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Technology, people, and place in microgrids: Addressing perceptions and engagement challenges for a rural Australian town

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ABSTRACT

Microgrids are emerging as a promising technological solution for providing reliable, sustainable, and cost-effective electricity to regional and remote communities. However, successful microgrid implementation necessitates not only technical and economic feasibility but also social acceptance within the communities where they are deployed. This paper presents a case study of a microgrid feasibility project in Victoria, Australia, employing a mixed-methods design to analyse community perceptions of microgrids and the role of engagement strategies in promoting community acceptance or leading to conflicts. Drawing on empirical findings from in-depth interviews ($n = 13$) and a community survey ($n = 62$), this research investigates the challenges and lessons associated with engaging a local community when investigating the feasibility of a proposed microgrid. The findings highlight the significant influence of place-based factors and community dynamics on project perception and social acceptance, emphasising the need for tailored engagement strategies that foster collaboration and maximise community participation. While best practices of community engagement do not guarantee community acceptance, this research demonstrates that proactive engagement and transparent communication can effectively address concerns and cultivate support for microgrid initiatives.

1. Introduction

The energy transition represents a complex and multifaceted process characterised by a shift away from carbon-intensive, centralised energy systems towards decentralised and decarbonised alternatives [1,2]. Renewable energy sources are poised to play a pivotal role in Australia's clean energy transition. In 2024, renewable energy accounted for 40 % of Australia's total electricity generation, up from 35.9 % in 2022. Among the various sources, wind energy contributed the largest share, providing 13.4 % of the nation's electricity, followed closely by rooftop solar, which supplied 12.4 % of total generation [3]. Rooftop solar, which is predominantly located in urban and suburban areas, was the largest contributor in terms of capacity growth, with 3.2 GW added in 2024. While small-scale rooftop solar continues to rise rapidly in urban settings, utility-scale renewable energy projects, such as large solar farms and wind farms, are primarily located in rural and regional areas, where land availability and resource potential are more favourable [4].

As the energy transition has gathered pace, local opposition to energy infrastructure siting has increased [5–7]. This resistance has been conceptualised through various lenses, including perceptions of fairness (distributive and procedural justice), place attachment and identity [8], populist and political ideology [9], and community acceptance [10–12]. While the NIMBY (Not In My Backyard) concept has been widely debated, local conflicts and trade-offs are increasingly recognised as inherent aspects of the energy transition [13,14]. Consequently, the role of local communities as key actors in shaping a sustainable energy transition has garnered significant attention in academic literature [15–18].

Participation and community engagement are considered potential solutions to avoid social conflicts and resistance to the projects [19,20]. Innovative community engagement strategies can promote collaboration between project teams and local stakeholders, leading to a reduction in social conflicts and an increased likelihood of social acceptance [1,21,22]. Empirical studies demonstrate that projects characterised by high levels of community engagement, consultation with local stakeholders, and participatory planning are significantly more likely to gain social acceptance compared to those with limited or minimal community involvement [23–25].

While participation and engagement possess a strong normative connotation and are widely regarded as important elements of

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community acceptance [12], critics argue that these processes are resource-intensive, requiring substantial time and financial investments that may outweigh their benefits [26–28]. This study aims to address these diverging perspectives and contribute to a more nuanced understanding of the opportunities and challenges associated with community engagement and participation in the context of microgrid development in rural Australia.

Renewable energy microgrids are gaining prominence as a transformative energy technology due to their capacity to enhance the reliability and resilience of the electricity supply in rural and remote communities [29–32]. Microgrids are commonly defined as "a group of interconnected loads and Distributed Energy Resources (DERs) within a defined electrical boundary, operating as a single controllable entity with the capability of connecting or disconnecting from the main grid to operate independently in islanded mode" [33–35]. When integrated with renewable energy sources and battery storage systems, microgrids are increasingly recognised as a viable solution for providing resilient, reliable, and affordable electricity to rural and remote communities [36–38]. In Australia, microgrids remain a niche, with the majority of pilot projects and feasibility studies conducted in Indigenous, rural, and remote communities, where they are explored as a solution to enhance energy autonomy, resiliency, and reliability in these communities [35,39,40]. Although the technical aspects of microgrids have been explored extensively in the literature [41–43], the social aspects, which are critical in the implementation of microgrids, have not been explored in detail [39,44–46].

Guided by an action research approach, this study investigated the following overarching research question: What are the challenges and drawbacks associated with engaging a local community in the conceptualisation and feasibility stages of a microgrid solution? Specifically, this research examines how community engagement strategies influence perceptions of the project and whether these strategies foster social acceptance or give rise to conflict. Furthermore, this study explores the potential misconceptions surrounding the notion of "good practice" in community engagement, highlighting the limitations of standardised approaches that may not adequately address the complexities and unique dynamics inherent in specific communities. By analysing these challenges and complexities, this research aims to generate valuable insights and lessons learned to improve the design and effectiveness of community engagement processes in microgrid development.

2. Literature review: social acceptance and exploring community engagement in the microgrid projects

The successful deployment of microgrids, like any technological solution, necessitates consideration of not only technical and economic factors but also crucial social dimensions [47,48]. As renewable energy projects, including microgrids, are increasingly deployed in and around rural communities, the question of their social acceptance by these communities becomes paramount. Wüstenhagen et al. (2007) define social acceptance in the context of renewable energy projects as "the acceptance of siting decisions and related policies by local stakeholders, particularly residents and local authorities [12]." This acceptance is critical for the progress and success of renewable energy projects, including microgrids [49]. Conversely, a lack of community acceptance and the presence of local opposition can significantly hinder the implementation of such projects [50].

The academic literature demonstrates that local communities have exhibited resistance to various renewable energy technologies, including wind energy, primarily due to visual and noise impacts [51–53], geothermal energy over the risk of groundwater contamination [54], smart meters for privacy concerns [21], large-scale solar farms, owing to land conflicts [49], tidal energy due to ecological impacts [55], and nuclear energy for safety concerns [56]. Consequently, community acceptance is critical for the successful deployment of renewable energy technologies, as it can significantly influence project implementation and long-term sustainability [57–59].

Effective community engagement is widely recognised as a critical component in achieving social acceptance of renewable energy projects, and it can play a pivotal role in the successful implementation of low-carbon distributed technologies, such as microgrids [60–63]. Engaging with local communities leads to the development of trust and partnership between community members and project stakeholders, which is integral for successful project implementation [64–68]. Besides, respecting local stakeholders involved in the engagement process and considering their input in decision-making is significant for developing a sense of ownership and legitimacy in the project [69–72]. Projects with active public participation and meaningful stakeholder input are more likely to be accepted by the local community, resulting in reduced social conflicts and opposition [73,74]. Various community engagement strategies can be employed to enhance community acceptance, with their application depending on the specific project requirements and scope [75–77]. Diverse community engagement methodologies, such as community surveys, questionnaires, interviews, webinars, workshops, community fairs, town hall events, scenario generation, and serious game approaches, are widely used in renewable energy projects [44,78–80].

While evidence suggests that effective community engagement can lead to increased acceptance of renewable energy projects and facilitate the achievement of decarbonisation targets, integrating public perspectives into decision-making processes presents inherent complexities and challenges as well [27]. Community engagement can be resource-intensive, and poorly planned strategies may lead to conflict and opposition within communities [81,82]. For instance, excessive information disclosure during webinars and workshops can result in information overload and misconceptions among participants [83]. Additionally, community groups with limited technical knowledge may encounter difficulties in comprehending complex project details, potentially hindering consensus-building and exacerbating conflict [84]. These challenges highlight the complexities associated with integrating public input into decision-making processes, particularly for projects involving technically intricate or contentious issues.

Despite the growing interest in microgrids as a decentralised energy solution, limited research has been undertaken in understanding the social acceptance of microgrids [44], creating a significant gap in the existing literature. For instance, Chalaye et al. (2023) developed a place-based methodology for site selection, focusing on socio-technical considerations [46]. Eklund et al. (2023) conceptualised the representation of community preferences across project stages, proposing a social capital-based framework to identify community characteristics [45], while Eklund et al. (2024) applied a Multi-Criteria Decision Analysis framework to evaluate microgrid business models [85]. Farrelly and Tawfik (2020) examined four Victorian microgrid projects, identifying common drivers and challenges [86]. Wright et al. (2024) applied a Strategic Niche Management lens to assess microgrids as niche innovations, focusing on stakeholder engagement, ownership, and business models, and highlighting key barriers [39]. Tahir et al. (2024a) presented empirical findings on the drivers and barriers within a microgrid feasibility study, offering policy recommendations to inform future funding programs and regulatory frameworks [35]. Additionally, Tahir et al. (2024b) conducted a qualitative analysis of community engagement across regional and remote microgrid feasibility studies, identifying challenges and strategies for more effective engagement [44]. Besides this research on the social aspects of microgrids [41,42,87], the literature on the factors influencing social acceptance around microgrids still remains underexplored. Furthermore, the complex role of community engagement in microgrid projects requires further investigation, as engagement outcomes can vary significantly, ranging from promoting acceptance to creating opposition and conflict [44].

Examining a case study from a rural Australian community provides a valuable opportunity to assess the effectiveness of community engagement strategies in enhancing social acceptance of microgrid projects. Analysing a specific case study will reveal whether employed community engagement strategies are achieving their intended objectives and, if not, identify key insights and lessons learned to refine future approaches.

3. Theoretical framework: technology, people, place, and process

To explore community perceptions of microgrids and engagement strategies in regional areas, multiple theoretical frameworks were reviewed. The Theory of Planned Behaviour [88] was considered but found insufficient for capturing community-level dynamics. The Diffusion of Innovation framework [89,90] offered insights into how new ideas spread within communities, while Social Practice Theory, and Arnstein's Ladder of Participation provided complementary perspectives [91]. However, none fully addressed the contextual and collective aspects of engagement central to this study's aims. This research primarily employs Hilary Boudet's "Technology, People, Place, and Process" framework to understand the role of community engagement in shaping social acceptance of microgrids [26]. This framework offers a comprehensive approach to analysing the complex interplay between technological developments and their social contexts, recognising the influence of various factors on community perceptions and project outcomes. The framework also provides a systematic approach to understanding how infrastructure or technological developments interact with social contexts, identifying technology, people, place and process as factors influencing a community's perception towards renewable energy technology [26]. This framework serves as a guiding structure for this research, with each element elaborated upon below.

3.1. Technology

The analysis of the potential benefits and associated risks of certain technology will often determine the perception of that technology within a local community [26]. For instance, public perception studies have found that fossil fuel generation is considered more risky and less appealing as compared to renewable energy technologies [92]. In this research, the perception around microgrids was analysed in the context of a feasibility study conducted by a team of researchers, practitioners and local community leaders.

3.2. People

This dimension of the framework highlights the influence of different sociodemographic factors on an individual's attitudes and behaviours towards the adoption of new technologies. For instance, some have found that women and young adults with higher education and higher income are generally more supportive of renewable energy projects compared with older generations, who can be more reluctant to change [90]. The case study captured the profile of the community group and investigated its different views and opinions surrounding microgrids.

3.3. Place

This dimension of the framework encompasses the influence of landscape, physical infrastructure, demography, layout, network topology, and historical experiences on community perceptions of new technologies [25]. These place-based factors can significantly influence the suitability and feasibility of different energy technologies within a given locality. For instance, proximity to cost-effective renewable energy resources (e.g., wind, hydro, biomass) and the existing configuration of the electricity distribution network will profoundly shape the technological choices available for community energy projects.

3.4. Process

Process-based strategies are critical in shaping community perceptions and acceptance of new technologies [93,94]. In the context of energy projects, the nature and extent of community engagement, including how communities are involved in decision-making processes, significantly influence their perceptions and acceptance of the project. Effective community engagement strategies aim to foster trust, transparency, and open communication, ensuring the community's right to participate and contribute to decision-making.

The research will be underpinned by this theoretical framework, providing a structural lens to examine the role of technology, people, place and process in social acceptance of new technology. Fig. 1 provides a summary of the different dimensions of the framework.

4. Methodology

A mixed-method case study methodology was employed to facilitate an in-depth exploration of the factors contributing to the social acceptance of complex community energy projects, such as microgrids. A case study is defined as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, utilising multiple sources of evidence [95]. This approach enables a comprehensive understanding of community experiences and the multidimensional nature of community engagement within rural contexts, capturing complexities that might be overlooked in broader qualitative studies. Furthermore, the case study approach allows for the integration of theoretical concepts with empirical observations, potentially leading to the generation of new hypotheses and theoretical insights [95].

A case study from a rural Australian town is particularly relevant as they were identified by the Australian government as a key focus for microgrid feasibility funding, due to their geographical location, less reliable and resilient energy supply, and higher energy costs. Lessons learned from this case provide valuable insights that can inform and guide similar initiatives in other communities across Australia [35].

The ethics application for this research (approval number: ETH22-7296) was prepared and submitted by the lead researcher and subsequently approved by the university's Human Research Ethics Committee. The project was classified as low risk. The application detailed the research methodology, participant recruitment processes, funding sources and disclosure of interests, as well as protocols for data collection, use, and participant involvement. Approval was granted to conduct both qualitative and quantitative components of the study. Prior to participation, interviewees were provided with a Participant Information Sheet outlining the purpose of the research, the reasons for their selection, potential risks, and how their data would be used. Contact information was also provided to address any questions or concerns participants may have had.

4.1. The case of Heyfield

As host of the MyTown Microgrid project, Heyfield, an Australian rural town in Victoria's Gippsland region with a population of approximately 2000 residents, was selected as the primary case study for this research. Initiated in 2020 with federal and state government funding, the MyTown project aimed to assess microgrid feasibility and engage the community in the planning process. The Heyfield MyTown Microgrid project aimed to undertake a detailed data-led microgrid and local energy feasibility study for the town of Heyfield (Victoria), built on a platform of deep community engagement and capacity building. At the core of this project was a novel community engagement approach which sought to empower the local community to own and progress the idea of a local microgrid supported by a team of researchers from different disciplines. Over the three-year duration, the project also aimed to develop the knowledge and tools to make it faster, easier, and cheaper for other regional communities to understand local energy propositions

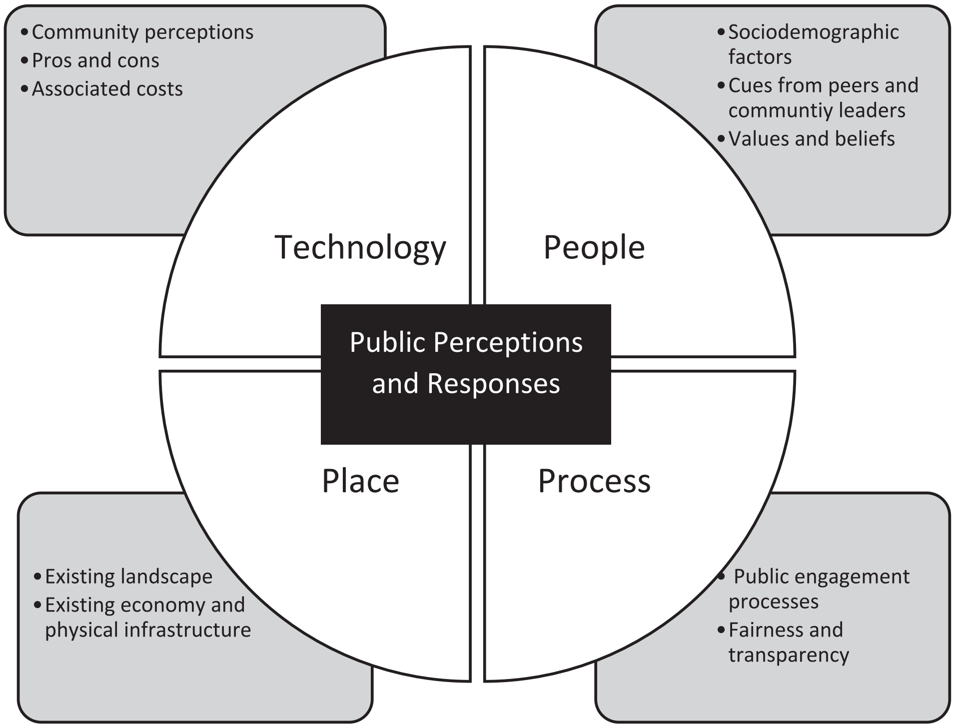

Fig. 1. Technology, People, Place and Process Framework for understanding public perceptions and responses. Retrieved from Boudet's framework [26].

for their community. The project's ultimate goal was to serve as a blueprint for a community-led approach towards understanding the feasibility of a local microgrid solution.

The project team, comprising members from the community, industry, academia, and government, sought to examine the microgrid value proposition for Heyfield while fostering community capacity and knowledge regarding clean energy solutions.

Sociodemographic factors, cultural norms, peer influence, and trust can all shape individual and collective perceptions of new technologies [26]. While sociodemographic factors such as age, gender, and religious affiliation can play a significant role in shaping perceptions, the analysis of the Heyfield case study did not reveal these factors to be critical in shaping perceptions of microgrids.

According to the Australian Bureau of Statistics (ABS) census data, the population of Heyfield is relatively evenly distributed between males (51 %) and females (49 %), with an average age of 47 years [96]. Furthermore, the region exhibits limited ethnic diversity. As illustrated in Table 1, the highest population density is found in the 55–75 age group, significantly higher than the national average. This suggests that many Heyfield residents are retirees or older individuals.

The median age in Heyfield is 47, notably higher than the national median of 38, indicating an older population profile in the region.

Fig. 2 presents the demographic profile of Heyfield, detailing language spoken, population distribution by gender, country of birth, and Indigenous identification. Similarly, Fig. 3 illustrates that 46 % of Heyfield's population is currently employed, while 43 % are retired or otherwise out of the workforce. This demographic composition contrasts with the employment data for Victoria and Australia overall, where a higher proportion of individuals are employed. The data suggests that Heyfield's population is characterised by a predominance of retirees and an older demographic profile (Fig. 4).

Established in 1841 due to its proximity to abundant timber resources, Heyfield's early economic development was inextricably linked to the timber industry. In subsequent decades, its location near the Latrobe Valley led to its emergence as a source of labour for the region's three coal-fired power plants, attracting workers from other areas. However, both the timber and coal industries are currently undergoing

Table 1
Heyfield demographics: average age vs age in Australia.

Age group	Occurrence in Heyfield	Percentage in Heyfield	Percentage in Australia
0–4	78	3.8	5.8
5–9	108	5.2	6.2
10–14	138	6.7	6.2
15–19	153	7.4	5.7
20–24	71	3.4	6.2
25–29	120	5.8	7.0
30–34	90	4.4	7.3
35–39	104	5.0	7.2
40–44	95	4.6	6.5
45–49	128	6.2	6.4
50–54	116	5.6	6.3
55–59	167	8.1	6.1
60–64	122	5.9	5.8
65–69	162	7.8	5.1
70–74	171	8.3	4.6
75–79	105	5.1	3.2
80–84	69	3.3	2.2
85 and older	68	3.3	2.1

fundamental transitions to meet the challenges of more sustainable practices. Consequently, Heyfield has evolved beyond its historical industrial identity, seeking new pathways towards economic and environmental sustainability.

To facilitate effective communication and collaboration between the project team and the community, a dedicated Community Liaison Officer (CLO) position was created. The CLO served as a central point of contact, responsible for coordinating communication and engagement activities between the project team and the Community Reference Group (CRG). Fig. 5 provides a visual representation of the key tasks and responsibilities associated with the CLO role.

In addition to the Community Liaison Officer, a Community Reference Group (CRG) was established to represent the broader community and provide input into the project's decision-making processes. The CRG

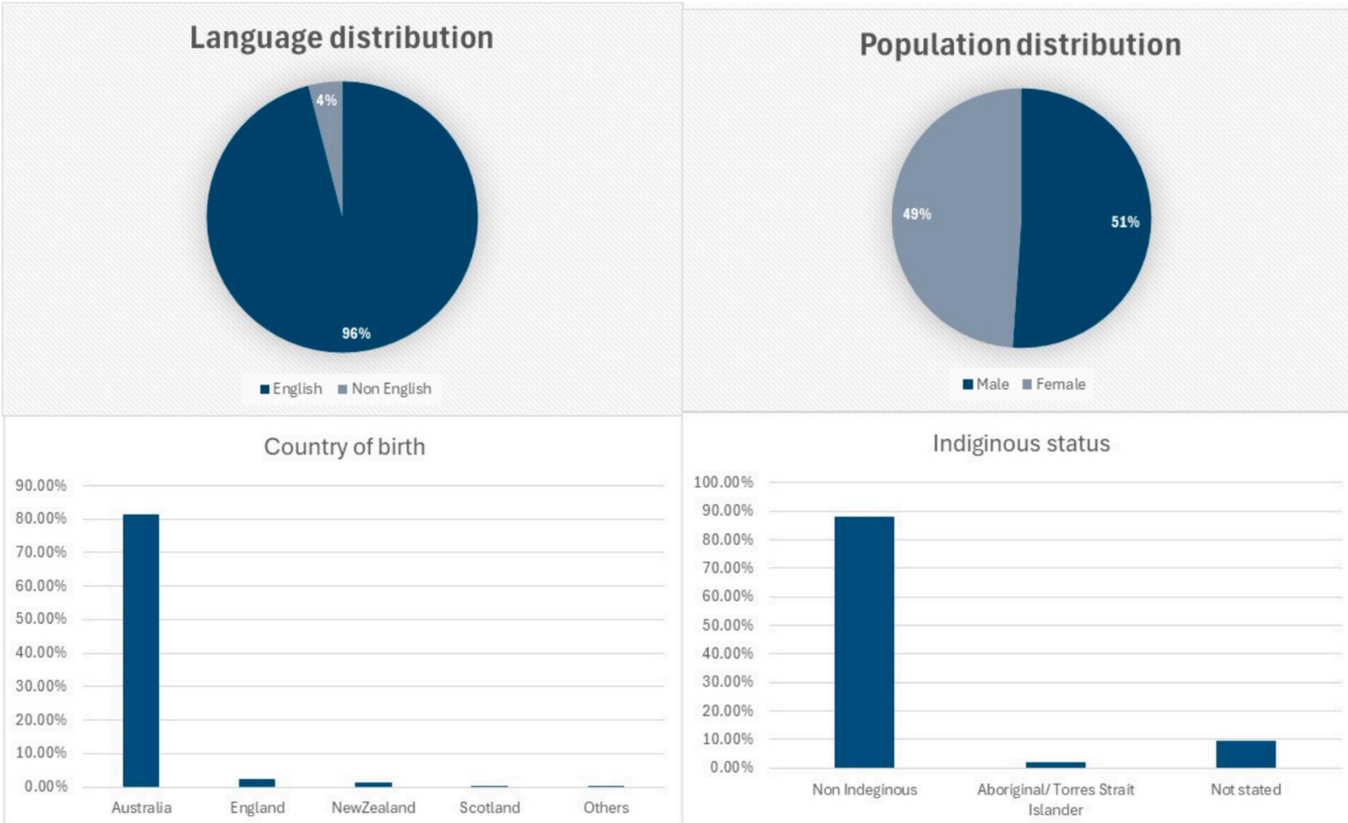

Fig. 2. Heyfield demographics.

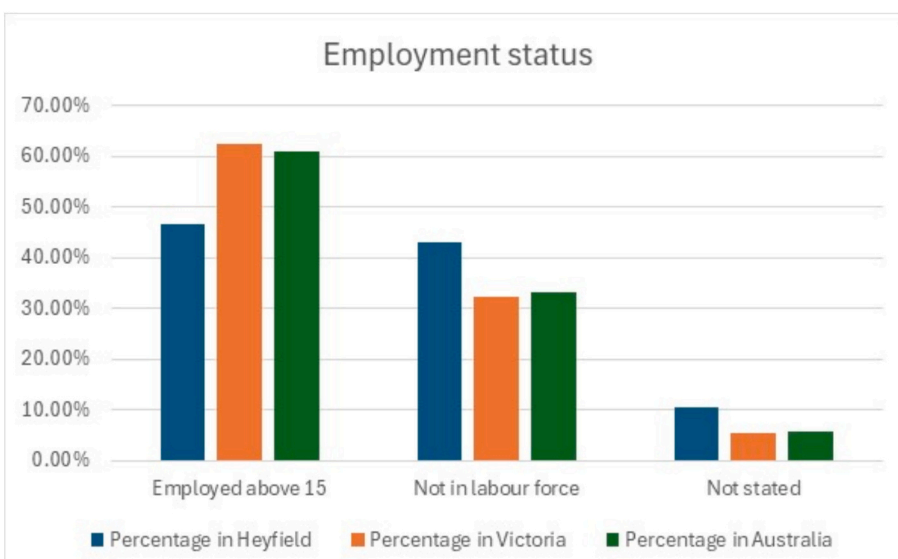

Fig. 3. Heyfield employment data.

served as a direct conduit between the project team and the local community, ensuring community perspectives were incorporated into project development. The group met regularly at the Heyfield Community Resource Centre (HCRC) to discuss project progress, research findings, and community feedback. The CRG's input significantly shaped the project's direction and outcomes.

The techno-economic analysis of a potential islandable microgrid solution for Heyfield revealed a marginally beneficial option for the community for just one of the scenarios investigated. Ultimately, the community and project team decided that the economic benefit was, therefore, not strong enough to warrant progressing with the implementation of the microgrid, given the major risks involved. However, alternative aspects of the microgrid that were evaluated (specifically various types of battery energy storage systems) did prove more feasible on their own and were the subject of a separate feasibility study, which was granted state funding to pursue (The details of the alternatives pursued have been stated in the appendix as an alternative to the microgrids). While some community members expressed

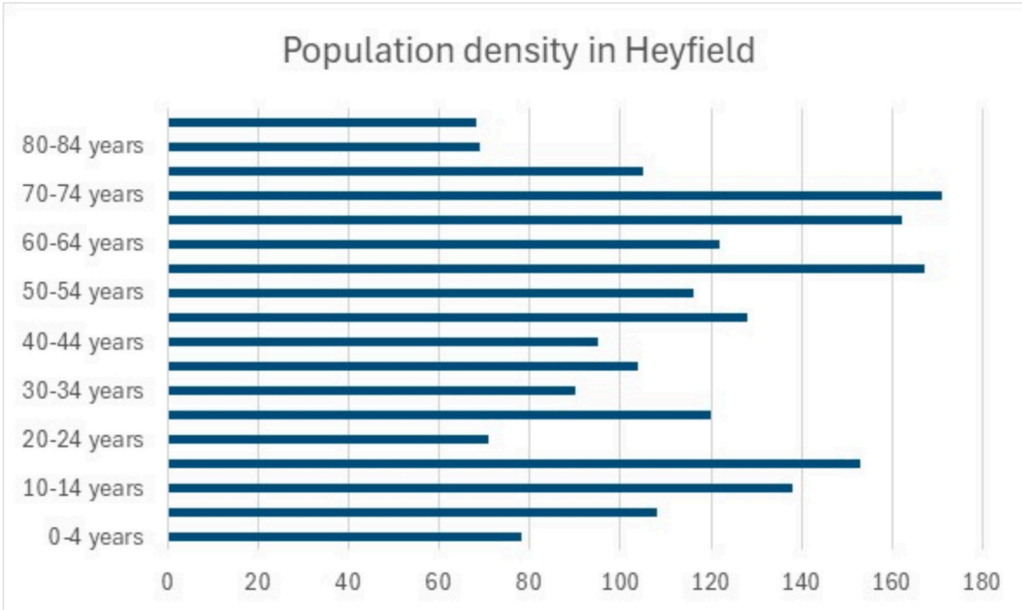

Fig. 4. Heyfield population density.

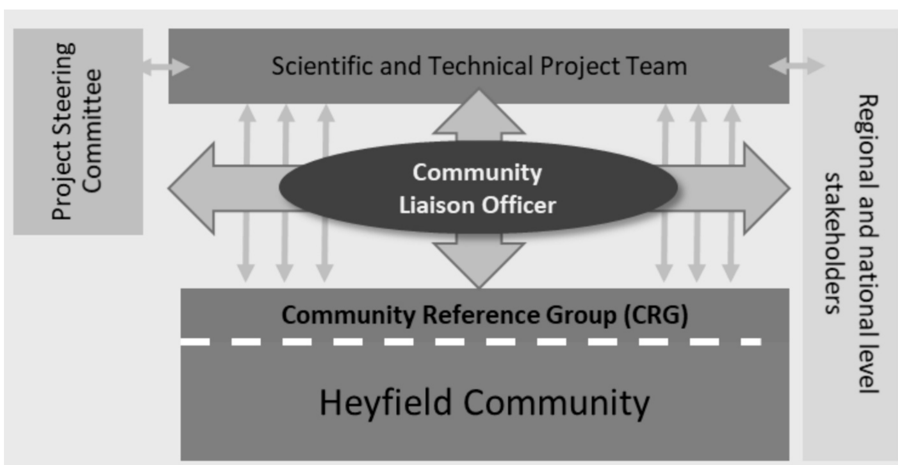

Fig. 5. Role of CLO and CRG (adopted from the Heyfield conceptual data and analytical report [97]).

disappointment, as they had invested time in understanding the microgrid value proposition, the project team emphasised the need to prioritise the provision of optimal energy solutions for the community by exploring alternative technologies.

4.2. Mixed methods approach

To explore the role of community engagement in shaping the social acceptance of microgrids under the lens of the Technology, People, Place and Process framework, this research employed a mixed-method approach for the data collection. To gather diverse perspectives from key stakeholders involved in the MyTown microgrid project, this research utilised a mixed-methods approach incorporating semi-structured interviews, community surveys, and document analysis. To ensure ethical integrity and transparency, this paper was led by a PhD candidate with a university scholarship, who conducted all the interviews and surveys. The other co-authors were drawn from the project team that were able to provide the necessary project context, while also contributing to the conceptual development, supervisory support, formal analysis, and reviews. The research process and interpretation of findings were led by the PhD candidate, but still as a collaborative effort, with a high degree of attention paid to maintaining the independence and integrity of the research through the ethical procedures that were followed.

4.2.1. Semi-structured interviews with the Community Reference Group

Semi-structured interviews ($n = 10$) were conducted with members of the Community Reference Group (CRG), who were actively involved in the project's decision-making processes and contributed community perspectives throughout the project. Members of the Community Reference Group (CRG) were recruited voluntarily, following an advertisement for the role in the local community newsletter. Interested individuals contacted the project team to express their willingness to join. Given their active involvement and ongoing engagement with the project, all the CRG members ($n = 10$) were selected as interviewees for this study. Interview questions explored participants' roles in the project, the extent of community inclusion in decision-making, challenges encountered during the engagement process, initial perceptions of the project, and overall perspectives on project outcomes. The semi-structured format, with interviews lasting approximately 20–30 min each, enabled flexibility in exploring the process-related dimensions of the "Technology, People, Place, and Process" framework.

4.2.2. Semi-structured interviews with the project team

Additionally, semi-structured interviews ($n = 3$) were conducted with project team members directly involved in the design and implementation of community engagement strategies. The project team interviewees were selected based on their roles and active involvement across key components of the project. Three team members were interviewed, each contributing to distinct aspects of the initiative, including community engagement, project management, and techno-economic analysis. Their selection aimed to ensure representation of diverse perspectives within the project team and to capture insights from those directly involved in the design and implementation processes. These interviews explored the development, implementation, and perceived effectiveness of the strategies employed.

4.2.3. Survey of local perspectives regarding microgrids

To explore broader perspectives beyond those of the CRG, a survey ($n = 62$) was conducted with members of the Heyfield community to understand general attitudes and perceptions related to the project. The survey aimed to assess the community's general understanding of microgrids, their familiarity with the outcomes of the MyTown project, and their perceptions of renewable energy microgrids, with the broader objective of capturing perspectives beyond those directly involved in the project. The survey incorporated both closed- and open-ended questions, exploring community perspectives on an ideal power system for the town, familiarity with renewable energy technologies, and willingness to adopt new technologies such as microgrids. The survey was distributed using both online and in-person methods. For the online distribution, the survey link was shared via email with individuals subscribed to the local community newsletter. In-person distribution was conducted through direct engagement with residents on the streets, in front of the market, as well as at key community locations such as the local resource centre and during town hall events. These multiple distribution channels were used to reach a broader cross-section of the community and to include those who may not engage regularly with digital platforms. The survey was open to all Heyfield residents, with participants recruited both randomly on the street and through online distribution channels.

4.2.4. Document analysis

Additionally, document analysis ($n = 47$) was conducted to complement the primary data collection. These documents included MyTown microgrid project reports, workshop outputs, presentation materials, prior project documentation, and other resources on the Heyfield MyTown Microgrid Project. The documents were reviewed to provide contextual depth, triangulate findings from the interviews and surveys, and situate the research within the broader socio-technical landscape of microgrid development in Australia.

By integrating qualitative case study methodology with mixed methods for data collection, this research methodology leverages the strengths of the "Technology, People, Place, and Process" framework to comprehensively address the research objectives. Fig. 6 provides a visual representation of how the mixed-methods approach aligns with the four dimensions of the framework, illustrating the interconnectedness of the various data collection methods and analytical lenses.

4.3. Data interpretation analysis

Interviews were audio-recorded with the participant's consent and later transcribed for analysis. Field notes were also taken to capture non-verbal cues and contextual information. Ethical protocols were followed throughout the interview process, including obtaining informed consent from participants, ensuring confidentiality, and addressing any potential biases.

The recorded data was transcribed, and transcripts were reviewed for any errors. After the review, NVIVO 12 was used to code the data to identify recurring themes and insights related to the Technology, People, Place, and Process framework. A thematic analysis approach was

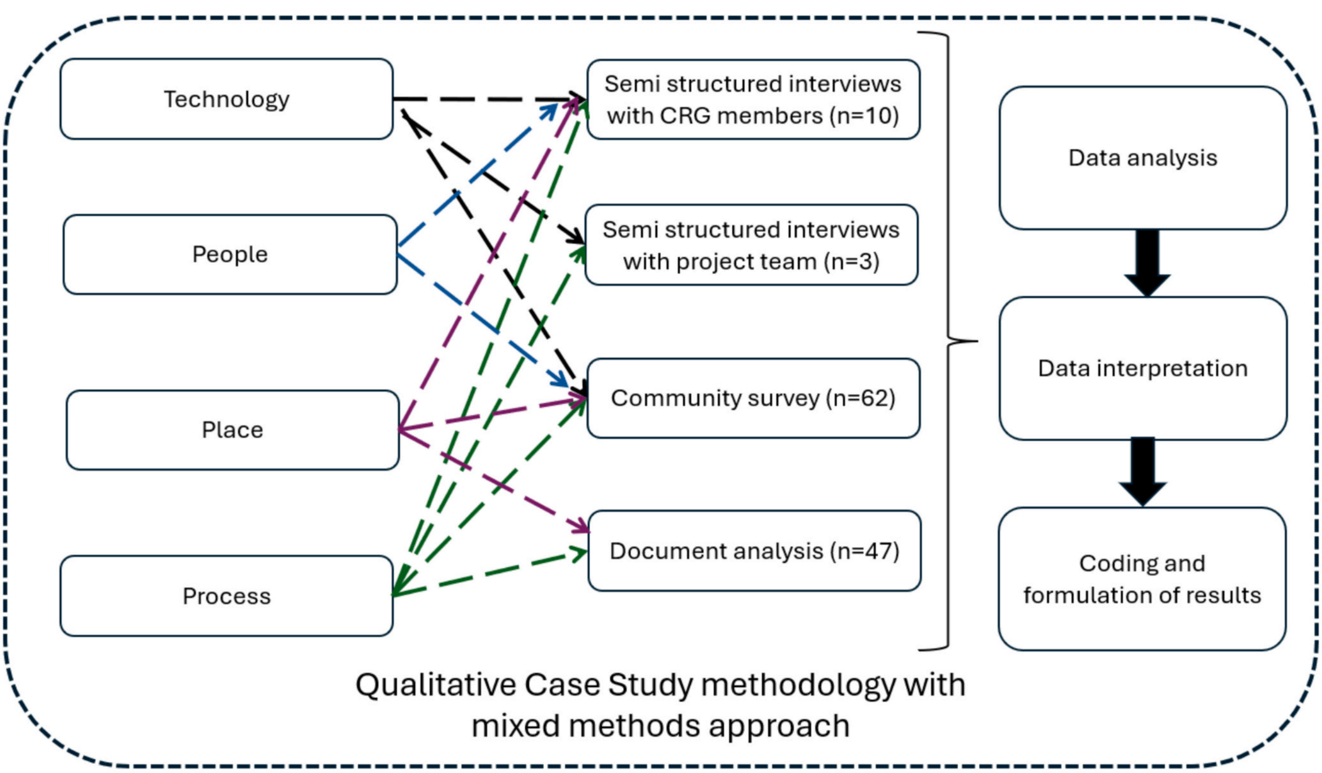

Fig. 6. Mixed-method approach.

employed to identify key patterns and themes emerging from the interview data, and themes were analysed using the technology, people, place, and process framework.

Transcribed interview data (including data from both CRG members and project team) were imported into NVivo 12 for qualitative analysis. A thematic analysis approach was employed using a deductive coding framework based on the Technology, People, Place, and Process (TPPP) model. Initial parent nodes were created corresponding to each of the four elements of the TPPP framework. Within each node, sub-nodes were inductively generated to capture recurring themes and emerging insights from the data. Field notes were also coded in NVivo to supplement and contextualise interview findings. Coding was done iteratively, with regular checks for consistency and accuracy.

4.4. Mitigating potential bias

While qualitative interviews provided valuable insights into the research, there are potential biases that must be acknowledged. Some members of the author team were also part of the broader project team involved in the Heyfield MyTown Microgrid Project. These members were included in the interview process as well to get the project team's perspective. However, to address the potential bias, the lead author, who is a PhD candidate and had no formal role in the community engagement component of the project, conducted all qualitative data analysis independently. Interview data were de-identified before analysis, and transcripts involving authors as participants were coded alongside others but checked against non-author interviews for triangulation. Coding decisions were reviewed by another independent researcher (stated as an author) not involved in the project. Other authors were involved in the review process and were not part of the analysis, thus reducing bias and maintaining research integrity.

The CRG members interviewed were self-selected volunteers who had actively approached the project team to participate. As such, they were likely more interested, engaged, and supportive of the project, potentially introducing a positive bias in their responses. Additionally, interviews were conducted with members of the project team who were directly involved in the development and implementation of the microgrid project. Although these interviews were carried out independently by the researcher, there remains the possibility of bias in favour of the project's outcomes and processes. These potential biases are acknowledged in the analysis and have been considered when interpreting the findings.

5. Results - through the lens of technology, people, place, and process framework

This section presents the findings from the qualitative case study, analysed and interpreted using the "Technology, People, Place, and Process" framework.

5.1. Technology

This section reveals the Heyfield community's perceptions around microgrids and how they view it and perceive it. A post-project survey revealed a significant lack of prior awareness regarding microgrids, with only 28 % of respondents indicating prior knowledge. This finding underscores the conceptual complexity of microgrid technology in terms of community comprehension.

The definitions communicated by the project team to the community were based on the technical and scientific perspectives, including the following:

"*Microgrids are defined as a group of homes and businesses that use, generate, and share electricity. It may be able to function both as part of the grid and autonomously. It will typically comprise solar PV systems or small wind farms to generate the majority of the electricity required, a battery system to store the electricity, a backup generator* (*typically diesel-powered*)*, and power electronics to convert energy and manage the system*"

However, the community survey revealed that participants' initial expectations of microgrids varied from the proposed definition, ranging from grid-connected systems to community-based power sharing. Fig. 7 presents a word cloud generated from the Heyfield survey responses, capturing the diverse range of community expectations regarding microgrids. The heterogeneity of responses reveals the complexity and breadth of community understanding surrounding microgrids.

One interviewee from the CRG group expected the microgrid to be a tool for locally generated renewable energy. He stated:

"*I didn't really know what a microgrid meant. And I thought a microgrid would be we'd buy all the power from Heyfield, and we'd sell it back to the community. That's what I thought a microgrid was. Although I would love to see something like that happening*".

(Community Reference Group, Interviewee 3)

This reflects the disconnect between the technical definitions of microgrids and community perceptions and expectations around them, underscoring the importance of clear communication and engagement to bridge this gap. The research also indicated that the majority of the community members were not aware of the term "microgrids" before the MyTown project, requiring additional efforts from the project team in conveying the right messaging and raising awareness about microgrids.

5.2. People

This part of the results section, under the 'people' dimension of the framework, highlights how demographic factors influence perceptions of microgrids. The data from the CRG interviews revealed the significant influence of word-of-mouth communication and peer influence in shaping community perceptions of the microgrid project in the Heyfield community. Information and ideas disseminated organically through personal networks, with individuals sharing their experiences and perspectives with peers, played a crucial role in shaping community attitudes towards microgrids. This natural dissemination of information through word of mouth and peer influence, beyond formal engagement channels, was important in shaping the perception of the people in the community. The Community Reference Group (CRG) members, who participated voluntarily and played an integral role in the project, were largely influenced to become involved through peer encouragement and community networks. An interviewee who was an integral part of the CRG group commented regarding setting up the group:

"*And when we got this grant. And so I'd set up this core set up, if you want to say, cheekily set up this core of people who are new if we got anywhere with our funding, hoping that they would get involved. It's always been me talking about it…Because people know me so well. And I know, they know my beliefs.*"

(CRG Interviewee, 4)

Another interviewee, when discussing the strong community-oriented nature of Heyfield, stated:

Fig. 7. Word Cloud for Microgrids Community Perception gathered from the Heyfield survey.

"*I think, I think it's Heyfield itself, which is a very community-oriented town. So it's quite unified with the idea of like, work from Heyfield would do stuff for Heyfield. So, you know, as a consequence, that makes it that's beneficial to starting any kind of project.*"

(CRG Interviewee, 6)

Similarly, a project team member also seconded that result, stating that:

"*Heyfield is a proud, close-knit community with deep roots as a timber town. Over the years, they've shown a remarkable ability to adapt and evolve, embracing sustainability as a shared vision for the future. The town takes real pride in its local initiatives—from community-led projects to environmental innovation—and that strong sense of identity and collaboration made it an ideal place to trial a microgrid feasibility study.*"

Project team interviewee 2

Another theme that emerged from the interviews was a strong community interest in the ownership of energy assets. The survey included a specific question on community ownership of energy infrastructure, asking participants whether they would be interested in owning energy assets. Results indicated that 63 % of respondents expressed interest in forms of ownership such as community-scale batteries, solar installations, and microgrids. This finding suggests that a substantial portion of the community recognises the potential benefits of local ownership, including greater energy autonomy, opportunities for revenue generation, and enhanced community participation in energy transition initiatives. However, participants also highlighted the need for greater support and clarity around potential business models and ownership structures to enable meaningful participation. For many, the concepts of joint ventures, cooperatives, or community trusts were unfamiliar or complex, raising concerns about financial risk, governance responsibilities, and legal requirements.

An analysis of the Heyfield community demographics, as outlined in Section 4.1, indicates a high proportion of retirees within the population. Our analysis has revealed that in such communities, traditional modes of engagement, particularly word-of-mouth communication and peer influence, are especially effective in shaping perceptions and fostering behavioural change. This observation is also consistent with findings in the wider literature, which highlight the importance of informal, trust-based communication networks in influencing attitudes and behaviours in similar community contexts [44,98,99].

While digital or technology-driven engagement strategies may prove effective in other contexts, in towns like Heyfield, securing the support of trusted local leaders is essential to ensure accurate information is disseminated throughout the community. In this context, trust emerges as a critical factor in community engagement.

Survey findings further reinforce the significance of community identity and values. When respondents were asked about their vision of an ideal power system, the majority described it as self-sufficient, community-owned, reliable, and beneficial for the local population. This strong sense of community cohesion was reflected throughout the survey responses.

Notably, 81 % of participants indicated awareness of the MyTown Microgrid Project. Of these, 75 % reported learning about it through the Heyfield Community Resource Centre, while 20 % cited word-of-mouth as their primary source. These findings highlight the importance of leveraging existing community networks and relationships in the design of engagement strategies. Future energy projects would benefit from tailoring community engagement processes to local contexts, with careful consideration of demographic characteristics and social dynamics.

5.3. Place

This dimension of the framework states that historical characteristics of a place where the population is situated significantly shape its community's perception of new technologies and initiatives [100]. In the case of Heyfield, the community has demonstrated a history of embracing sustainability initiatives, including those related to energy and water efficiency. This historical context suggests a potential receptiveness to innovative energy solutions, such as microgrids, which align with the community's established values and priorities.

Heyfield is an excellent example of how a community can transform its energy landscape, shifting from a primary industry-based, extractive past to one that seeks to embrace a more environmentally sustainable future. The town has a demonstrated high level of volunteerism and is familiar with the sustainability work being undertaken by the Heyfield Community Resource Centre, which is supported by the community. The Heyfield Community Resource Centre (HCRC) initiated and led the Sustainable Smart Town program in which almost half of Heyfield's households were engaged in a three-stage program. It involved a bulk purchase scheme for solar panels, flag installations for behaviour change, and posting coloured stickers on letterboxes to acknowledge participation in the program. The flag system was a crucial component to the program's adoption, demonstrating the locals' adoption of water, energy and waste efficiency measures: a white for taking the first steps in the program, a blue flag for making their home or business more sustainable, and a green flag recognises homes and businesses that have significantly reduced their carbon footprint. The great success of this initiative was recognised with the World Environment Day Award from the United Nations Association of Australia in 2011.

An interviewee who was actively involved in the project stated:

"*We worked with the community, you know, 13 years ago, on our flag programme with the locals that lived here through that. They were so supportive, because they knew what we achieved with our flag programme, you know, with the United Nations award. Yeah. We were finalists for the Premier's Award, and we won the Sustainability Award.*"

(CRG Interviewee, 7)

Heyfield has also won other accolades since embarking on the renewable energy journey, which are presented in Table 2.

Results from the survey indicated that 95 % of respondents expressed support for initiatives related to the energy transition. This included a general willingness to embrace new technologies and a positive attitude towards participating in community energy projects such as microgrids. This finding aligns with the project team's observation that the community exhibited a progressive stance towards adopting innovative energy solutions.

5.4. Process

This section of the framework investigates the role of project processes in shaping the perceptions of the local community. The community engagement process aimed to enhance collaboration and knowledge sharing between the project team and selected community members, facilitating a shared understanding of microgrid solutions and

Table 2
Awards and accolades won by Heyfield as a community for sustainable initiatives.

Award won	Year
Energy Globe Awards – National Winner (Australia)	2023
Climate Action Award Finalist –Neighbourhood Houses Victoria	2021
ACFE Learn Local Legend - Gippsland Region	2018
Australia's Strongest and Most Resilient Community	2017
Finalist Wellington Shire Council Community Group of the Year	2017
World Environment Day Awards	2011
Finalist State Premiers Award	2011
Prime Super winner	2011
Pam Keating Tidy Town winner	2011
Winners of United Nations of Australia Assoc "World Environment Day Awards" for the Heyfield Sustainable Smart Town Program	2011

incorporating regular feedback. This approach sought to enhance community capacity building, ensure knowledge transfer, and promote the acceptability of microgrids.

The project team implemented various engagement initiatives to broaden community involvement and raise awareness about microgrids. These initiatives aimed to inform residents about the project and encourage their active participation. Table 3 provides a comprehensive overview of the community engagement strategies employed during the project. The data presented in this table were derived from the interviews conducted with the project team ($n = 3$) and by analysing the project reports. The engagement activities were tailored to the local context, ranging from formal town hall meetings and CRG discussions to informal street-level interactions and educational outreach in schools. Collectively, these initiatives demonstrate the team's effort to build trust, enhance technical understanding, and ensure inclusive participation in the project.

Table 3
Overview of community engagement strategies employed in Heyfield.

Community engagement strategy	Elaboration	Rationale
Town hall events	Conducting town hall events to engage the community about the project, talking about the project scope and associated benefits	Creating awareness of the project and educating people about the potential benefits.
On-street engagement	Recruiting people to participate in the decision-making process and community reference groups.	Engaging more people to be a part of the project.
Weekly meetings	Fortnightly meetings with the CRG members to keep them updated about the project's progress, seeking their input on the matters	Capacity building and enhancing knowledge in the CRG members and community liaison officers.
Webinars and workshops	Conducting online or face-to-face webinars and workshops to enhance technical knowledge and create energy literacy in the community.	Capacity building and enhancing technical knowledge in the CRG members and community liaison officers
On School engagement	Engaging with school children to create energy literacy at the school level, targeting the future generation.	Intergenerational engagement
Poster presentation	Poster presentations in the HCRC highlighting the important information about the project	Creating awareness of project deliverables and outcomes to the local community members
Community Dashboard	Communicate information on the project to the wider Heyfield community at highly visible sites accessible to the public.	Demonstrating project outcomes, increasing awareness and energy literacy in the local community
Project video demonstration	A 10-minute video documentary was made to educate the community about the project's journey and outcomes.	Disseminating the research findings
Media reports and coverage (newsletter)	A monthly newsletter to keep the community aware of the project progress and outcomes	Creating awareness in the local community
Community fairs	Preparing a stall in a local community fair to engage with local installers and technicians for potential work	Engaging with local installers enhancing local workforce.

5.4.1. Community feedback on the processes

Analysis of the interviews and survey results indicated positive community perceptions of the engagement processes employed in the Heyfield microgrid project. Notably, 85 % of survey respondents reported an increased understanding of microgrids following the project's community engagement initiatives. Most respondents rated the community engagement processes favourably (8–10), suggesting a high level of satisfaction with the implemented strategies.

An interviewee in the CRG group stated, while talking about the positive community engagement strategies:

> "*I think, I think the team that we've got that are doing the feasibility study are fantastic. Yeah. And they've been so good at explaining everything to us and driving it along*".
>
> (CRG Interviewee 1)

While the community engagement process was generally well-received, some interviewees expressed concerns and challenges. Certain members of the CRG voiced dissatisfaction with the allocation of project funds towards community engagement activities during the feasibility study, indicating a potential area of tension and differing priorities between stakeholders.

An interviewee while criticising the project stated:

> "*I'd be interested to see where the money went, all those millions of dollars, or 1000s, or whatever, it was just some, you know, a spreadsheet of what was spent on each piece. Because really, it was obvious fairly early on, there wasn't going to be much of an outcome. On the ground, I mean, community education, I suppose. But only a few of us really stayed for the long haul. So it seems to be a lot of money spent. And, yeah, I just don't know, who's learning more, I guess the researchers are learning more than the community*."
>
> (CRG Interviewee, 9)

Throughout the project, the team employed various strategies to ensure effective communication and engagement. For example, when announcing techno-economic findings to the community, simple analogies were used to explain complex technical concepts in an accessible manner. The project team also conducted dedicated webinars to convey the findings in a clear and comprehensive way. Recognising that the outcomes of the feasibility study might not be welcomed, the team facilitated open discussions with the members of a community reference group, focusing on potential future steps and exploring alternative energy solutions. Overall, the feedback received at the end of the project was largely positive, with community members acknowledging that they were provided with clear and accurate information. However, some remained unconvinced and expressed dissatisfaction with the outcome of the feasibility study, highlighting the ongoing challenges associated with managing diverse perspectives and expectations in community-based energy projects. This commitment to transparent communication and prioritising community needs, even when it involves conveying potentially disappointing outcomes, is a crucial aspect of the project's process-oriented approach.

Table 4 summarises the results captured from the semi-structured interviews from the CRG members, project team and the survey under the lens of the Technology, People, Place and Process framework.

6. Discussion

This section provides a comprehensive discussion of the findings presented in the previous section, analysed through the lens of the Technology, People, Place, and Process framework. It offers an in-depth interpretation of the results, exploring their implications for community engagement in microgrid development and highlighting key insights relevant to policymakers, practitioners, and community stakeholders.

Table 4
Summary of the results under the lens of the technology, people, place and process framework.

Framework element	Community perceptions and responses towards microgrids
Technology	• Unfamiliar, complex technology • Lack of transparency of risks and benefits • Engagement strategies to increase understanding and awareness (Launch event, on-street engagement with local community, technical webinars and workshops, Business model workshops, Community fairs, Webinars and online reading material)
People	• Community Reference Groups for capacity building and inclusive decision-making. • Community Liaison Officers for capacity building and project facilitation. • Strategies for increasing community engagement (one on One engagement, school logo design competition, liaisons with schools with events, Posters and presentations, Meetings in the community centre, project video to be played at the key centers, community data dashboards installed in public places)
Place	• Historical context of engagement and leadership on sustainable initiatives • Strong support for clean energy initiatives • A community centre that's an active hub for community participation • Historical context of an area that's traditional local industries (timber, coal) are transitioning.
Process	• Stakeholder engagement (nominating community liaison officers, formulating community reference groups) • Community engagement strategies (webinars and workshops for creating awareness and understanding of microgrids, face-to-face interactions and meetings, Interaction with schools and local installers, project videos and community dashboard)

6.1. Engaging with people with different levels of energy literacy

A key challenge encountered by the project team was effectively engaging with community members who possessed varying levels of energy literacy. This challenge was compounded by the expectation that these individuals would actively participate in the decision-making process, shaping the project's trajectory and outcomes [101]. Communicating complex technical concepts, such as microgrid functionalities and techno-economic feasibility assessments, to individuals with diverse backgrounds and levels of understanding required careful consideration and innovative communication strategies.

The project team recognised the importance of investing time and resources in building community capacity and knowledge. This involved explaining fundamental concepts, the rationale behind the research, and the potential implications of microgrid implementation for the community. While allocating resources and effort to community education was crucial for informed decision-making, it also required significant dedication from both the project team and the community members involved.

Varying energy literacy levels within the CRG presented additional challenges as some technically proficient individuals perceived the simplification of concepts as a waste of time and resources, leading to tensions, consultation fatigue, and participant withdrawal. Furthermore, the extended duration of the feasibility study (three years) presented challenges for maintaining consistent community engagement. Participant attrition necessitated the ongoing integration of new members, requiring repeated explanations of fundamental concepts and project details. This continuous onboarding process proved resource-intensive for the project team and generated frustration among established members who possessed greater familiarity with the project's complexities.

This highlights critical challenges in community engagement for complex energy projects and reveals that community engagement is a resource-intensive process that requires dedicated time, funding, and expertise to ensure meaningful participation and informed decision-making. Moreover, effectively managing diverse energy literacy levels within the community is crucial for maintaining engagement, avoiding conflict, and ensuring that all participants feel valued and heard.

6.2. Navigating complexity and managing expectations

The research findings revealed a strong community interest in microgrids and a high level of motivation in the local community to participate in the energy transition initiatives, as indicated in Section 5.3. However, the complexities associated with microgrid technology and project implementation presented significant challenges for community members. Understanding the technical aspects, economic feasibility, and regulatory implications of microgrids was demanding, even for individuals with prior knowledge of energy systems [45]. This complexity led to frustration among some participants, with some even withdrawing from the engagement process due to feeling overwhelmed. Consequently, employing accessible language, providing ample opportunities for dialogue and feedback, and actively addressing community concerns and misconceptions are essential strategies for fostering a shared understanding and facilitating informed decision-making. While the final outcome was to recommend that a microgrid solution should not be pursued, the high level of community engagement in the project contributed to more informed decision-making, enhanced trust, and stronger collaboration between stakeholders. It demonstrated that despite the inherent complexity, meaningful engagement can enhance community engagement, regardless of the final technical deployment.

Furthermore, managing expectations from the outset is crucial [102]. Clearly articulating the project's scope, objectives, and potential outcomes, including the distinction between feasibility studies and implementation projects, can help avoid misunderstandings and frustration among community members. In the case of Heyfield, some participants expressed disappointment when the feasibility study concluded that a microgrid was not the most viable option at that time. This disappointment stemmed from a perceived mismatch between their initial expectations and the project's outcomes. These expectations, such as the assumption that the feasibility study would lead directly to microgrid implementation, may have been partly shaped by early project communications, which some interpreted as implying a more immediate pathway to deployment. As a result, some community members questioned the rationale for investing resources in a feasibility study that did not produce tangible infrastructure. This highlights the importance of clearly and transparently communicating the purpose, scope, and potential outcomes of each project phase, including the possibility that a microgrid may ultimately not be the most viable solution. By proactively managing expectations and addressing concerns as they arise, engagement practitioners can better navigate these challenges more effectively and maintain community support throughout the project feasibility process.

6.3. Balancing community empowerment and technical complexity in engagement

While there is a normative objective to increase community participation in decision-making to enhance project legitimacy and social acceptance, the increasing complexity of energy systems presents challenges in ensuring that all community members possess the necessary knowledge and capacity to engage meaningfully [102,103]. It is essential to avoid simply "spoon-feeding" information to the community and instead promote a sense of ownership and empowerment by providing opportunities for genuine participation and informed decision-making.

However, expecting all community members to have a deep understanding of complex technical issues is unrealistic and potentially counterproductive. This raises the question of how to balance the desire for increased participation with the recognition that lay people may not possess the professional knowledge required to fully grasp all aspects of the project. Addressing this challenge requires a flexible approach to community engagement that acknowledges the diverse knowledge levels and capacities within the community. One strategy is to provide differentiated engagement opportunities that cater to varying levels of interest and expertise. This could involve offering introductory workshops and information sessions for those seeking a general overview, while also providing more in-depth technical workshops and forums for those interested in delving deeper into specific aspects of the project. Additionally, creating opportunities for community members to share their knowledge and expertise, even if it is not directly related to energy systems, can promote a sense of ownership and value of their contributions.

Furthermore, it is essential to adopt a "small wins" approach, breaking down complex projects into smaller, more manageable phases with clear objectives and milestones. This allows community members to see tangible progress and feel a sense of accomplishment, even if the overall project is complex and long-term. Celebrating these small wins can help maintain momentum, build trust, and encourage continued participation. Ultimately, effective community engagement requires a flexible and adaptive approach that recognises the diverse needs and capacities of community members. By balancing the desire for increased participation with the need for clear and accessible communication, project developers can foster a sense of shared ownership and responsibility, leading to more successful and sustainable energy transitions.

6.4. Tailoring engagement to people, place, and process

This research highlights the critical importance of considering the specific "people, place, and process" context when designing and implementing community engagement strategies for microgrid projects. The engagement strategies employed in Heyfield proved effective due to their alignment with the community's characteristics and the project's context. The community's openness to new technologies and its positive reception of webinars and online engagement activities enabled the successful implementation of these strategies. However, this research also highlights that a "one-size-fits-all" approach to community engagement is unlikely to be effective [44]. This observation aligns with existing literature, which suggests that community engagement often extends beyond the boundaries of individual projects and varies significantly depending on the specific context and circumstances of each initiative [104]. In communities with limited experience with renewable energy projects, different strategies may be required to foster understanding and acceptance. For instance, in communities where digital literacy or internet access is limited, alternative engagement methods, such as face-to-face workshops, community meetings, or printed materials, may be more appropriate. Similarly, in communities with a history of opposition to energy projects, building trust and addressing concerns through direct communication and relationship-building will be paramount. This may involve establishing ongoing dialogue with community leaders, facilitating opportunities for open and transparent communication, and actively involving the community in decision-making processes [67]. By carefully considering the "people, place, and process" context and tailoring engagement strategies accordingly, project developers can enhance the effectiveness of their efforts and increase the likelihood of achieving positive project outcomes.

6.5. Situating Heyfield within the national microgrid context

While the Heyfield case study provides valuable insights into the interplay of people, place, and technology in shaping community engagement outcomes, it is important to situate these findings within the wider national landscape of microgrid development. Mathew et al. (2025) demonstrate that in remote Central Australia, solar microgrids remain uncommon, even where technical feasibility is established, due to excessive reliance on subsidised diesel generation, limited awareness of associated environmental costs, and socio-cultural resistance to change. These findings highlight the need to align community perceptions with institutional frameworks and norms in order to facilitate the broader adoption of microgrid technologies [105].

Tahir et al. (2024), and Simon et al. (2024) in their analysis of a national cohort of microgrid feasibility studies funded under the Regional and Remote Communities Reliability Fund (RRCRF), found that although social and cultural drivers frequently underpin community engagement, many projects are impeded by persistent challenges, including inadequate funding, limited energy literacy, consultation fatigue, and the complexity of participatory processes [35,39]. These barriers align with the Heyfield experience, where high levels of community engagement were evident, but implementation was ultimately constrained by techno-economic factors. Given that the outcomes of RRCRF-funded projects remain pending, a review of all completed feasibility studies would be valuable to examine how technological, demographic, and locational factors have influenced microgrid feasibility and the associated community engagement processes.

Collectively, the insights indicate that scaling microgrid adoption across Australia requires more than context-specific, place-based engagement strategies; it necessitates coordinated institutional frameworks, supportive policy environments, and targeted capacity-building initiatives. The Heyfield case study reinforces that while socially embedded engagement is essential, its effectiveness depends on complementary measures, including sustained funding, regulatory certainty, and robust knowledge-sharing mechanisms, to convert local commitment into long-term energy system transformation.

7. Conclusion

This study highlights the complexities of community engagement in a microgrid feasibility study conducted within a rural Australian community, examining how community engagement strategies influence community perceptions towards microgrids. By employing the "Technology, People, Place, and Process" framework, this research analysed the factors influencing community perceptions towards microgrid initiatives, revealing key challenges and opportunities in the community engagement process.

The findings highlight the significance of tailoring engagement strategies to the unique characteristics of each community, recognising that a "one-size-fits-all" approach is ineffective and can lead to negative outcomes. Designing effective community engagement requires an understanding of the local context, including social dynamics, energy literacy levels, and community expectations. Project stakeholders and community engagement practitioners should acknowledge the diverse range of knowledge within communities and avoid presupposing a uniform level of understanding regarding complex energy projects. Adopting inclusive engagement strategies that cater to varying backgrounds and literacy levels is crucial. Employing clear and accessible communication, devoid of technical jargon, ensures that all community members feel heard, understood, and empowered to participate meaningfully.

Community engagement strategies should be designed as a two-pronged approach: first, to educate and empower community members with the necessary knowledge and understanding of the project, and second, to facilitate their meaningful participation in the decision-making process. Despite the implementation of best practices in community engagement, challenges can arise due to the complex and dynamic nature of community interactions. Negative comments and opposition to projects can be mitigated through clear, transparent, and respectful engagement that acknowledges and addresses community concerns. The Heyfield case study exemplifies this, demonstrating that even when project outcomes diverge from initial community expectations, leading to frustration, proactive and resource-intensive engagement focused on the community's sustainable future helps maintain trust and support.

This research also reveals that community engagement is a long, complex, and resource-intensive process that demands consistent effort, transparency, and commitment from the project team as well as community groups. Furthermore, maintaining agility in community engagement activities is crucial to addressing emerging challenges and sustaining community interest in the project. While each community presents unique challenges, a deep understanding of the people and place factors highlighted in this study helps shape community perceptions of renewable energy technology.

Lastly, this research also reinforces that the social dimensions of microgrids are of immense importance, and addressing social acceptance is paramount to the project's progress. Community engagement, while challenging, is fundamental to ensuring community acceptance and long-term sustainability. As research on microgrids continues to grow in Australia and other regions around the world, these insights will be particularly beneficial for engaging rural and remote communities in meaningful ways.

CRediT authorship contribution statement

Farzan Tahir: Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Conceptualization. **Scott Dwyer:** Writing – review & editing, Supervision, Formal analysis. **Scott Kelly:** Supervision. **Franziska Mey:** Writing – review & editing, Supervision, Methodology.

Declaration of competing interest

The authors declare that they have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

A.1. Alternate initiatives explored in MyTown Microgrid Project

Initiatives explored	Energy bills	Reliability and resilience	Community involvement	Environmental benefit	Future proofing
Microgrid	×	✓	✓	✓	?
On site options	✓	✓	✓	✓	?
Load flexibility & control	✓	✓	✓	✓	✓
Community renewable generator	×	×	✓	✓	×
Community battery	?	✓	✓	✓	✓
Community retailers	?	×	?	?	×
Standalone power at critical sites	×	✓	?	×	×

A.2. Interviewee details and characteristics

Interviewee	Characteristics and interests
Interviewee 1	Ecologist with an interest in sustainability and a pioneer in the installation of solar panels in Heyfield
Interviewee 2	A teacher with a curiosity about renewable energy technologies and was interested in the community projects.
Interviewee 3	Member of the Heyfield Community Resource Centre and an active part of the initiatives in the region.
Interviewee 4	Interested in renewable energy innovative technologies, with concerns about the fragility of the grid
Interviewee 5	Government employee with an environmental background. Participated in finding solutions for the benefit of the community.
Interviewee 6	Electrician with strong technical knowledge of the energy market.
Interviewee 7	Anthropologist with a strong role in community engagement around the project
Interviewee 8	Customer interest in energy and interested in climate change initiatives
Interviewee 9	Member of Heyfield community Resource Center, with strong interest in renewable energy project.
Interviewee 10	Landowner, with a farming background, interested in community projects.

A.3. Interview script for CRG members

Please introduce yourself, and when did you get involved in the project and the major driver/what inspired you to be a part of CRG group?

CRG and microgrids:

- What is the concept of microgrid or microgrid according to you?
- What were your initial thoughts of the project and how the project turned out?

Community engagement and communication strategies:

- Can you comment on the role of community reference groups in these projects and how important was the community engagement?
- Was CRG effectively included in the decision-making process?
- Since you are interacting with the community members, what was the community sentiment of the project in the beginning and now? Is there any change in the local awareness of the community, and the perception of microgrids in the community since the project started?
- What were the major issues this project was aiming to resolve and up to what level this feasibility study was able to achieve the desired goals and objectives?
- What challenges did you encounter as a CRG member in the project? and how did you cope up with that?

Community batteries:

What are the community perceptions on community batteries or behind the meter batteries? (some people have reservations so just wondering the community perception on this).

Business model and the project ownership?

What are your views on the ownership of the project?

Conclusion:

- What is the best possible energy solution for Heyfield according to you?
- Out of all the options, and technologies, what do you think is the best energy solution for Heyfield and why? (Community battery, load flex, microgrid, standalone systems) etc.
- What are your future recommendations for the project and implementation studies?

How would you review the overall progress of the project?

- What went well in the project?
- What are the things that you wanted the team to improve?
- What's your perception of the project in the beginning as compared to that in the end?
- Looking back at the journey, what could've been done differently?
- What do you think could be done differently in terms of improving project management or communication?
- What advice do you give to someone who is starting the similar project in the future?
- Is there any change in your perception of the project from the start to finish)
- How does the ideal electricity system look like in Heyfield or what do you want to see?

A.4. Survey questionnaires for Heyfield community

Do you have a solar in your home?

☐ Yes
☐ No

Do you own a battery as well?

☐ Yes
☐ No

What kind of hot water system do you have?

☐ Electric hot water
☐ Gas hot water system
☐ Heat pump

Do you own or rent a house?

☐ Own
☐ Rent

Are there any energy monitoring devices installed in your premises?

☐ Yes
☐ No

Have you experienced the issues of power outage or voltage drop in the past years (before the beginning of the project)

☐ Yes
☐ No

If yes, what kinds of issues related to power supply (if any) have you experienced and how often?

Do you consider current electricity prices to be high or are you satisfied with the current electricity prices?

☐ Very expensive
☐ Somewhat expensive
☐ I am okay with this.
☐ Not expensive
☐ Not expensive at all.

Are you open to install new technologies to reduce the electricity cost in your house/business?

☐ Yes

☐ No

Are you interested in owning the energy assets?

☐ Yes
☐ No

If yes, what assets are you interested in?

☐ Community battery
☐ Owning a solar system or a battery
☐ Diesel generator
☐ Microgrid

How is your experience with your energy retailer?

☐ Satisfied
☐ Somewhat satisfied
☐ Neutral
☐ Not satisfied
☐ Dissatisfactory

How confident are you that your current energy set-up will be reliable and sustainable?

☐ Extremely confident
☐ Somewhat confident
☐ Neutral
☐ Less confident
☐ Not confident at all

What is your perception of renewable energy resources?
Which renewable energy technology interests you the most?
How does the ideal power system structure look like in Heyfield according to you?
Have you heard about the MyTown microgrid project?

☐ Yes
☐ No
☐ A little

Have you heard about the term “microgrid” before the MyTown Microgrid project?

☐ Yes
☐ No

What is the first word that comes to mind when you hear the term “microgrid”?
Should the microgrid be self-sustainable/island able?

☐ Strongly agree
☐ Somewhat agree
☐ Neutral
☐ Somewhat disagree
☐ Strongly disagree

Has the MyTown microgrid project increased your awareness on local energy solutions? (Energy literacy)

☐ Very much
☐ Somewhat
☐ Same as before
☐ Not much
☐ Not at all

What are your expected outcomes at the end of the MyTown microgrid project? (Rate from 1 to 5)

☐ Cost effective electricity
☐ Reliable supply of electricity
☐ Resilience at the time of natural disasters

☐ Community ownership of the project
☐ Awareness in the local community

Were the community decisions and outputs considered in the project?

☐ Highly considered
☐ Somewhat considered
☐ Not considered completely
☐ Not at all considered

How will you rate the community engagement strategies employed in the project (1 being the lowest and 10 being the highest)

☐ Yes
☐ No

How likely are you going to be involved in the future studies?

☐ Highly likely
☐ Somewhat likely
☐ Neutral
☐ Less likely
☐ Not at all

How will you rate the significance of the My Town microgrid project for your local community? (1 being the least significant and 10 being the highly significant).

How did you hear about the project?

☐ Google
☐ Facebook
☐ Instagram
☐ Heyfield Community Center
☐ Community member (word of mouth)
☐ Newspaper/media reports
☐ School
☐ Others

Are you willing to spend money on sustainable energy solutions for affordable electricity in the future or prefer the existing system?

Have you heard about the concept of load flexibility?

☐ Yes
☐ No

Have you heard of the energy efficiency and what comes in your mind with this word?

Are you willing to use hot water system from peak to off peak if it leads to savings on your electricity bills?

☐ Yes
☐ No
☐ Maybe (depends on the incentive)

When do you mostly run your hot water system?

Will you be willing to change the schedule of using hot water system for the possibility of cheaper electricity.

☐ Yes
☐ No
☐ Maybe (depending on the incentive)

What are your thoughts on changing your habits regarding the usage of hot water systems?

Will you trust the retailer or network provider to control your hot water systems or air conditioning for the cheaper electricity?

☐ Yes
☐ No
☐ Maybe (depends on the incentive)

Will you be willing to replace your current HVAC system with the more efficient one?

☐ Yes

☐ No
☐ Maybe (depends on the incentive)

Are you willing to install energy monitoring devices a☐nd control technologies?

☐ Yes
☐ No
☐ Maybe (depends on the incentive)

What are your thoughts on installing new technologies to increase electricity affordability and replacing the old ones?

Data availability

Data will be made available on request.

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