
- with its own generation and storage – which may be a mix of behind-the-meter and community or front-of-the-meter resources;
- that can operate in both grid-connected and islanded mode;[18] and
- can actively balance and optimise local and network supply to benefit its community.[19]

This definition is used in the remainder of this report.

4.2 The feasibility of microgrids – early positioning piece on where we have focused.

To what degree are microgrids feasible in Donald and Tarnagulla? What are the most significant opportunities and barriers?

4.21 Under the current environment fully islandable microgrids are not economically feasible in towns like Donald or Tarnagulla

The project found that while establishing the entire towns of Donald or Tarnagulla as microgrids was not economically viable, there are opportunities for benefit to use many of the technologies and techniques used in microgrids to establish community energy projects that could meet some community objectives related to electricity supply. For example, community batteries, local renewable generation, peer-to-peer trading schemes, and establishing a local community-oriented energy provider were all initiatives that might bring a net benefit if appropriately scaled and designed. Doing so would require further analysis and assessment by relevant bodies (including Powercor and probably an energy retailer with an interest in community-oriented new energy technology deployment) in conjunction with a community-based energy group to ensure that community interests and objectives are represented and considered in project development.

The project's technical and economic assessments identified the most significant factors that determine whether microgrids are viable (that is, provide a net economic benefit). These include:

- the relative cost of batteries or other storage technologies;
- the expected frequency and severity of weather events or natural disasters that affect reliability;
- the financial impact of reliability incidents (outages and recovery from them) or the value attributed to reducing the impact; and

---

[18] This aspect of the definition was contentious. According to the Recommendations to Regulators on Microgrids report: "After much consideration our view remained that islandability is warranted in a microgrid definition, for two main reasons: islandability is what distinguishes a microgrid from an embedded network; and community interest in microgrids is frequently driven by the desire for more reliability and resilience – functions that require islandability. Even if a microgrid never actually operates in islanded mode, islandability is a key aspect of its raison d'etre, identity and functionality."

[19] Recommendations to Regulators on Microgrids report, p. 18

- the capacity of the governance framework and regulatory environment to enable the microgrid to operate as a coordinated resource.

It is important to recognise that these factors interact with each other. For example, decreases in battery costs and increases in reliability benefits would both have a significant impact on net present value (NPV) for a microgrid – so if both change together, less change in each is required to enable net benefits. Incremental changes across multiple factors have a similar cumulative benefit as a significant shift in a single area. This is important when considering the impacts of policy and regulatory initiatives and the interplay between these frameworks and commercial operations within the network.

In another example, regulatory adjustments to better enable microgrids to operate as coordinated entities with respect to the wider grid would improve access to grid-based value streams and enable microgrids to earn revenue when grid-connected to help meet the costs of maintaining islandability.

Reductions in some of these barriers also add additional value to existing technologies. For example, Project 8 found that there was limited value in installing additional community-scale solar PV because existing privately-owned PV already met most energy needs during solar generation hours. Reductions in battery costs would enable more storage and thus enable more surplus solar generation to be used outside of solar hours.

And while the cost of diesel fuel for backup generation was not as significant a factor as the cost of storage, battery price reductions that enabled more storage would reduce the need for diesel generation and not only help meet emission reduction objectives, but also limit exposure to any price on emissions that may be implemented in the future.

One area that was not explored in detail was changes in per-connection electricity usage. A study assessing the likely impact of improvements in appliance efficiency and the thermal performance of housing on energy demand of homes and commercial and industrial premises would be useful. Continued increases in behind-the-meter solar penetration may also have a significant impact. Confounding factors might be electrification of gas loads and uptake of electric vehicles.

4.22 The expected technology mix of a future microgrid

The microgrid designs used in the project were all consistent in their use of a combination of solar generation, battery storage and diesel generation for backup. There was some variance in the utility of microgrid solar PV generation due to high behind-the-meter solar penetration in the communities and limitations in the expected capacity of battery storage.

With regard to the physical design, *Project 4 – Area hosting capacity assessment* recommended distributed deployment of PV, storage, and backup generation (co-located with each distribution substation) rather than centralised installation, due to greater flexibility and additional LV network power quality opportunities. Modelling done by the *Economic and risk assessment* team found that centralised battery energy storage systems (BESS) operated to benefit the entire community yielded higher financial benefit overall than distributed privately-owned BESS operated for individual benefit. However, a key factor in the latter modelling was the lack of coordination when operating distributed

BESS. Further work comparing the performance of distributed vs centralised energy resources operated in both cases in a coordinated manner for whole-of-community benefit would be instructive.

The *GWMWater site assessment* found that, with a funding contribution from ARENA's RAMPP program, a partial microgrid centred on the GWMWater plant in Donald and the nearby industrial precinct was likely to yield a small net economic benefit. The project initially recommended further feasibility assessments and modelling of this option to ascertain whether it should go ahead, but changes to eligibility for RAMPP funding overturned the economic viability so the additional assessment was not done. However, this demonstrates how close to feasibility similar projects may be. Such a project in a community with worse reliability might be cost effective without RAMPP funding, and this could be a useful proof of concept for similar microgrid projects.

If such a project was implemented, it would also highlight issues around community trust and social licence for microgrid projects led by large private and government-owned corporations. If part of a town is able to continue having power during a grid outage and part is not, this could raise issues of social and economic equity – especially when considering that expenditure by a DNSP and a public utility on a project such as this ultimately comes from everybody's utility bills. This is an example of how community engagement and participation in projects such as this is critically important.

4.23 The feasibility and benefits of microgrids and microgrid technologies in general

As discussed in the section above on the 3.25 Economic and technical opportunities of microgrids, during the course of this project considerable investigation, modelling, assessment and evaluation has been done on the technical approaches for implementing microgrids, the financial costs and benefits, the probable functions of microgrids and the value streams they could potentially access. *3.212 GWMWater site assessment* also reviewed 55 other sites in the Powercor network and documented key factors that determined whether microgrids were likely to be feasible based on location, network topology, extreme weather event risk and community energy demand. Additionally*, 3.22 Community engagement* and *the 3.23 Community Energy Transformers (CET) Forum* identified critical factors when engaging with communities; and *3.214 Recommendations to regulators* identified the type of regulatory issues and the approach to addressing them needed to enable microgrids to access value streams and be governed for community benefit.

4.3 Models for microgrids

What are the probable investment, ownership, business and governance models for microgrids? What are the opportunities and challenges with these models?

Besides Project 11, the projects were focused on either the technical dimensions of the microgrid or the social and community dynamics *under existing arrangements*. The overall finding was that a microgrid would not be cost-effective for either of the towns under current market and regulatory settings. As such, there was not a lot of work done on investment, ownership or business models for microgrids. Project 11 focused on regulatory barriers and what could be possible if those constraints were removed.

As discussed in the *3.214 Recommendations to regulators* section on page 30 above, there are two most likely models for a community-scale microgrid: one owned and operated by the DNSP, probably in conjunction with large businesses located within the microgrid and third party operators of generation and storage within the microgrid; and one independently owned by a third party (possibly a social enterprise accountable to the community) with operation likely to be contracted out to a DNSP, a ring-fenced entity associated with a DNSP, or a government-backed community benefit energy business. Currently, independently-owned microgrids are unlikely except in greenfield sites, because existing network assets are owned by DNSPs. However a DNSP could partner with a community-owned entity to jointly operate a microgrid, and it's foreseeable in the future for a community energy enterprise to lease or purchase DNSP assets. These two models are different enough that it's likely the regulatory frameworks that encompass them would be different, probably based on the closest analogues: the DNSP-led SAPS (stand-alone power system) framework, and the embedded networks framework respectively.20 This is discussed in more detail in the *Recommendations to Regulators* report.

4.31 The DNSP-owned microgrid

In the near future, the most likely model is the DNSP-owned microgrid because it's a simpler pathway: the DNSP already owns and operates the network, has more visibility than anyone on the costs, load characteristics and opportunities, can directly access value created by reducing its own exposure to costs associated with reliability, infrastructure maintenance and repairs. Changes in the regulatory framework for DNSPs to more fully value expenditure to improve resilience to major reliability events, or to apply reliability standards in a more granular way (and thus possibly require higher reliability in rural and remote areas) would increase this value.[21]

Assuming a regulatory framework for a DNSP-owned microgrid is based on the DNSP-led SAPS framework, a DNSP-owned microgrid framework would need some adjustments to account for the difference in operation from a SAPS when in grid-connected mode, such as:

+ facilitating access of DER operators and retailers to wholesale and system services markets when grid-connected, while operating under an administered pricing regime when islanded;
+ a mechanism (market-based or contractual) for the DNSP to procure network services from third party DER operators when grid-connected – as this is likely to be a significant value stream for a microgrid;
+ possibly, a provision to allow local area use of system cost-reflective tariffs within the microgrid to assist with demand management; and
+ optionally, a provision to allow a vertically integrated DER owner and retailer, possibly a social enterprise/community benefit business, to operate within the microgrid – as this could be an effective way of increasing value by coordinating demand and supply within the microgrid and sharing value with customers.

---

[20] This aligns with the nature of a microgrid being comparable to either a SAPS that can also connect to the grid, or an embedded network that can also disconnect from the grid.

[21] For a more detailed discussion of this see CutlerMerz, ENA, & TEC (2020a) *Opportunities for SAPS to enhance network resilience: Final Report October 2020 and* CutlerMerz, ENA, & TEC (2020b) *Network Resilience – Potential benefits of a requirement to provide for resilience: Final report 23 December 2020*.

4.32 The independently owned microgrid

Microgrids owned and operated by third parties – for-profit businesses or community-oriented social enterprises – are unlikely in the near future because of complexity relating to DNSP ownership of the network infrastructure, having the equipment and expertise to operate it, and having maximum visibility of network performance, opportunities and constraints. However, it could be a model for 'greenfield' estates (new developments), or in the medium to long term – when microgrids and distributed energy generation are more ubiquitous and the role of networks has changed accordingly – for existing communities.

Because operating a microgrid will remain a highly technical enterprise dependent on specialist skills and equipment (that few outside DNSPs have), it is likely that an independent microgrid would need to have a contractual arrangement with a DNSP, a ring-fenced DNSP-associated entity, or another specialist business with the requisite skills and equipment[22] to operate the microgrid.

Assuming a regulatory framework for a third party owned microgrid is based on the embedded network framework, a third party owned microgrid framework would need some adjustments to account for the difference in context and operation from a regular embedded network, such as:

- a regime that balances price regulation and access to retail contestability to ensure efficient and equitable consumer outcomes whether grid connected or islanded;
- allowing network charges in order to finance network investment and operation as well as allow cost-reflective network tariffs and other mechanisms for network demand management;
- an explicit connection entitlement to the wider grid; and
- a regulatory process for managing microgrid operator failure.

4.33 Financially sustaining a microgrid

The feasibility assessments done as part of this project compared the net present value (NPV) of proposed microgrids against the baseline of the status quo: the cost of meeting energy needs through the current grid connection. In these assessments, higher costs (for investing in and maintaining community-scale generation and storage, and operating the microgrid) are offset (or not) by savings from improved reliability (that avoids the costs of baseline, worse reliability), lower energy costs where realised, and any other value streams that can be accessed by a microgrid but not without. The 1.6 MW concept microgrid initially proposed by the *3.212 GWMWater site assessment* (discussed on page 27) would have achieved a marginal net benefit in this way, and if it had have been able to access the additional funding to achieve viability and be established, it would have been financially sustained through normal operation.

In the *3.211 Economic and risk assessment* (on page 26 above) and *3.214 Recommendations to regulators* (on page 30 above) teams explored another possibility: adjustments to the regulatory framework to better facilitate access to additional value streams. They demonstrated the potential for microgrids to earn additional revenue by engaging with external markets as a coordinated entity,

---

[22] This could potentially be a role for the new State Electricity Commission or a similar government-owned utility with a community benefit objective.

and to share it with the microgrid community by virtue of a microgrid gentailer[23] structured as a social enterprise with a community benefit orientation. The modelling to support this was exploratory and indicative, but comprehensive enough to demonstrate that the potential exists. More detailed assessment on a case-by-case basis is required to be conclusive: but there seems to be an opportunity in the future for some microgrids to earn revenue to offset investment and operating costs and thus deliver the reliability benefits a microgrid can provide at no net cost to the community.

5.0 Communities and microgrids

What was the community response to the project? What are the opportunities and challenges engaging with communities in microgrid projects?

This project was undertaken with these two specific communities because in each town there was existing community interest in a future focused community-based renewable energy project to address sustainability and reliability issues. Accordingly, a fundamental objective of this project was to prioritise the communities' objectives.

It should be noted that because the project was explicitly about exploring the feasibility of a microgrid, some in the community came to understand their own objective as 'developing a microgrid' and felt the project had failed by not delivering one. In fact many of the community objectives did not require a microgrid. For example

- Increasing solar hosting capacity was a valued objective for the Donald community, and during the course of this project Powercor was able to increase solar connections.
- The proposed community battery will increase local use of local generation, another community objective.

This was a good lesson in scoping and titling a project appropriately, and the value of focusing on the problem to be solved rather than a specific technical solution.

5.1 Engaging with the Donald and Tarnagulla communities

The community engagement team interviewed 20 community members and identified a number of values pertaining to their energy supply. The recommendations to regulators team engaged with three more community members and gained some further understanding of their aspirations. Together these can be interpreted as a non-exclusive set of possible objectives for a microgrid or other community energy project.

It's important to recognise that the people interviewed and engaged with do not constitute a group that can be considered representative of either community – some wider consultation is advisable. However, the values and concerns expressed by them are consistent with findings from other community energy projects, as documented by the roundtable discussion held as part of the project.

---

[23] A *gentailer* is a business that is both an owner of generation and an electricity retailer.

This summary of community values is taken from the *Recommendations to regulators* report.

5.2 Environmental sustainability (decarbonisation)

- Reducing emissions by reducing reliance on fossil-fuel generated electricity.
- Generating more renewable electricity on-site, using:
    - community energy (shared renewable generation); and
    - private solar shared with the wider community.

Realising these objectives will at some point require increasing distributed energy resources (DER) hosting capacity within and around the communities – so this is another, implicit objective.

It's worth noting that while community members talk about electricity when discussing emissions reduction, LPG (propane in steel bottles or large tanks) is also used in the community – domestically and industrially. In particular, some community members have told us that industrial plants in Donald use LPG because there is insufficient network capacity to serve those loads with electricity. Any work with the communities on emissions reduction will need to consider the emissions of LPG usage and, ultimately, potential for fuel substitution.

Additionally, we note that most designs and models for the microgrids in this Feasibility Study include diesel generators as either part or all of the microgrids' generation. It is important that this issue is made clear to community members, especially in the context of the value set by some on emissions reduction.

5.3 More reliability and resilience – especially for essential services and vulnerable groups

- Being able to meet its own electricity needs if there is an outage on the grid, which implies:
    - sufficient generation and storage to meet all or some of the communities' demand for a given period of time; and
    - islandability: the ability to operate independently of the wider grid.
- Possibly, being able to ration electricity during long-duration outages to serve those most in need when there's not enough to go around, which also requires:
    - a process for agreeing and setting parameters for this; and
    - a system to action it.

The second point – being able to ration electricity – is something implied by some comments in the interviews, and is sometimes proposed in community energy discussions with other communities. Further engagement is needed to determine the extent to which it is held and understood in the community. Designing and delivering an approach to prioritising critical loads in times of limited supply was the focus of *3.29 Stakeholder impact investigation* (see page 25 above).

5.4 Manage (reduce or prevent from rising) costs

Many people believed a microgrid or other community energy project could help moderate rising energy costs – which seem particularly egregious because of the reliability issues with both towns' supplies, typical for small communities toward the end of rural feeders. Some ways of managing costs through a microgrid or other community energy initiative could be:

- increase hosting capacity and install more private DER.
- community energy and non-profit community retailer which could:
    - purchase from the wholesale market when local generation is insufficient; and/or
    - arbitrage local DER generation in the wholesale market.
- earn revenue from selling a range of system services.

Techno-economic analysis undertaken by this project also shows that coordination of demand and supply within the microgrid enables more strategic exchange with the wider grid and energy market, yielding further cost reductions. This may require a proactive microgrid energy provider that handles retail, storage and generation. This is discussed further in the *Recommendations to regulators* report.

5.5 Local ownership or control of energy resources

Many members of the community placed a premium on the "local-ness" of electricity generation. Some people in Donald expressed a desire to have a locally based energy supplier, as was the case until the early 1960s;[24] and in both towns there was a certain pride derived from the significant investments in rooftop solar and other private DER.

This translated into a sense of ownership of the electricity and a desire for greater control over how that electricity is distributed. Local community members were seeking to derive more local benefits from those investments. They are also seeking to share energy locally in a way that is equitable and prioritises community members who are vulnerable to energy hardship and have the greatest need.

In one sense, local energy sharing happens automatically (albeit passively) when DER is in the community and especially if a microgrid is managed in order to maximise benefit to the community. But to make it more tangible for the community, this could entail:

- a community battery to store surplus solar generation;
- a system for active peer-to-peer sharing/trading; and
- a system for reporting local share of generation.

In another sense, there still remain local benefits – network support through minimum and peak demand management – that cannot be fully captured due to regulatory constraints. Local use of system (LUoS) network tariffs could be a way of reflecting the economic benefits of high levels of local

---

[24] https://donaldhistory.org.au/welcome/donald/

generation. We note that this raises the more complex question of whether more cost-reflective tariffs should also be used for electricity consumed from the wider grid.

As the project progressed, some interest was expressed in a local government-owned energy provider; or the potential of the new State Electricity Commission (SEC) to provide generation and retail services as a not-for-profit community benefit provider. Certainly community-oriented governance and value sharing will be needed if a microgrid is to offset higher energy costs with revenue from accessing internal and external value streams. This is discussed further in the *Recommendations to regulators* report.

5.6 Support economic development

Some of the strongest advocates for a microgrid in Donald saw it as a way to drive local economic development and bring new investment to the town. There were two aspects to this:

- Increased reliability and capacity could both enable existing businesses to expand, as well as attract new businesses to come to Donald. Members of Donald's business community told us that some local businesses had to switch from electric to gas-fuelled equipment due to the limited capacity of the town's electricity supply.
- A microgrid could be seen as a demonstration project or "living laboratory" that showcases the innovation and community cohesion in Donald and puts the town "on the map", leading to greater attention and investment.

We note that such economic development goals can change both the rationale and calculus of costs vs benefits of a microgrid by expanding the horizon, both spatially and temporally, of what a microgrid sets out to achieve. Also, local economic development goals are governed by state government planning, economic policies and development regimes, rather than the narrower field of electricity regulation.

5.7 Community needs vs energy solutions

The approach generally taken by community members is to think about what they need first, and the techniques for meeting those needs second, and with less precision because they are looking for guidance on how to meet their needs. This is exemplified by this quote from a Tarnagulla resident, from late in the project:

> *In my opinion the community are after reliable, sustainable and affordable energy needs. We have experienced many power outages in recent times and it would be good if the township could weather these times with a bridging supply from a battery bank, or something like that. Personally I have installed a battery system at home and [work] and I know the public hall has a battery too. My home system also acts as an energy system that is managed by the grid to feed back when needed.*[25]

---

[25] Communicated to Project 11 researchers over email.

5.8 The Community Energy Transformers (CET) Forum

The *Community Energy Transformers (CET) Forum*, held in Bendigo on 5 June 2023, brought together people from community energy projects right around Victoria in a full day event with researchers, policy-makers, network businesses, and local governments. The objectives of the event were:

- to better understand community energy groups in terms of their composition, constituencies, knowledge base, skillsets, goals and objectives, values, and so on;
- to better understand the perspectives of community energy groups – how they understand the energy industry and policy bodies and what they do, what they need (and don't need) from energy businesses and authorities that are trying to help them;
- to understand how communities can be better supported and assisted in developing and implementing energy projects; and
- to upskill people in community energy groups, and to provide them with tools and knowledge to help them take tangible actions in advancing their objectives.

The key components of the forum were:

5.81 A panel discussion with proponents of other funded community energy projects

People from institutional partners of four quite different projects talked about how they worked with the communities, how they developed the projects, their challenges and opportunities, what they achieved and what they learned.

Panellist 1: Community scale batteries in northeast Victoria

Nick Mason Smith from Indigo Power discussed this project, funded through philanthropic donations and crowdfunding a grant from the new energy jobs fund. In this project, two DNSPs – AusNet Services and Essential Energy – worked with local community groups (in Beechworth and the upper Ivan's valley), and local Councils. Working in towns that are vulnerable to extreme weather and fire events and have regular outages, the difference between resilience and reliability is important. The project assessed different behind-the-meter and front-of-meter technologies and decided to create a community power plant with a combination of solar PV and battery storage.

Panellist 2: Clairview & Stanage Bay microgrid feasibility study

Jake Anderson from Energy Queensland discussed this ongoing project, funded through the Regional and Remote Communities Reliability Fund. This project worked with two small towns (100 local residents) categorised as regional community rather than remote, both with poor reliability due to being on feeders that pass through heavily vegetated and bushfire prone areas – leading to both more frequent outages, and longer restoration times due to the expanse of the network and the time required to locate and restore these faults. The project aims to:

- Determine the community's perception of energy reliability and resilience. What are their energy aspirations, concerns around energy? It’s important to assess level of energy literacy and willingness to participate and adopt some of these new technologies.
- Develop and understand the technical challenges of a microgrid.
- Explore, through industry research and customer engagement:
    - the various microgrid models that could work for the targeted communities;
    - the various ways that communities and networks can benefit from community batteries and the ability to microgrid them;
    - how to define the value flows; and
    - how to understand and address the regulatory challenges and roadblocks in order to drive real change and construct alternative solutions.

Community diversity and self-actualisation have been a key focus. The communities are very engaged with the project, and with energy issues generally. Many of them have invested in improving their own reliability already – but some residents and businesses without the capacity to do so risk being left behind.

Panellist 3: MyTown microgrid

Emma Birchall discussed this project in Heyfield, Gippsland. Funded through Regional and Remote Communities Reliability Fund, this project is a collaboration with Federation University, RMIT, and Ausnet Services with support from the Institute for Sustainable Futures at University of Technology, Sydney, new energy technology business WattWatchers, Heyfield Community Resource Centre, and the local Council. The goal is to undertake a detailed microgrid feasibility study, and also develop knowledge sharing tools to making it faster and easier for other communities to undertake similar projects themselves.

The project was a response to community-reported issues around energy reliability. It started with vision workshops facilitated with community agencies to get the community reference group and other stakeholders to verbalize their vision for an energy future. WattWatchers energy usage monitoring devices were installed on premises’ switchboards to help the community better understand their energy usage. The community was keen to make better use of the locally generated renewable energy to increase reliability whilst boosting the local economy.

A microgrid was found to be technically feasible, but not financially viable. Other local energy solutions were investigated, including implementing a Smart Energy Upgrade and electrification program. Community-scale neighbourhood batteries were also considered, and it was recognised that clarity was needed about what it could deliver and what people's expectations of it would be.

Highlights of the project were mobilising the community and transforming the community reference group into an expert knowledge group, and building an effective energy literacy program that included developing a *community dashboard display* (installed in high traffic areas around town) showing aggregated information on the town's usage, generation, and exports. A key lesson was the importance of identifying key stakeholders within the community, bringing along a diverse team of social scientists and engineers, and ensuring clear communication (for example: what is a feasibility study, and what is it not). Another success was to

Panellist 4: Donald and Tarnagulla Microgrid Feasibility Study

David Gormley O'Brien discussed this project, primarily reflecting on lessons learned regarding community engagement. These were summarised as the four Fs:

- **Full representation.** A larger and more diverse group of community representatives would have helped build a broader understanding of community needs.
- **Frustration.** Community groups want to see something concrete at the end of a project, especially a large project where they have been engaged over a number of years.
- **Fixation.** By being so overtly about a microgrid, the project raised expectations that a microgrid would be the outcome and those expectations were dashed when it was not. Better to focus on the problems being addressed and find the right solution through working with the communities and technical experts together.
- **Flexibility**. The project needed to be nimble to adapt to changing external circumstances (such as the impacts of the pandemic) and changing expectations as the technical work began to make it clear that a microgrid was unlikely.

5.82 Presentation on community energy as a social innovation

This session, presented by Sangeetha Chandrashekeran from the University of Melbourne (and lead on the recommendations to regulators work) explored the social, geographic, institutional and redistributive dynamics of energy systems and their relevance to community energy projects. It focused in particular on working with the diversity of communities, and understanding the different types of motivations, values and benefits and how they interacted with each other and influenced project design and objectives. Key points about the changes needed included:

- In order to best enable community energy projects, some changes in policy and regulatory frameworks are needed.
- Distribution network businesses need to work more closely with communities to improve their understanding of local energy and communities' relationship with their energy supply.
- In the development of microgrids, how is value best shared among all involved and how can it be unlocked under the current framework. New approaches and models are needed.
- For community-scale storage, how can value best flow back to the community to offset the costs? A whole new approach is needed to account for the value of local energy resources, and this has implications for how costs are allocated across the entire grid.

5.83 An overview of the Microgrid Assessment Tool developed as part of the project

Mohamed Abdelrazek from Deakin University discussed the *Microgrid Assessment Tool* developed as part of the project and gave a demonstration.

5.84 Focused capacity-building workshops on community energy project development

Three workshops were held, each aimed at people or groups at a different stage of the community energy project journey:

- *IDEATION:* groups that are interested in starting a community energy project or in formally organising to address climate change but haven't yet figured out exactly what type of project to do or what type of group to establish;
- *PLANNING:* groups that have specific project goals and a baseline understanding of their area's energy needs and goals, but may not have worked out all the details, secured funding, and so on; and
- *ACTION:* groups that are almost or are shovel ready, with documented plans to achieve their community energy needs and have coordinated with the community to create an ownership model and operational plan.

The purpose of the workshops was to connect people together from different projects at similar stages, to generate some discussion about how communities are identifying their energy priorities and going about developing projects to address them, and to provide information and tools to help groups develop their projects, including:

- Overview of the structure of the energy system and where community-level projects fit in
- How to access network usage data to help scope projects
- Resources to assist with community engagement
- A *Community Energy Canvas* process and worksheet[26] to help guide project proponents through all the steps that must be taken to develop an implementable project
- Overview of potential sources of funding for projects
- Introduction to the *Microgrid Assessment Tool* developed by Deakin University as part of the project.

The workshops were very effective at generating discussion and new connections between people at similar stages of their community energy journey. They also demonstrated that people with projects at each of the three stages had different needs and challenges.

---

[26] See Appendix 1: Community Energy Canvas for the worksheet

Ideation workshop

Groups in the early stages of conceptualising or developing a project or group are still very focused on engaging with other people in the community, and local government. They generally haven't engaged with energy industry bodies or technical experts.

The conversation with this group focused largely on energy literacy – understanding how the system works, how and where a community project could fit in, and what type of project might best address the group's needs or ambitions. There was an identified opportunity here for assistance and guidance from an accessible organisation or service.

Planning workshop

Groups at this stage have generally engaged with energy industry bodies and technical experts and have a clearer sense of the opportunities and challenges. In many cases this included a sobering realisation of the limits of what community groups can do and retain agency while doing – for example, the complexity of the practical implications and requirements of owning and operating energy resources or network nodes. Some of these groups are frustrated by the need to cede some of the ownership and control of energy resources to government or industry bodies in order to progress the project. This affected their sense of agency in their work and sense of ownership of the projects they had developed. As one participant expressed it: losing control of how the project was implemented and evolved was their reward for initiating the project and seeing it through to the ready-to-implement stage.

Members of this workshop were very keen to have easier access to the resources and tools they needed to scope up their projects to be shovel-ready and supported the creation of an online clearinghouse of resources and tolls to help groups develop projects – along the lines of what was earlier discussed with regard to the Microgrid Assessment Tool. They agreed that a 'one-stop-shop' online with the Tool, links to DNSPs' data portals, and other reference material on establishing and running groups and navigating the energy regulatory landscape would be a real assist for community energy groups.

The community energy groups participants were from were generally motivated by both environmental and economic outcomes – cleaner and cheaper energy. Most of them had worked with DNSPs and had both a good working understanding of their role, and a good working relationship with them. However, they were not particularly enamoured of the notion of private energy corporations and were generally quite open to the possibility of working with government- or community-owned utilities in meeting their community energy needs.

Some of the groups had had first-hand experience of the realities of engaging with a diverse community – a few had developed projects with quite clear objectives and priorities, engaged with the broader community to build support only to find that there was a range of community needs and aspirations –leading them to revisit their project design and recalibrate to account for a wider range of objectives.

Action workshop

Groups at this stage have done the work, designed their projects and are focused on securing the resources to begin or continue them. As these projects were further down the road than the other groups, they had become more aware of the challenges of sustaining the work they were doing. As most groups were volunteer run, many were dealing with the limitations of volunteer projects – people running low on energy or having to step back in order to rebalance other parts of their lives. Consequently, there was a growing focus on how to secure more funding to resource ongoing project management. Some groups had been fortunate enough to find sufficient funding to achieve sustainability, but others were still searching. There was a growing awareness that there was much more funding available to start projects than to maintain them.

6.0 A microgrid for Donald and Tarnagulla?

What is likely to be implemented in the communities as a result of the project?

There are indications that one or more of the following list may be done in Donald and/or Tarnagulla as a response to the project.

6.1 A community battery for Donald?

As discussed above, the 3.212 GWMWater site assessment (on page 27 above) found that, with a funding contribution from ARENA's RAMPP program, a partial microgrid centred on the GWMWater plant in Donald and the nearby industrial precinct was likely to yield a small net economic benefit. The project recommended further feasibility assessments and modelling of this option to ascertain whether it should go ahead, and Powercor and GWMWater have indicated they will continue to explore it. Such a project could have been a useful proof of concept for similar microgrid projects, and this would have been a factor in determining whether this further work should be done.

Following the realisation that the project could not go ahead, Powercor and GWMWater refocused on installing a community battery in Donald's industrial precinct. This would help meet some of the objectives the concept microgrid was designed for (providing extra capacity and some more reliability for GWMWater and surrounding businesses) as well as some of the objectives of the broader community (increasing usage of locally generated electricity). The development work for this initiative is still ongoing.

6.2 More DER uptake in the communities?

The project has energised existing conversations in both towns around using renewable energy resources to improve reliability, advance emissions reduction, and showcase the towns as innovative and future focused. The new DER installed as part of the project has been a tangible example of this. Communities in both towns appear to be more engaged around renewable energy issues and have seen first-hand how DER brings individual and community benefits. It is likely that private DER penetration in the towns will continue to grow.

Additionally, while undertaking this work Powercor did some additional analysis of the network capacity issues in and around Donald, and undertook some cost-effective upgrade work on the feeder and LV network to increase the performance of the feeder and the solar hosting capacity within Donald.

6.3 Community energy initiatives?

The greater understanding gained by many in the community about how the energy system works and in particular the interactions between DER and the grid, seems to have inspired more conversations about collective responses as well. Additionally, some in the community felt that their expectations had not been met as the project initially appeared to be focused on developing community microgrids but this has not eventuated – beyond the possibility of a limited-scope microgrid in Donald focused on meeting business needs and pursued as a partnership between two large corporations rather than a community-oriented project. Given the resources made available to the communities about how to scope and develop community energy projects, and the potential of projects such as community batteries or a community-benefit-oriented social enterprise energy retailer to meet some expressed community needs, a community energy project of some kind may emerge in either of the towns.

7.0 Microgrids for other communities?

How can the project outcomes assist and inform other remote and regional communities?

The reports produced by this project contain a wealth of information to support other communities exploring energy project possibilities for dealing with their energy issues, and the tolls developed in this project are coming together as a centralised online source of resources to help communities. These are discussed with considerable detail throughout this report.

The project has also highlighted a number of important issues to consider when developing energy projects in regional communities, especially when institutional bodies are partnering with community groups.

7.1 Microgrids are socio-technical undertakings

A key insight from this integrated project was that energy projects, particularly decentralised energy, are fundamentally social *and* technical undertakings. It is not possible to decouple the social dimensions from the technical, nor vice versa. What is technically feasible must also align with social objectives. Importantly the social underpinnings of energy projects are complex. They comprise the community's aspirations, but they also must be embedded in broader societal expectations about equity and distributive welfare, essential service provision, and other values-based standards.

7.2 The microgrid may be one solution but what is the underlying problem?

This project sought to test the feasibility of a technical artefact – a microgrid. As such, it commenced with a technical response, rather than a problem that new energy developments could respond to. Had the project commenced with a problem-identification process then the outcome may have looked quite different. We observe that by proposing a microgrid from the outset, the microgrid was set up as a solution to multiple problems that the community sought action on – from sustainability and emissions reduction, to local economic development, to energy sovereignty. As such, the community came to want a microgrid because that was what was proposed and transferred a host of local aspirations onto the idea of a microgrid. The network, on the other hand, continued to see the microgrid largely as a technical response to system issues such as reliability, and ultimately found that whilst the microgrid could address some technical issues it was not the most cost-effective way to do this. The ways of measuring value were also very different for the network compared with the community. This produced seemingly irreconcilable perspectives. A focus on problem-definition from the outset would have helped clarify the scope of work and helped to manage community expectations.

The other advantage of a problem-oriented approach is that there may be a variety of social and technological solutions to the problem that do not involve a microgrid. For example, if the primary problem identified by key stakeholders is a lack of reliability, a large battery storage solution may be sufficient to address the problem, without having to develop a more complex microgrid arrangement.

7.3 What is the role of the community where a microgrid is sited?

Microgrids are place-based technical infrastructure that can activate and engage local communities in ways that centralised energy solutions generally do not. Yet there is little clarity or precedents around the role of communities in these kinds of developments. Part of the problem is the slippery nature of the community itself. Social science research shows that there is no predefined essential community identity, rather it is context dependent. Communities are dynamic and held together through norms and social relations. There are different ways of defining what is fair and just from a community perspective, and balancing the interests of a local community against the interests of other grid users. We note that there are significant differences in the cost to serve regional, remote, sub urban, and urban communities. The responsibility for determining frameworks for cost allocations rests with elected government not the network.

In undertaking microgrid projects it is necessary to grapple with questions such as: who does the project empower? What does it enable now and into the future? Who is included and excluded? How do we define value (both financial and non-financial) to assess the project?

Local institutions and entities, particularly local government, have a very important role to play in facilitating discussions around these questions.

7.4 Challenges of determining feasibility

The project approached the question of feasibility in a number of different ways. For example, the community engagement work addressed issues of social feasibility and desirability, several workstreams focused on technical feasibility and integration with the grid, and and some others addressed feasibility from a regulatory perspective. Whether a microgrid is feasible depends on the criteria or metrics that are applied; whether it is feasible from a holistic perspective involves a multidimensional perspective and a variety of criteria. Clarity is needed around the metrics that are being used to determine feasibility. A key question that arose in this project was around the conditions for feasibility, given the emerging nature of the technology and the enabling environment. Whilst certain elements of the project were not feasible under current settings, relatively minor changes in the market or regulatory environment could shift the feasibility assessment. It is useful to see feasibility studies as not simply a single point in time assessment, but to test a few different scenarios for feasibility. That would enhance the applicability of the study and assist in planning.

By the same token, it is important to recognise that regulatory, market and technical issues may be possible but not feasible. It is important that the likelihood of change within the relevant timeframe is taken into account. The regulatory assessment took a realistic approach to the regulatory changes needed to shift the economic feasibility. Recognising the barriers to and work involved in achieving a rule change that would change the calculus of a microgrid in Donald or Tarnagulla, the researchers proposed a framework review that provided clarification and leveraged off the existing regulation of similar decentralised technologies such as SAPS and embedded networks.

7.5 Stakeholder engagement needs more resourcing and funding

There needed to be greater investment of time and resources in the early part of the project with a focus on stakeholder engagement and problem-identification. We acknowledge the significant constraints caused by the pandemic, nonetheless, there needs to be greater recognition of how a technical electricity project is embedded in its social, cultural and economic context. We note the 10 tips provided by the community engagement team for increasing community engagement with an emerging technology:

- **Identify community champions:** A coalition of visionary community leaders, perhaps from local clubs, local business owners, and established community social media groups, can help coalesce community engagement, inspire enthusiasm, overcome uncertainty and resistance, and strongly represent community interests to institutional partners.
- **Develop an understanding about what the community knows**: Getting a solid sense of community perspectives and understandings helps project partners meet them where they are at and speak their language.
- **Cast a wider net:** In working with communities, actively seeking views from beyond the vocal and engaged minority will surface a polyphony of perspectives that represents a more authentic community voice.

- **Work with the community to create a shared vision:** Taking a co-design approach – work with the community, by the community, for the community – leverages community investment that builds a sense of ownership of a project.

- **Activities that support community groups (interest-based model):** Creatively engage with the community in novel and interesting ways to capture their attention – people will be more willing to share their thoughts once you have sparked their interest.
- **Share success stories:** Hearing a success story from a town or group of people who went through a similar process can reduce anxieties and build a sense of possibility.
- **Develop resources and toolkits:** Practical resources well-targeted to community needs and aspirations boost knowledge and confidence.
- **Host an event to share community outcomes:** Maintain a positive feedback loop to assure communities their investment is paying off and they have had an influence. Engage children too – they are the generation who will likely be most affected, plus they will talk to their parents, grandparents and friends about their experiences.
- **Keep in contact:** This is another part of the positive feedback loop. Ongoing connections with the community will keep conversations going and keep them informed.
- **Put trust at the forefront:** Encourage transparency and respect from the start. Be open to feedback and adaptable to the ever-changing landscape. People lose trust quickly if they feel they are being 'managed'.

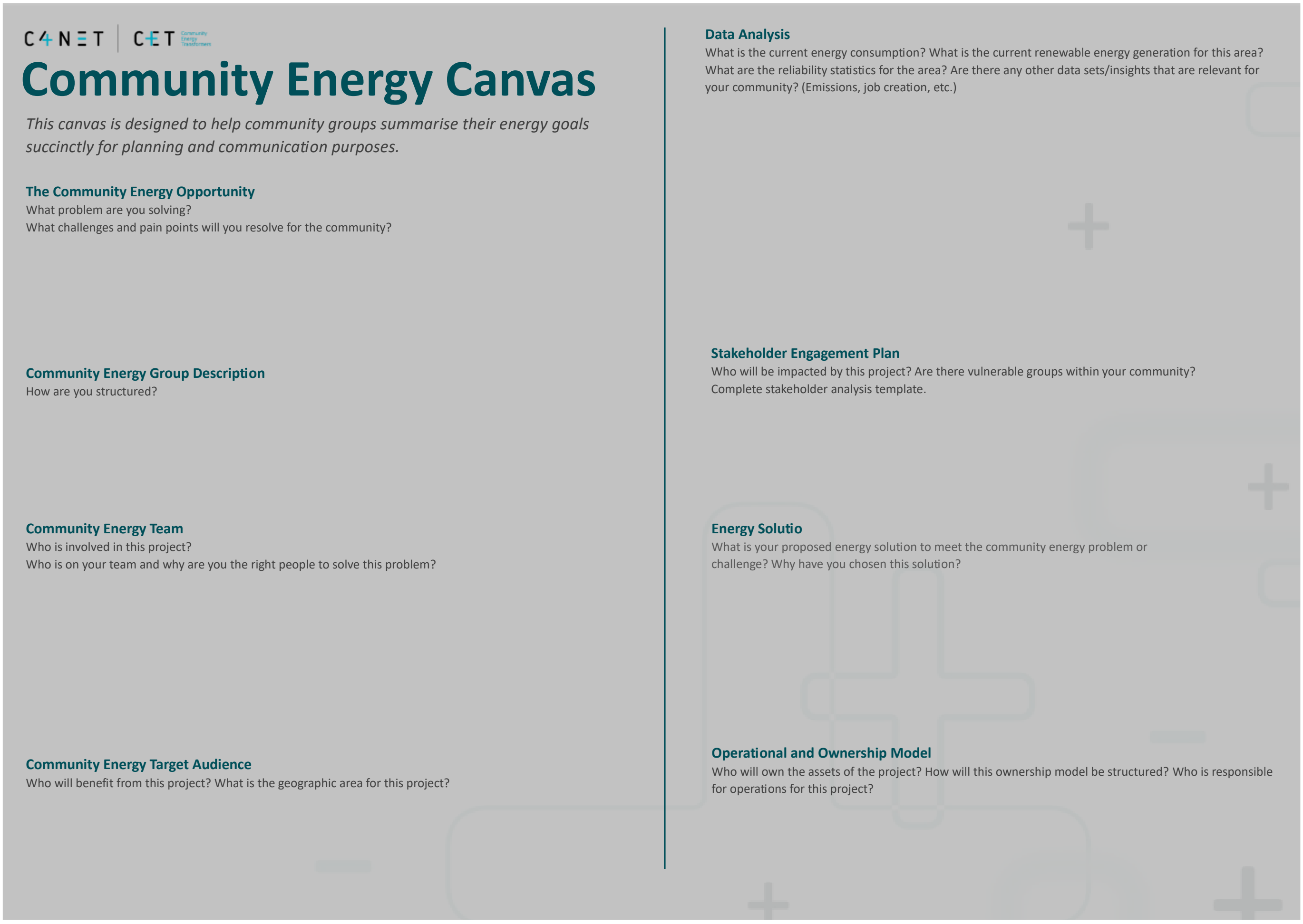
7.6 Regional communities have specific needs, how do these needs relate to electricity service providers?

Electricity is social as well as a physical infrastructure. Electricity design and planning shape opportunities for some, whilst potentially constraining opportunities for others. Electricity system entities often understand the purpose of energy narrowly, in terms of their own regulatory remit and business and operating models. It requires some imagination, collaboration and regulatory change for these entities to engage in a broader discussion about electricity and local needs. Microgrids bring these issues to life, and raise questions about who is the right entity to govern for broader goals and possibilities. There is much to be said for enabling conversations that go beyond narrow sectoral concerns to explore the full potential of electricity developments. This can lead into a conversation about who has the authority or agency to enable certain aspirations and the limits of entities, like networks, to be able to do that. This kind of conversation is useful for clarifying and maintaining expectations without closing down conversation and avoids unnecessarily limiting the vision for the microgrid from the outset. It is important that discussions about goals are eventually grounded in the realities of what is possible – but research projects such as this one have the opportunity to broaden the imaginative landscape for electricity in a way that sectoral thinking rarely allows.

Appendices

Appendix 1: Community Energy Canvas

The Community Energy Canvas is a planning tool designed to guide community groups through the steps they need to take and the issues they need to consider when developing a project.



C4NET | CET

Community Energy Canvas

This canvas is designed to help community groups summarise their energy goals succinctly for planning and communication purposes.

The Community Energy Opportunity
What problem are you solving?
What challenges and pain points will you resolve for the community?

Community Energy Group Description
How are you structured?

Community Energy Team
Who is involved in this project?
Who is on your team and why are you the right people to solve this problem?

Community Energy Target Audience
Who will benefit from this project? What is the geographic area for this project?

Data Analysis
What is the current energy consumption? What is the current renewable energy generation for this area? What are the reliability statistics for the area? Are there any other data sets/insights that are relevant for your community? (Emissions, job creation, etc.)

Stakeholder Engagement Plan
Who will be impacted by this project? Are there vulnerable groups within your community?
Complete stakeholder analysis template.

Energy Solutio
What is your proposed energy solution to meet the community energy problem or challenge? Why have you chosen this solution?

Operational and Ownership Model
Who will own the assets of the project? How will this ownership model be structured? Who is responsible for operations for this project?

Funding Requirements

What amount of funding is required for this project? How will the funding be allocated?

Project Implementation Timeline

Briefly, how will you roll out this project? What are the phases of implementation?

NOTES:

Appendix 2 : Town energy dynamics

Number of customers by customer type and by town

Customer type	Donald	Tarnagulla	Total
Agriculture	10		10
Commercial	146	10	156
Domestic	706	106	812
Industrial	43	7	50
Total	905	123	1028

Total energy and maximum demand by town

Town	Channel	Energy (kWh)	Demand (kW)
Donald	E	7907601	95
Turnagulla	E	5847076	32

Total energy and maximum demand by customer type and town

Customer type	Donald		Tarnagulla		Total
	kWh	kW	kWh	kW	kWh
Agriculture	21,016	3.3	-		21,019
Commercial	2572368	95	25,629	6.888	2,572,463
Domestic	4,441,376	12	488,975	32	4,441,388
Industrial	657,419	37	61,668	6.325	657,456
Total	**7,692,179**		**576,273**		**7,692,326**

Total number of PV customers and installed capacity by town as December 2018

Town	Customer no.	Capacity (kW)
Donald	233	1320
Tarnagulla	41	174
Total	**274**	**1494**

Total energy exported and maximum demand exported by customer group and town

Customer type	Donald		Tarnagulla		Total
	kWh	kW	kWh	kW	kWh
Agriculture	0	0		-	0
Commercial	70848	37.33	2431	1.58	73279
Domestic	682092	4.58	488974	32	1171066
Industrial	170363	9.11	61668	6.32	232031
Total	**923303**		**553073**		**1476376**

Centre for New Energy Technologies Ltd
ABN 56 626 202 480

centre-for-new-energy-technologies
C4NET_Vic

C4NET.com.au