The Breaze Inc.

Regional Guide to Community Energy

A guide for community members across Central Victoria to learn more about community energy options.

BALLARAT RENEWABLE ENERGY AND ZERO EMISSIONS

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About the Guide

Ballarat Renewable Energy and Zero Emissions Incorporated (BREAZE Inc.) commissioned this guide, which is produced by Hepburn Energy, as part of its work for the Grampians Community Power Hub.

The Community Energy Guide stems from the State Government funded Community Power Hub Program. This initiative supported seven community groups around Victoria to help communities plan and assess the feasibility of various community energy projects. BREAZE Inc. led the Grampians Community Power Hub in which Hepburn Energy participated, as the Hepburn Branch.

Purpose of the Guide

The purpose of this guide is to inform local people and groups in the regions, about community energy, appropriate technologies, models, and processes for delivery.

The guide provides:
- context and background information on the energy system
- information on technology and models
- examples and case studies of community energy projects
- advice on how to deliver a project
- and links to other resources

How to use the Guide

The guide is structured to break down information so it's approachable to a wide range of readers.

If you're a novice in this area, with little exposure to community energy work, we recommend reading Energy Background (see Section 2) and skimming through the Appendix (see Section 7). These sections break down jargon and terminology to help you make the most of reading this guide.

If you're a community energy pro with a strong interest in this space, jump into whichever section interests you.

COMMUNITY POWER HUB GRAMPIANS

BALLARAT RENEWABLE ENERGY AND ZERO EMISSIONS

Hepburn Energy

Section: 02

Energy Background

Policy and political context

Climate change is one of the most pressing issues of our time, with the International Panel on Climate Change (IPCC) highlighting community action as essential to mitigation and adaptation efforts (IPCC, 2022). Globally the community energy movement has been growing to address these issues, but in Australia, this space is still emerging. Federal and State policies, like Renewable Energy Targets, have enabled large-scale renewable energy deployment but small and mid-scale community-led projects have had limited support to date. However, various programs and policies are now coming to life, presenting new opportunities for community energy initiatives.

Regional context

The Grampians Region has a population of roughly 220,000 people and covers 4,861,944 hectares, with the largest centre being Ballarat with 123,150 residents as at 2022. Across this region, various community energy and sustainability groups have been involved in renewable energy projects and climate strategies (Adapt Grampians, 2021).

The Traditional Owner Corporations of this area include: Dja Dja Wurrung, Eastern Maar, Gunditjmara, Wadawurrung, Wurundjeri and Wotjobaluk (Jaadwa, Jadawadjali, Jupagulk, Wergaia and Wotjobaluk) Peoples (Adapt Grampians, 2021).

Energy system basics

The energy system describes how energy services are provided, including energy production, transportation and use (Groscurth, Bruckner, & Kümmel, 1995). The electricity system is part of this, transmitting and distributing electricity through 'the grid' (AEMO, 2021).

The grid comprises:
- Generators: the energy stations that produce electricity
- Transmission and distribution lines: that carry electricity across states and regions
- Transformers: that change the electricity voltage for distribution or use.

The grid has different 'levels', with transmission and distribution lines able to carry different voltages of electricity. This means that different kinds of electricity generators are suited to different parts of the grid. Transmission networks have high voltage capacity (up to 220kV) and typically serve large-scale generators (10MW+) (Australian Energy Regulator, 2009). Distribution networks range in voltage (22kV - 66kV) and can serve mid-scale generators (100kW-10MW). Low voltage lines (240V) typically serve residential properties and small-scale generators such as household solar (0-100kW) (Orkestra, 2022).

Our energy system is co-ordinated with a combination of markets and regulation. In Victoria (and across the Eastern seaboard) the National Electricity Market (or the NEM) is the market that services electricity demand.

Electricity generation can come from various technologies and resources. In Victoria, the main sources are brown coal (60.1%), followed by wind (19.2%), rooftop solar (8%), hydro (6.3%), gas (3.1%), utility solar (3%) and battery (0.3%) (OpenNEM, 2023).

While fossil fuels (mostly coal) are the predominant energy source in Victoria, shifting to 100% renewables and eventually, net-zero emissions is essential in terms of climate action.

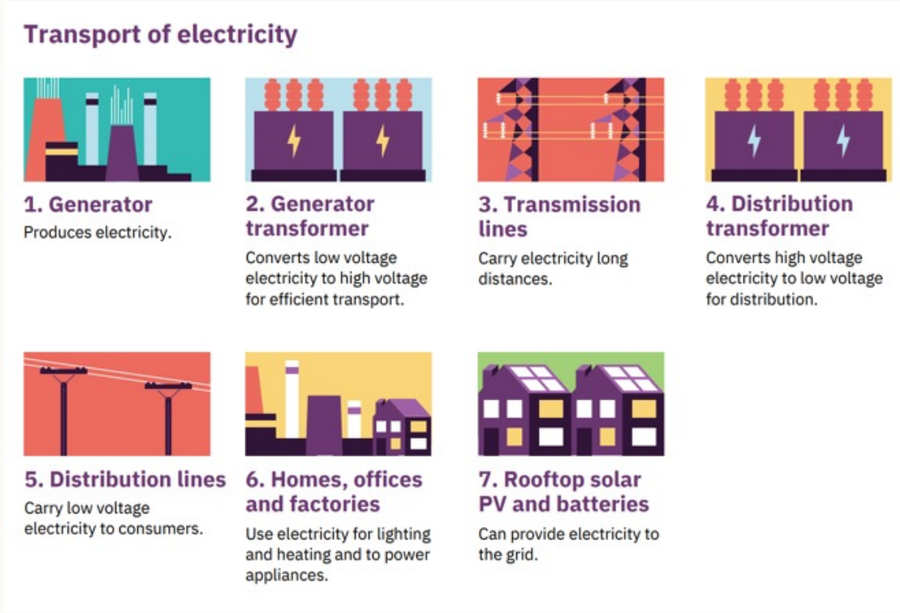

Figure 1.Transport of Electricity, Fact Sheet: The National Electricity Market, AEMO (2021)

Renewables and Distributed Energy Resources

Renewable energy uses abundant natural resources that never run out (ARENA, 2023). Popular renewables include solar, wind and hydropower, while others like geothermal, bioenergy and wave or tidal energy are less common in Australia (Clean Energy Council, Geothermal, 2018) (Clean Energy Council, Bioenergy, 2018). Storage technologies are also evolving, including residential, community and commercial batteries and a growing fleet of electric vehicles. Furthermore, energy efficiency retrofits and appliances can also intersect with these technologies, helping households and businesses make the most of renewable energy resources and reduce their energy costs. Some of these Distributed Energy Resources (DERs) can be connected or virtually synchronised to form systems like microgrids and Virtual Power Plants.

Community energy

Community energy refers to projects where a community group either initiates, develops or operates a renewable energy or energy efficiency initiative and is the primary beneficiary. Community groups often form these projects based on a common interest in growing and benefiting from renewables. Aims may vary from one community to the next, but an interest in climate action and energy savings often drives them.

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Technology Options

Community energy and climate projects can use many different energy technologies or DERs. The technologies used will depend on local issues, aims, interests and available resources (see Section 5). In the following section, we describe a few of these that may be more relevant in our region.

Solar power

Rooftop solar

Rooftop solar greatly contributes to Victorian electricity generation, accounting for roughly 9.7% of our total electricity supply (OpenNEM, 2023). Australian households have been early movers in this space, with roughly 30% of homes now having a rooftop solar system (DCCEEW, 2023). Rooftop systems are not limited to households but can also be installed on commercial rooftops. They vary in scale from roughly 3kW for residential properties and under 100kW for commercial properties.

Example: East Grampian Health Service
In 2021 the East Grampians Health Service installed rooftop solar across several facility carparks. With funding from a bequeathment, a State Government grant via the Grampians Renewable Energy Program, and support from BREAZE Inc. via the Ballarat Community Power Hub Pilot (2017-2020), the project installed roughly 491kWs of solar. In total these solar panels cost approximately $1.1million and are expected to save the facility close to $76,000 per annum (East Grampians Health Service, n.d.).

Utility-scale solar

Utility-scale solar comprises the same photovoltaic (PV) technology as rooftop solar but is deployed at a larger scale. These solar systems are usually installed on farms and range in size from 1MW to hundreds of megawatts. Typically mid to large-scale solar is installed above ground, across several acres. Over recent years we've seen new models of mid-scale solar, such as solar gardens or solar banks, which are designed to offer the benefits of renewable energy to households that cannot afford upfront costs or lack the space to install them.

Example: Natimuk Solar Farm
Natimuk Community Energy has been working towards a 1.6MW community solar farm, and in 2022 they submitted their planning permit application. This solar farm would be built over 2.2 hectares with 4,572 panels. The group received its planning permit in early 2023 and is now looking at governance models to deliver this project (Scalzo, 2022).

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Wind Power

Mid & Large Scale Wind

Wind power is one of Australia's most cost-effective and fast-growing renewable energy resources. Larger projects are complicated to connect to the grid and even smaller projects under 5MW, while easier, are still challenging. Large-scale wind (inland and offshore) needs to be located near transmission infrastructure to export energy back into the electricity grid. While large-scale wind projects are very viable, they require an excellent wind resource and a large amount of land. Offshore wind has been gaining interest in Australia but is unlikely to be delivered at the community scale.

Micro Wind

Many people have heard of micro or mini wind. This is where a household or business installs a small wind turbine at their property, with a capacity of 1-30kW (max 100kW). While this technology has been established for a long time, operating costs and lack of sufficient maintenance warranties may be a barrier. These wind installations are 3-5 times the cost of rooftop solar and there are no subsidies in Victoria to make them affordable.

Batteries

Residential & Community Scale Batteries

Batteries store electricity when it's abundant, so it can be used later, often when supply is limited. They can help smooth out variable renewable energy supply and back up households and facilities that have electricity reliability issues. This technology has been chiefly used 'off-grid', but as prices come down, more households and businesses are deploying them. We're also seeing growing interest at the community and distribution network level to install battery technology to address these grid issues.

While this technology has grown in popularity, research is uncovering some significant limitations in community-scale batteries. One of the common models advocated for is a front-of-meter system on distribution-level transformers (the poles and wires outside your home). Extensive modelling conducted by Orkestra found that across Central Victoria, not a single one of these batteries would stack up financially (Orkestra, 2022). In fact, they noted that these projects were incredibly risky, with ongoing operating costs and maintenance unable to be covered by the community-scale batteries' income. This means that these projects would all operate at a loss. Even with grant funding, they could become 'stranded assets' that can't be repaired or replaced when they age or break.

● **Case Study:**
Totally Renewable Yackandandah

Totally Renewable Yackandandah has worked with community energy retailer, Indigo Power to deliver a community battery, titled ‘Yack 01’. This battery is behind-the-meter (located at a property) at an old sawmill and complements a 65kW solar system.

Location: Yackandandah, Victoria
Community group: Totally Renewable Yackandandah
Website: https://totallyrenewableyack.org.au/
Partners: Mondo
Retailers: Indigo Power
Technology: SunGrow 274kWh battery system, coupled with 65kW rooftop solar
Governance: The battery is owned and operated by the community retailer Indigo Power. Data tracking and sharing is done by Mondo (a subsidiary of AusNet).
Funding: $104,000 community raised |$100,000 underwritten loan | $171,000 Victorian Government New Energy Jobs Fund
Reference: (Teron, 2021) (Totally Renewable Yackandandah, n.d.)

Summary of key benefits:
Environmental: the battery helps to reduce emissions through increased uptake of local solar and time-shifting locally produced renewable energy.
Knowledge: the project helped clarify the potential and challenges in deploying community-scale batteries.

Operating model: Indigo Power owns and operates the battery. They use demand management technology to charge and discharge at times that maximise value. The battery is expected to power 30-40 homes in the evening.

Key hurdles:
The Covid-19 pandemic created substantial delays for project delivery and installation due to supply chain issues.

Timeline:
2019: Started raising funds
2020: Received State Government New Energy Jobs Fund grant
2020-2021: Planning, designing, commissioning
2021: Installation and operation

Case Study:
Yarra Energy Foundation

Yarra Energy Foundation was one of the first community organisations to deploy a community-scale battery in Victoria. Their 110kW battery system is designed to cut emissions and was delivered in partnership with their local distributor CitiPower.

Location: Fitzroy North, Melbourne, Victoria (CitiPower-owned land)
Traditional Owners: Lands of the Wurundjeri Woi Wurrung
Community group: Yarra Energy Foundation
Website: https://www.yef.org.au
Partners: CitiPower, Australian National University, Mill Software, Yarra City Council
Retailer and aggregator: Acacia Energy
Installer: Ventia
Technology: 110kW/309kWh Pixii PowerShaper Battery Energy Storage System (BESS)
Governance: The battery is owned and governed by Yarra Energy Foundation
Funding: $800,000 State Government Neighbourhood Battery Initiative | $150,000 YEF & CitiPower | $550,000 in-kind work and contributions from project partners |$17,000 per annum in operating expenses.
Reference: (Wallin, Hensey, & Shue, 2022)

Summary of key benefits:
Environmental: the battery helps to reduce emissions through increased uptake of local solar and time-shifting locally produced renewable energy.
Knowledge: the project helped clarify the potential and challenges in deploying community-scale batteries.

Operating model:
Yarra Energy Foundation owns the battery and operates it with third parties. Third parties were needed to make the most out of the battery, with retailer and aggregator Acacia Energy unlocking market revenue and distributor CitiPower enabling grid access and providing technical support.

Other project elements:
A key element of the project was creating software systems that would be open source and could help other communities deploy batteries. Project partners at the Australian National University worked with open-source software to create an 'optimiser' that can be used to set the objectives of the battery.

Hurdle 1: Capital cost and operating costs
Yarra Energy Foundation found that the cost of the community battery meant that their project (and other urban community battery projects) could not offer financial benefits directly to households. The price of a battery system (installed) alone came to roughly $1,000/kWh, and maintenance and operation costs mean that profits are low to non-existent. However, depending on the year, revenues are expected to offset operational expenses on average. As a not-for-profit organisation, Yarra Energy Foundation is focused on environmental benefits, charging the battery during periods of solar generation and discharging during periods of peak demand.

Hurdle 2: Information
The Yarra Energy Foundation community battery project was a first-of-a-kind for Victoria and had limited information about such projects or examples to draw on. They found it challenging to get the data they needed to deliver. This included sourcing information about where the battery should be placed on the network. Most of these issues were managed by forming solid partnerships with their distributor CitiPower and experts from the ANU's Battery System Grid Integration Project.

History/timeline:
2021: Formed partnership with CitiPower, later joined by ANU
2021 Council showed support
2021: Developed a business and ownership model and conducted a feasibility study
2021: Awarded Neighbourhood Battery Initiative funding from the State Government
2021: Decided on tariff structure, council planning, community engagement & site selection
2021-2022: Retailer aggregator found, battery system developed, connection design developed, delivery and installation.
2022: Battery placement and artwork agreed with the local community (residents)
2022: Completed and operational

Image source: Simon Tucci ABC, https://www.abc.net.au/news/2022-06-05/community-battery-in-melbourne-unveiled/101127080

Minigrids / Microgrids

Microgrids help participants use Distributed Energy Resources (DERs) like solar and batteries more effectively. This ability to share resources improves the return on investment and enables penetration of renewables. Microgrids ultimately aim to be connected to the wider electricity network but can 'island off' in times of need. This technology is being deployed in various remote areas and islands which have faced energy supply and reliability issues and are increasingly common in Victoria being deployed on a street-by-street basis without islanding capability.

Example: Euroa Microgrid Demonstration Project

Euroa sits at the end of a transmission line and experiences unreliable power. They partnered with Mondo to deliver a microgrid demonstration project, funded partly by a State Government grant of $680,000. This project provided free infrastructure to six businesses and roughly 20 households to connect to the microgrid (EECA, 2023). Participating businesses have signed a solar Power Purchase Agreement (PPA), saving between 30-40% on electricity bills so far (Mondo, n.d.).

Virtual Power Plants

Virtual Power Plants (VPP) are a similar concept to microgrids, except less constrained by geography. VPPs use internet technologies to aggregate consumption and production from multiple households and businesses. This allows DERs like solar, batteries and 'flexible' loads to participate in markets for energy generation and grid support services.

Example: Solar Victoria VPP

In 2021 the State Government's Solar Victoria kicked off a VPP pilot designed to enable community members and businesses to connect their DERs and save on bills. As part of this pilot, households could apply for a battery rebate to install new batteries that would be VPP-capable and connectable. The VPP pilot closed to customer applications in December 2022 but will be operating until 31 December 2024. Solar Victoria is now in a research phase looking at the pilot's results and success (Solar Victoria, 2023).

Bioenergy

Energy generation from biomass uses the burning of organic matter (e.g. crop waste) to produce heat energy at various scales (e.g. firewood is a type of biomass). At large (commercial) scale, biomass is burnt to produce either heat to supply district heating or to produce steam for power generation.

The creation of biogas (from the breaking down of biomass) is undertaken either actively in a biodigester or passively by capturing 'waste' biogas from landfill sites or sewage treatment. Bioenergy is generally positively perceived but is not a well-established industry in Australia.

Example: Beaufort Hospital

In 2012 interest was growing in the potential of Bioenergy to offer alternative fuel and the Central Highlands Agribusiness Forum (CHAF) developed a strategy for deployment. Beaufort Hospital installed a wood chip-fired boiler system as a demonstration project. The boiler has a 110kW capacity and fits within a 12m shipping container that houses the fuel store. The system meets most of the heating needs that were previously met by an LPG gas system (which is still connected as a backup). The project was expected to pay back in 12 years, saving the facility $34,966 a year in heating costs and cutting roughly 140 tonnes of CO2e p.a (Pyrenees Shire Council, n.d.).

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Greenpower

Renewable electricity is usually accredited through the government's GreenPower Program. It can be purchased through a power purchase agreement (PPA) directly with a renewable energy supplier, choosing GreenPower from an energy retailer or using an offset product. GreenPower is the only voluntary, government-accredited program that enables consumers to match their electricity usage with certified renewable energy.

Energy Efficiency

Energy efficiency generally involves installing an appliance or measure that reduces input energy use. Typically, there are upfront (capital) costs associated with installing the measure, which are then offset through reduced energy usage.

Fuel switching / electrification
Fuel switching involves the replacement of an appliance with one that uses a different fuel input. The most common and preferred fuel-switching applications for households involve a switch from gas or wood-based (combustion) technologies to electrical technologies – that both have higher efficiencies and can be powered/ supplied from renewable energy (either on or off-site).

Example: Heat Pumps

Heat pumps make use of cool liquid refrigerants whose liquid-to-gas properties enable them to efficiently transition cold air to warm air and vice versa. These systems only require a tiny amount of electricity compared to conventional systems and can be powered by solar to make them even more sustainable (Renew, 2017).

Demand management
Demand management typically involves managing and ideally reducing maximum electrical demand. Measures are targeted at short-duration events – such as maximum demand levels on extreme heat days in summer. Demand management may be targeted at a site (e.g. household) level, or across a region or part of a network, and it can involve technological or behavioural approaches.

Example: Daylesford Dharma School

In 2022, Hepburn Energy supported Daylesford Dharma School in installing demand management software and devices from Solar Schools and WattWatchers. The school now has a detailed energy profile, showing what they're generating and consuming. The Solar Schools software also helps school staff and students decide how to reduce their emissions further and improve energy efficiency (The Local, 2022).

Community Energy Matters

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Funding models

Community energy proponents need to consider the best model to deliver their projects. These different models offer unique benefits and challenges, with different approaches having flow-on effects for project planning and delivery. The following section describes some common models for community energy and climate projects.

Donation / philanthropic projects

Donation and philanthropic projects are one of the more straightforward pathways to delivering community energy initiatives. In these projects, a community will fundraise through grants, donations, or crowdfunding platforms to support their efforts. Host sites are often community assets, such as local facilities, service providers and not-for-profits. These projects are typically small in scale, ranging between 5-50kW capacity. Funders range from residents to councils to governments and their contributions are usually a one-off payment (C4CE, 2017).

Example: CORENA Quick Win Climate Projects

CORENA's Quick Win climate projects support proponents with cost-effective climate proposals to access zero-interest loans. Loans support solar, energy efficiency, electric vehicles and gas-switching projects. These loans are then repaid through bill savings which go back into the revolving fund and can support more initiatives (CORENA, n.d.).

Example: BREAZE Inc. Revolving Fund

BREAZE Inc. invests public donations collected via its registered charity arm to the BREAZE Inc. Revolving Fund to offer not-for-profit community organisations no-interest loans to install solar, batteries and/or solar hot water systems. As an ACNC-registered charity, BREAZE Inc. has been assisting not-for-profits across the region to access renewables since 2016. Recipients are often social housing providers or disability service providers. Recent examples include rooftop solar for McCallum Disability Services, and 37 cottages in the Old Colonists' Association community retirement village, solar and batteries for Pinarc Disability Services, and rooftop solar for Woodbine Inc, a disability services provider in Warracknabeal (BREAZE, 2023).

Example: Hepburn Energy Impact Fund

The Hepburn Energy Impact Fund is a multifaceted program that benefits community groups, wind farm neighbours and local events. The Fund is comprised of a legacy impact stream, a neighbourhood benefit stream and an event sponsorship stream. The legacy impact fund seeks to enable collaboration with community groups to deliver targeted projects that support long-term climate and sustainability objectives. The Impact Fund has supported 114kW solar projects, 50kWh of battery projects and over 100 small community projects since 2011 (Hepburn Energy, 2022).

Example: Large-scale funds

Various large-scale wind farms operated by commercial developers have community funds available. These include:

Waurbra Wind Farm is 33km northwest of Ballarat and operated by Acciona. The fund has donated over $630,000 to community groups, sporting clubs, not-for-profits, and schools in Waubra and the local area. In 2021 they provided more than $20,000 to various community groups and organisations (Acciona, n.d.).

The Crowlands Wind Farm is roughly 25km northeast of Ararat and is operated by the commercial developer Pacific Hydro. This wind farm has provided $226,000 to 33 local projects since being commissioned (PacificBlue, n.d.).

The Bulgana Wind Farm is 11km southeast of Stawell and is operated by Bulgana Green Power Hub. This wind farm has provided $120,000 annually since its inception in 2018. The fund is administered by the Northern Areas Council (Bulgana Green Power Hub, n.d.).

The Lal Lal Wind Farm is near Ballarat and owned by Atmos Renewable and Northleaf Capital Partners. Since 2017 the wind farm has supported 36 community projects providing more than $410,000 in total (Lallal Wind Farm, 2023).

The Moorabool Wind Farm is a commercial wind farm owned by Goldwind. It offers a community Fund which has invested $450,000 through funding, sponsorship and community partnerships (Goldwind, 2021).

Community-based bulk buys

Bulk buys enable many households to access renewables or energy efficiency technology at affordable prices. Bulk buys seek to reduce common barriers to purchasing these technologies by creating a streamlined and trusted process. This makes it far easier for households to access good-quality technology and take action. Bulk buys can be delivered for a range of technologies, including solar, batteries, heat pump hot water systems, electric vehicles, heating and cooling systems and other energy efficient technologies (C4CE, 2017).

Example: More Australian Solar Homes (MASH)
More Australian Solar Homes is a solar and battery bulk-buy, first established in Castlemaine, that then expanded across Central Victoria. This bulk-buy sought to make the process of researching, purchasing and installing residential solar straightforward and affordable to residents and businesses.

Example: Geelong Community Solar Program
Geelong Sustainability group partnered with RACV Solar to deliver the region's solar and battery bulk-buy. Over 281 homeowners and businesses in the Greater Geelong, Surf Coast, Colac Otway, Queenscliffe and Golden Plains Shires participated. The bulk-buy installed 2.5MW of renewable energy, expected to cut 2103 tonnes of CO2 each year. Furthermore, the program supported free solar installations for six community facilities totalling 100kW (Geelong Sustainability Group)

Example: Hepburn Energy EV Bulk-Buy
Hepburn Energy partnered with the Good Car Company to deliver electric vehicle bulk-buys. This program makes affordable second-hand (and now new) electric vehicles available. Their pilot in 2020 sold 16 cars just in the Hepburn Shire and their 2023 program will be selling across a wider area (Hepburn Z-NET, 2023).

Community investment projects

Many communities are interested in owning and operating renewable energy facilities and hope to receive returns on these investments. These 'community investment' projects are often led by local sustainability or community energy groups. While community investment projects have the potential to generate significant local benefits, they're also challenging to deliver. These projects require strong community support to attract local investment, technical and financial expertise to develop projects, and competent staff to navigate regulatory requirements and ensure rigorous management. These projects may take on various governance structures, including co-operatives and companies (C4CE, 2017).

Case Study:
Haystacks Solar Garden

The Haystacks Solar Garden is a community investment project. This project seeks to help households locked out from solar because they rent, don't have a roof or can't pay the upfront costs. Participants essentially buy a small portion of the solar farm and then receive a credit on their energy bills for the solar they produce.

Location: Grong Grong, New South Wales
Community group: Pingala
Website link: https://haystacks.solargarden.org.au/
Partners: Community Power Agency, Komo Energy
Retailer: Energy Locals
Technology: 1.5MW solar array
Funding: $1.3 million from NSW Regional Mid-Scale Solar Program, the total value of the project is $2.6 million.
Governance: Distributing co-operative structure governed by a board of voluntary directors.
Reference: (Grong Grong Solar Farm, n.d.)

Summary of Benefits
Community: There are 333 solar plots available to people across VIC, NSW, ACT, SA and South East QLD, with locals in the area having first preference.
Social justice: The solar garden model enables renters or people unable to afford solar systems to benefit from renewables.
Financial: Members will receive $505 a year off their electricity bills for 10 years.
Environmental: The project will cut 3,100 tonnes of CO2 per annum.

Operating model: People join the co-operative for roughly $50 and then purchase at least one solar plot, via a Co-operative Capital Unit (CCUs). Members must then switch to the retailer Energy Locals (since Covid), which discounts their bills.

Hurdle 1: Retailer went into administration
The Covid-19 economic downtown and Ukraine conflict created widespread instability in global energy markets. This knocked out several smaller community retailers, including a key project partner, Enova Energy. The Haystacks team navigated this issue by switching to Energy Locals, another energy retailer interested in sustainable energy and community benefits.

Hurdle 2: Unable to deliver subscription model
Solar gardens in the US use a subscription model where participants sign up to a solar garden. But due to the initial capital cost, Haystacks could not make this model work. Instead, they opted for an upfront solar purchase lower than typical household systems ($4,200 for 3kW compared to $5,500 for 6kW) facilitated by Co-operative Capital Units (CCUs) (Bloch, 2022).

History/timeline:
2016: Local farmer, solar project manager and community energy expert start collaborating towards an accessible solar model
2020: NSW Regional Community Energy Funding Received
2020: Land secured
2020: Incorporated as a distributing co-operative
2020: Planning approval in November
2022: Retailer change in 2022
2022: Offer date to Riverina members 30 August 2022
2022: Offer date to wider area members in October 2022
2023: To be constructed mid-year

Case Study:
Hepburn Energy

Hepburn Energy is Australia's first community-owned wind farm, now working towards battery storage and solar. Community members invested close to $10 million to establish this 4.1MW wind farm, which provides dividends back to members and a wide range of other community benefits.

Location: Leonards Hill, Hepburn Shire, VIC
Community group: Hepburn Energy
Website: https://www.hepburnenergy.coop/
Retailer: Flow Power
Technology: The wind farm is composed of two Senvion turbines with 4.1MW capacity. And the co-operative is looking to add a 5MW (AC) solar farm and up to 10MWh battery storage.
Governance: Distributing Co-operative, board of Voluntary Directors
Funding: $9.8 million community investment |$975,000 Sustainability Victoria's Renewable Energy Support Fund |$750,000 Regional Development Victoria's Regional Infrastructure Development Program | $3.1million Bendigo Bank loan
Reference: (Hepburn Energy 2022)

Summary of benefits
Community: Hepburn Energy has an Impact Fund, which supports local community projects that tackle climate and environmental challenges.
Environmental: The wind farm has offset 116,216 tonnes of CO2 since it first began generating in 2011. The Impact Fund has supported 114kW of community solar and 50kWh of battery.
Financial: Hepburn Energy provides dividends to members and significant contributions to local events, community projects and neighbourhood facilities.

Operating model: Hepburn Energy is a community investment project with over 2000 members, 50% of whom are local to the region. The wind farm is managed in-house by a small team with operations and maintenance delivered by wind developer Vestas.

Hurdle 1. The removal of the carbon price and reduction of the RET
The wind farm was established when there was bi-partisan political support for a carbon price and the Renewable Energy Target. Climate policy instability caused a massive drop in the value of one of the wind farms' main income sources - Large Scale Generation Certificates (LGC's). This loss of income reduced profits and meant that dividends could not be delivered until 2019. Hepburn Energy seeks to future-proof its project by boosting economies of scale, delivering solar and battery storage.

History / timeline:
2007: Co-operative formation
2010: Construction
2011: Over 2000 members and starts generating power
2018: Community commits to zero-net emissions target
2019: Hepburn Z-NET Community Transition Plan identifies need for more solar and battery to reach zero-net emissions target for 2030
2022: Receive planning permit for solar and battery

Community-developer partnerships

As community investment projects can be challenging to deliver, many local groups have moved towards community-developer partnerships. These partnerships are less risky and onerous for community groups as they involve working with a renewable energy developer to deliver the project. These initiatives can be instigated by a community or a developer and can be adapted to suit that particular community's interests and needs. Some community-developer partnerships also involve dual ownership, where community members invest in a smaller portion of the project, reducing risk (C4CE, 2017).

Case Study:
Newstead Solar Farm

The Newstead Solar Farm seeks to support the community's ambitions to reach 100% renewable energy. This community-developer partnership is delivering a 3MW solar system with a 5MWh battery that will be owned and operated by Flow Power with the community participating via a local electricity offer.

Location: Newstead, Victoria
Community group: Renewable Newstead
Website: https://renewablenewstead.com.au/
Retailer: Flow Power
Technology: 3MW solar farm with 5MWh battery system. The project site covers 6.2Ha and consists of 4,320 PV panels on tracking frames that follow the sun. Together with a unique and Victorian-first Direct Current (DC) coupled system, the Newstead Energy Project is a technically innovative build.
Governance: Flow Power, with local community engagement
Funding: $1.1 million from the Victorian Government
Reference: (Flow Power, n.d.)
Operating model: Community Developer partnership where Flow Power will build, operate and own solar and battery farm.

Summary of benefits:
Community: Helping community reach 100% renewable goals
Environmental: Reducing emissions through renewables
Financial: Offering local community competitive Greenpower

Key hurdles: Unlocking a viable model
Renewable Newstead was initially interested in community ownership and investment models. Through detailed financial analysis and modelling, they believed that this investment presented too great a risk to community investors. Instead of going with a community investment model, they went for a community-developer partnership – where the developer owns the asset but also the risk of the project.

History/timeline:
2011: Concept of Renewable Newstead established
2018: Business case for solar developed
2018: Funded by the Victorian Government with 1.1 million to look into project
2021/2022: Finalise partnership with retailer and developer, Flow Power
2023: Project construction commenced

Community-council partnership

Community-council partnerships are a tried and tested model for delivering local renewable or efficiency projects. These partnerships benefit from access to council resources, including physical assets like buildings and land for renewable energy systems and administrative support. These partnerships are often initiated by community groups who seek council involvement (C4CE, 2017).

Example: Bendigo Regional Archive Centre
In 2017 Bendigo Sustainability Group partnered with the City of Greater Bendigo to install solar on a community facility, the Bendigo Regional Archive Centre. This collaborative project installed 30kW of solar which supplies over 25% of the facility's needs. Funding was sourced from a grant from Bank Australia, a loan and funds from Bendigo Sustainability Group. The electricity generated by the system is then sold to council at a commercial rate (Community Solar Portal, 2018).

Community electricity retailing models

Community electricity retailers either support community energy by purchasing power from them or support community participation in the electricity system. Examples of electricity offers that support community energy initiatives include Indigo Power and Hepburn Energy. Both products are available to community customers and provide income towards local energy initiatives. Some community electricity retailers do not have a direct relationship with a community generator but instead use co-operative governance structures to vote on important decisions, such as where profits should go.

Indigo Power
Indigo Power is a community-owned energy company and social enterprise committed to return 50% of its profits to clean energy and community projects. Indigo Power takes advantage of a mini-grid (delivered by Mondo) using local battery and solar power to trade energy between residents and Indigo Power customers. This Indigo Power retail offer is a white-label product, where Energy Locals delivers back-end retailing services and functions (Indigo Power, 2023).

Cooperative Power
Cooperative Power is a not-for-profit energy co-operative aiming to redistribute its profits towards renewable and community projects. This co-operative came from the union movement and seeks to ensure that everyone can access fair and stable pricing. They practice democratic decision-making around profit margins through participatory budgeting, distributing much of their profits back to community projects. Organisations can become members of Cooperative Power, allowing them to decide where profits go. This is also a white-label product of Energy Locals (Cooperative Power, 2020).

Hepburn Energy
Hepburn Energy is offering a community retail offer backed by their retailer, Flow Power. This offer seeks to support community efforts to reach zero-net emissions by 2030 while providing customers with an affordable 100% GreenPower product. The offer was established to reward locals for the large amount of renewable energy they produce (Hepburn Energy, 2022).

100% renewable energy towns

Several towns in the region have 100% renewable energy goals. To date, only Daylesford in the Hepburn Shire has achieved this with their local wind farm, Hepburn Energy. Becoming a 100% renewable energy town involves mapping out various routes to achieve this, bringing together feasibility studies and community engagement. Various arrangements can be used to work towards 100% renewable energy towns, including incorporated associations and collaborative partnerships (Lane, Hicks, Memery, & Thompson, 2015).

Case Study: St Arnaud 100% Renewable Energy Town

The community of St Arnaud has a strong track record on climate action with several local groups working in this space. This has led them to look at renewable energy projects and most recently, with assistance from the Grampians Community Power Hub, a full analysis of reaching 100% renewable energy for the town. This project is in its early stages and has involved a comprehensive study looking at potential pathways to reach this target (Middleton Group, 2023).

Location: St Arnaud, Northern Grampians Shire, Victoria
Community group: St Arnaud Community Renewable Energy Association
Website: Unavailable
Partners: BREAZE Inc., Middleton Group
Governance: Yet to be determined

Summary of potential benefits:
Community: The project would seek to make renewable energy more accessible and give community members opportunities to be involved
Environmental: Cutting emissions through reaching net-100% renewables
Financial: Enable household energy savings through a wide range of strategies

Operating model: This project is investigating potential pathways to 100% renewables through the township of St Arnaud. This could be achieved through a combination of mid-scale solar (between 1-5MW), residential solar and battery storage, and potential microgrid deployment.

Case Study: Trentham 100% Renewables and Microgrid

The Hepburn Shire town of Trentham faced significant storms that isolated the community and kept power out for days in 2021. This town has been active on climate issues and these events highlighted the need for more energy independence. These shared factors inspired community members to work towards a renewable-powered community battery or micro-grid. In 2022 Hepburn Shire Council funded Middleton Group to provide modelling to help them plan future pathways (Middleton Group, 2022).

Location: Trentham, Hepburn Shire, Victoria
Community group: Trentham Sustainability Group
Website: https://trenthamsustainabilitygroup.com/
Partners: Middleton Group
Governance: Yet to be determined
Funders: Hepburn Shire Council

Summary of potential benefits:
Community: The project would seek to make renewable energy more accessible and give community members opportunities to be involved
Environmental: Cutting emissions through reaching zero-net energy
Financial: Enable household energy savings through a wide range of strategies

Operating model: Yet to be determined.

Zero net emissions communities

Various villages, towns and Local Government Areas are committing to reach zero-net emissions before state and national targets. Like 100% renewable energy towns, these communities work together to map out pathways to tackle emissions across all major sectors. These efforts are often grounded in baseline studies, which assess local emissions across an LGA, providing a foundation for emission reduction efforts. The LGA efforts are highly collaborative, bringing together councils, community groups, local residents, services and businesses to map out the tools and technologies needed to achieve zero-net emissions.

Ballarat

The City of Ballarat has a plan to achieve zero-net emissions by 2030 that was developed by Ironbark Sustainability in consultation with the community. This plan offers detailed actions required to achieve its target. The plan looks at five key outcome areas, zero net homes, zero net businesses, zero net new developments, zero net transport and zero net waste and builds on their work in the renewable energy space (City of Ballarat, 2022).

Hepburn Z-NET

Hepburn Z-NET is a collaborative partnership across the Hepburn Shire bringing together community groups, experts, businesses and council to work towards zero-net emissions by 2030. Hepburn Z-NET is guided by a Community Transition Plan (CTP) which was first released in 2019 and endorsed by the Council as the community-wide plan, offering a comprehensive assessment of the shire's emission profile and community-backed strategies to cut them. These strategies span stationary energy, waste and wastewater, land use, land clearing and forestry (LULCF), agriculture and transportation. Within the CTP is an implementation plan which is reviewed and carried out by a Community Roundtable. This Roundtable is comprised of community groups, council and business representatives. Since kicking off the project in 2019, the shire has seen dramatic improvements, particularly in electrification.

Section: 05

Delivering a project

If you're interested in delivering a community energy project, you'll need to consider the best process for your specific initiative. While many factors will influence what makes sense for your community, we've offered some steps to help you start.

Project planning and delivery

Depending on the scale and scope of the community energy project, planning and delivery can range from very simple to a more complex and cyclical process.

Broadly speaking, all community energy projects involve the following steps (Lane et al. 2015):

Initiation: where a group (sometimes a developer) identifies an idea
Social feasibility: assessing community support and interest
Technical feasibility: looking for a site, undertaking technical studies, assessing the operating structure (if needed), investigating required approvals
Business case: project costs, income and funding pathways
Planning: consider planning zones and regulations, grid connection
Capital raising: raising funds needed to deliver the project
Construction: order equipment, technology, contractors, and civil works undertaken if needed
Operation: energy infrastructure installed, managing the project and undertaking evaluations
Decommissioning: End-of-life considerations, replace/ refurbish technology to continue into the future

Establishing a project idea

Successful community energy projects seek widespread support across the area/region where they're delivered. These projects often require community champions who volunteer their time to develop a vision and communicate its value. Many community energy groups take on this role, establishing these projects and driving community engagement.

Clarifying the aim and scope

Critical to any community energy project is establishing clear aims. Proponents should understand the problem they're trying to solve and their rationale for this solution. Some questions to ask before starting a project include:

- What is the problem we're trying to solve? How significant is this problem?
- Who is affected by this problem? Are they interested in this solution?
- Do we have the capability and resources to work towards this?
- Could a different solution address this problem more effectively?

It's important to answer these questions because it's not always the case that renewables and/or storage are the right solution for community concerns. This could be due to the costs involved or because alternative solutions exist.

For example, while community-scale batteries are exciting, they're often prohibitively expensive and may never recoup the investment made by community members or government funders. And for those communities concerned about reliability of electricity supply, sometimes a better solution is to upgrade grid transformers at a fraction of the cost.

Answering these questions helps to refine the project's aims and scope by considering what's involved, who needs to be at the table and the resources needed to deliver.

Community engagement & context

Central to any community project is tailored and appropriate community engagement. Good community engagement goes beyond seeking compliance with local and state requirements but helps to build trust, local ownership and forge relationships critical to delivering solid projects.

Area	Motivator	Benefit
Environment	Mitigating emissions	Carbon emission reductions
	Reducing fossil fuels	Avoiding fossil fuel pollution
Social	Social capital and local benefits	Community empowerment
	Having land suitable for projects	Greater decision making
		Improved social license
Technological	Curiosity and enthusiasm around renewables	Renewable Energy Industry development
		Greater energy self-sufficiency
		Renewable energy education
Economic	Local jobs	Potential income streams for those delivering projects, working on them, participating in them, or targeted groups or assets
	Local investment opportunities	Regional development
	Community funding	Income diversification
	Efficiency programs	Building community assets
Political	To build political power	More awareness and capability in political processes
	Support engagement in climate activism	Creating community actors able to support renewable energy future

Table 1. Adapted from Lane, Hicks, Memery & Thompson's Guide to Community-owned Renewable Energy for Victorians (2015) Figure. Motivators and benefits of community energy.

Before commencing a project, it's important to understand the context. This involves considering the location, its physical characteristics, existing energy infrastructure, social and economic conditions of the area, the regulatory environment, the physical environment and the political landscape. This information can then inform technical, financial, and social feasibility studies required for mid-scale projects.

Technical, financial & social analysis

Another critical step in delivering a community energy project is to assess its technical, financial and social feasibility. The scale of these analyses will depend on the scale of the project. For more significant projects, proponents should form pre-established criteria to use as a benchmark for decision-making. (Lane, Hicks, Memery, & Thompson, 2015).

These analyses then help guide project implementation decisions such as technology decisions, financial models and any other key considerations.

The table below indicates some of these core analyses needed to develop a project.

Overarching	Area	Questions to answer
Desirability: Do people want it?	Context	What are community members interested in?
		What are the strengths and assets of the community and partners we're working with?
Feasibility: What is technically and physically possible?	Context	What policies, energy markets, legal structures and fundraising rules will we need to address?
	Technical	What are the technical inputs we need
		What are the technical implications of this project
Viability: What is going to work financially?	Business case	What is the financial business case for this option?
		What business model will we deploy?
		Who is our business model designed to benefit?
	Risks	What are the possible negative consequences of this project?
		Are there any social, environmental, political, financial or technical risks?
		How can risks be managed?

Table 2. Key questions to ask in determining if a project is feasible, viable and desirable, Adapted from Lane, Hicks, Memery, & Thompson, Guide to Community-owned Renewable Energy for Victorians (2015).

Governance and financial models

Good governance is crucial to running an effective community energy project. Different organisational structures may be needed depending on the community energy model being deployed. For instance, community investment models will require a legal entity like a cooperative, an incorporated association, public company, trust or other corporate structure. These structures have a range of legal and financial responsibilities and require regular reporting and auditing in some form. These structures also affect the entity's tax, insurance, employment law, and banking considerations (Hicks, Ison, Gilding, & Mey, 2014).

Another approach is for established organisations to lead these projects, as they will have existing financial processes, insurance cover and other potential resources. Where these organisations are not-for-profits, they may also have additional perks, like deductible gift recipient status, which can make fundraising more appealing.

Community projects can also be delivered through collaborative partnerships, which bring together various organisations and entities. Members of a collaborative partnership are usually enabled with Memorandums of Understanding.

Governance structures may also need to change over time. We recommend reading the Community-owned renewable energy: a how to guide for more information (see Hicks et al. 2014).

Operation and maintenance

Operation and maintenance depends on the project model and technology delivered. For instance, mid-scale projects will require a complex team of operations and maintenance professionals. In contrast, a simple rooftop solar project requires only basic care and no ongoing contracts beyond standard warranties. We recommend reading the Community-owned renewable energy: How to Guide for more information on operation and maintenance (Hicks, Ison, Gilding, & Mey, 2014).

Evaluation

It's helpful for projects to have some form of evaluation to assess strengths and weaknesses and/or what could be improved. The scale and scope of evaluation is tied to the nature of the project. Larger projects may require something more substantial while smaller projects could be evaluated with a series of simple questions. Learnings from these evaluations can then be provided to stakeholders and the community energy space.

Section: 06

Free resources and funding opportunities

A wealth of resources are available that tackle community energy and how to deliver renewable projects. The first port of call should be the Community Power Hub website.

We recommend reviewing these additional resources should you wish to deliver a community energy project.

1. Community-owned renewable energy: a how to guide
2. Guide to Community-Owned Renewable Energy for Victorians
3. Community Engagement and Benefit Sharing in Renewable Energy Development in Victoria (2021) guide for Victoria
4. Community-scale Battery Booklet
5. Small-scale Community Solar Guide
6. The C4CE Knowledge Hub

Funding resources

Various government bodies and community groups provide funding for energy and climate projects. As these programs change frequently, we've listed some of the key Federal and State agencies and local councils and groups that may fund opportunities.

Federal Government

Department of Climate Change, Energy and the Environment and Water (DCCEEW)
DCCEEW is the primary federal department for climate and energy projects. They deliver various programs seeking to help communities and businesses reduce emissions.
Link: https://www.dcceew.gov.au/

Local Government

Various local governments have programs providing funding for community projects and sustainability. These vary greatly in their scope, eligibility and funding availability, so make sure to go to your local council's website to find out what programs exist.

- Ararat: http://ararat.vic.gov.au/community/grants-and-funding
- Ballarat: https://www.ballarat.vic.gov.au/grants
- Moorabool: https://www.moorabool.vic.gov.au/Services-and-support/Community/Grants/Community-Grants
- Macedon Ranges: https://www.mrsc.vic.gov.au/About-Council/Find-A-Grant
- Golden Plains: https://www.goldenplains.vic.gov.au/community/grants
- Pyrenees: https://www.pyrenees.vic.gov.au/Community/Community-Funding-Program
- Central Goldfields: https://www.centralgoldfields.vic.gov.au/Council/Community-grants
- Hepburn: https://www.hepburn.vic.gov.au/Residents/Support/Grants
- Mount Alexander: https://www.mountalexander.vic.gov.au/Grants
- Greater Bendigo: https://www.bendigo.vic.gov.au/Services/Community-and-Care/Community-grants
- Loddon Shire: https://www.loddon.vic.gov.au/For-residents/Community-support/Council-grants
- Northern Grampians: https://www.ngshire.vic.gov.au/Residents/Grants

Community programs

Community organisations also make funding available for energy and climate projects.

CORENA
CORENA is a non-profit volunteer-run organisation. They developed a revolving fund to support proponents with cost-effective climate proposals to access zero-interest loans. These loans are repaid through savings on power bills over time. These repayments go back into CORENA's revolving fund to support more projects.
Link: https://corenafund.org.au/

Community groups and contacts

If you would like to get more involved in community energy, the best place to start is with your local group. Some regions and towns only have informal networks, so It's worth reaching out to your local sustainability group to see if anyone is working in this space. See our list below and check if there's a community energy group in your area.

Ballarat Renewable Energy and Zero Emissions Incorporated
Leading climate, sustainability and energy projects in Ballarat and surrounding areas working with various partners and stakeholders to deliver action.
https://breaze.org.au/

Hepburn Energy
Operating a wind and soon-to-be hybrid solar and battery farm in the Hepburn Shire and delivering energy and climate programs in nearby parts of Moorabool Shire.
https://www.hepburnenergy.coop/

Moorabool Environment Group
Work on a range of environmental, energy and broader issues.
https://mooraboolenvironmentgroup.org.au/

Renewable Newstead
Driving energy and climate projects in the township of Newstead in the Mount Alexander Shire.
https://renewablenewstead.com.au/

Macedon Ranges Sustainability Group
Working on a range of environmental, energy and climate initiatives across the Macedon Ranges Shire.
https://mrsg.org.au/

Mount Alexander Sustainability Group
Working on sustainability programs and projects, including energy and climate change initiatives across the Mount Alexander Shire.
http://masg.org.au/

Natimuk Community Energy
Is an initiative seeking to establish community energy projects in Natimuk, working towards solar and other initiatives.
https://www.facebook.com/NatimukCommunityEnergy/

Pomonal Power
An initiative of the Pomonal Progress Association, currently working on the Pomonal Power Supergrid project.
https://www.pomonalpowersupergrid.com/

St. Arnaud Community Renewable Energy Association
Is a community group currently working on a business case for a local project or series of projects.

Transition Creswick
Transition Creswick works to build a more resilient and connected local community.
https://www.facebook.com/TransitionTownCreswick/

Trentham Sustainability Group
Drive projects on energy, conservation, local food and waste in the Trentham area. Within this group is the Trentham Renewable Energy group.
https://trenthamsustainabilitygroup.com/

Community Power Hubs
The Community Power Hubs were funded in 2021 to support community members in delivering community energy projects across the state. This initiative has been discontinued. You can find information and resources about the program on the Community Power Hub website. This website also offers links to the many community organisations across the state that participated in this program. https://www.communitypowerhub.net.au/

Section: 07

Appendix

Behind-the-meter
A project which is 'behind-the-meter' sits at a customer's property and may or may not be integrated into the electricity network itself. The focus here is on self-consumption and is managed within the property. This could be a residential or commercial property.

Community energy
Community energy is where communities are involved in developing, producing, distributing, selling and buying energy assets and their output. Community battery A community battery is any kind of battery storage technology deployed by or for direct community benefit, such as community ownership.

Community-scale battery
A community-scale battery is the umbrella term for a battery located in a regional area on the low voltage or distribution network. For urban environments the term neighbourhood battery is more commonly used.

Distributed Energy Resources
Distributed Energy Resources (DER) are energy resources on the distribution network which produce electricity and/or help to manage consumer demand. This could include solar PV, batteries, demand management at other technologies.

Distribution lines
Distributions lines are part of the electricity network, taking power from large scale transmission lines to lower voltage lines.

Distributor
A distributor owns the power lines poles and infrastructure involved in the transportation of electricity from the distribution network to homes.

Electricity
Refers to energy which can be distributed through electricity networks and used by homes, businesses, and industry. This does not include heat or gas energy which are also important energy sources. Energy Is a broad term referring to the capacity for power from many sources, including mechanical, light, chemical and electrical. This includes electricity, gas and heat sources.

Energy independence
Energy independence means enabling households and businesses to make the most of their own local renewable capacity.

Energy system
The energy system is a broad term describing how energy services are provided.

Front-of-meter
Front-of-meter energy systems are connected to the grid, and therefore not metered at a private property (see behind-the-meter).

Generator
An asset that produces electricity or gas. This can be produced through renewable sources such as wind or solar, or through fossil fuels such as coal or gas.

Low voltage lines
Are part of the distribution network but at a lower voltage than distribution lines. These low voltage lines transport energy to residential properties.

Metrics
– Kilojoule (KJ): a measure of energy equal to 1000 joules
– Kilowatt (kW) a measure of electricity equal to 1,000 watts
– Kilowatt hour (kWh): electricity equal to 1,000 watt hours
– Megawatt (MW): a measure of electricity equal to 1,000 kilojoules
– Megawatt hour (MWh): a measure of electricity equal to 1,000kilojoule hours

National Electricity Market
The National Electricity Market is a wholesale market through which generators and retailers trade electricity in Australia. It interconnects the six eastern and southern states and territories and delivers around 80% of all electricity consumption in Australia.

Renewable energy
Includes energy from the sun, water, wind and heat. Renewable energy technologies include wind turbines, solar photovoltaic cells, hydropower, wave power and geothermal.

Retailer
Retailers purchase electricity and gas from generators through the wholesale market, which they then sell to their own customers. Retailers also require authorisations through the Australian Energy Regulator.

Transformers
Transformers convert the voltage of electricity higher or lower to enable distribution to and from households or commercial properties.

Transmission lines
These are large scale networks that transport high voltage electricity across large areas of land. These typically service distribution lines but occasionally connect to large scale generators.

Voltage
Voltage is the electric potential between two points. Where voltage is higher, there is a greater current of electricity flowing through.

Virtual Power Plant
A Virtual Power Plant is where digital communication technology is used to connect distributed energy resources (like residential battery and solar) to deliver services or capabilities in aggregate.

Low voltage lines
Are part of the distribution network but at a lower voltage than distribution lines. These low voltage lines transport energy to residential properties.

References

Acciona. (n.d.). Waubra Wind Farm. (Acciona, Producer) Retrieved May 2023, from https://www.acciona.com.au/waubra/?_adin=02021864894

Adapt Grampians. (2021). Grampians Region Climate Adaptation Strategy 2021-2025. Ballarat: Department of Environment, Land, Water and Planning.

AEMO. (2021). Fact Sheet: The National Electricity Market. (AEMO, Producer) Retrieved May 2023, from Australian Energy Market Operator: https://aemo.com.au/-/media/files/electricity/nem/national-electricity-market-fact-sheet.pdf

ARENA. (2023). Renewable Energy. (Australian Renewable Energy Agency, Producer) Retrieved May 2023, from https://arena.gov.au/what-is-renewable-energy/
Australian Energy Regulator. (2009). State of the Energy Market 2009. Commonwealth of Australia, Melbourne.

BREAZE. (2023). Social Solar by BREAZE is changing - stay tuned. (Ballarat Renewable Energy and Zero Emissions, Producer) Retrieved May 2023, from https://breaze.org.au/programs/soc-sol-link

Bulgana Green Power Hub. (n.d.). Local Benefits. (B. G. Hub, Producer) Retrieved May 2023, from https://bulganagreenpowerhub.com.au/local-benefits/

C4CE. (2017). Small-Scale Community Solar Guide - Version 2. The Coalition for Community Energy. The Coalition for Community Energy. Retrieved May 2023, from http://c4ce.net.au/wp-content/uploads/2017/09/C4CE-Small-Scale-Community-Solar-Guide-v2.pdf

C4CE. (n.d.). Knowledge Hub. (Coalition for Community Energy, Producer) Retrieved May 2023, from https://c4ce.net.au/knowledge-hub/

City of Ballarat. (2022). Ballarat Net Zero Emissions Plan. City of Ballarat, Ballarat.
Clean Energy Council. (2018). Bioenergy. (Clean Energy Council, Producer) Retrieved May 2023, from https://www.cleanenergycouncil.org.au/resources/technologies/geothermal

Clean Energy Council. (2018). Geothermal. (Clean Energy Council, Producer) Retrieved May 2023, from https://www.cleanenergycouncil.org.au/resources/technologies/geothermal

Community Solar Portal. (2018). Bendigo Regional Archive Centre. (Community Solar Portal, Producer) Retrieved May 2023, from https://www.communitysolar.org.au/solar-project/bendigo-regional-archive-centre/

Cooperative Power. (2020). We're taking the power back. (Cooperative Power, Producer) Retrieved May 2023, from https://www.cooperativepower.org.au/

CORENA. (n.d.). Revolving fund. (CORENA, Producer) Retrieved May 2023, from https://corenafund.org.au/revolving-fund/

DCCEEW. (2023). Solar PV and batteries. (Department of Climate Change, Energy, the Environm, Producer) Retrieved May 2023, from energy.gov.au: https://www.energy.gov.au/households/solar-pv-and-batteries#:~:text=Australia%20has%20the%20highest%20uptake,have%20been%20installed%20across%20Australia.

East Grampians Health Service. (n.d.). Significant savings to health service through solar project. (East Grampains Health Service, Producer) Retrieved May 2023, from https://eghs.net.au/news/significant-savings-to-health-service-through-solar-project

EECA. (2023). Microgrids. (Victorian State Government, Producer) Retrieved May 2023, from Energy Environment and Climate Action: https://www.energy.vic.gov.au/renewable-energy/microgrids#heading-5

Gelong Sustainability. (2023). Community Solar Success! (Gelong Sustainability;, Producer) Retrieved May 2023, from https://www.geelongsustainability.org.au/community-solar-success/

Goldwind. (2021, September 8). Moorabool Wind Farm Community Fund supports eight community iniatives with more than $120,000. Moorabool: Goldwind Australia Pty Ltd. Retrieved from https://mooraboolwindfarm.com/wp-content/uploads/2021/09/Goldwind-Media-Release-Moorabool-Wind-Farm-Community-Fund-supports-eight-community-initiatives-with-more-than-120000.pdf

Grong Grong Solar Farm. (n.d.). Grong Grong Solar Farm & Haystacks Solar Garden. (Grong Grong Solar Farm, Producer) Retrieved May 2023, from https://gronggrongsolarfarm.com.au/grong-grong-solar-farm-haystacks-solar-garden/

Groscurth, H. M., Bruckner, T., & Kümmel, R. (1995). Modeling of energy services supply. Energy, 20(9), 941-958.

Hepburn Energy. (2022). (Hepburn Energy, Producer) Retrieved May 2023, from https://www.hepburnenergy.coop/

Hepburn Energy. (2022). Hepburn Energy Annual Report 2022. Daylesford: Hepburn Energy.

Hepburn Z-NET. (2023). Hepburn EV Bulk-Buy. (Hepburn Z-NET, Producer) Retrieved May 2023, from https://hepburnznet.org.au/program/ev-bulk-buy/

Hicks, J., Ison, N., Gilding, J., & Mey, F. (2014). Community-owned renewable energy: A how to guide. Community Power Agency. Sydney: Community Power Agency.

Indigo Power. (2023). Powered by the community. (Indigo Power, Producer) Retrieved May 2023, from https://indigopower.com.au/

IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Cambridge, UK and New York, NY, USA: Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

Lakey, M., Lane, T., & D'Arma, C. (2023). Community-scale Batteries: A guide for community members across Central Victoria to learn more about community-scale batteries. Hepburn Energy, Daylesford.

Lallal Wind Farm. (2023). Benefit Fund. (L. W. Farm, Producer) Retrieved May 2023, from http://www.lallalwindfarms.com.au/community/benefit-fund/

Lane, T., & Hicks, J. (2021). Community Engagement and Benefit Sharing in Renewable Energy Development in Victoria. Victorian Government, Department of Environment, Land, Water and Planning, Melbourne.

Lane, T., Hicks, J., Memery, C., & Thompson, B. (2015). Guide to community-owned renewable energy for Victorians. Melbourne, Victoria, Australia: State of Victoria.

Middleton Group. (2022). Energy and Climate Resilient Trentham. Middleton.

Middleton Group. (2023). Renewable Energy Opportunity Report. Middleton Group.

Mondo. (n.d.). Euroa Micro grid kicks off. (Mondo Power, Producer) Retrieved May 2023, from https://mondo.com.au/news/euroa-micro-grid-kicks-off

OpenNEM. (2023, May). OpenNEM. Retrieved May 2023, from https://opennem.org.au/energy/vic1/?range=1y&interval=1w

Orkestra. (2022). Neighbourhood Battery Initiative - Final Report. Orkestra Technologies Pty Ltd.

PacificBlue. (n.d.). Crowlands and Ararat Sustainable Communities Fund. (PacificBlue, Producer) Retrieved May 2023, from https://www.pacificblue.com.au/our-energy-production/community-funding-and-engagement/crowlands-and-ararat-sustainable-communities-fund

Premier of Victoria. (2022, October 19). Newstead On Its Way to Clean Energy. (Premier of Victoria, Producer) Retrieved May 2023, from https://www.premier.vic.gov.au/newstead-its-way-clean-energy

Pyrenees Shire Council. (n.d.). BioEnergy Resources. (Pyrenees Shire Council, Producer) Retrieved May 2023, from https://www.pyrenees.vic.gov.au/Residents/Environment/Regional-Energy-Project/BioEnergy-Resources

Renew. (2017). Hot water savings: Efficient hot water buyers guide. (Renew, Producer) Retrieved May 2023, from https://renew.org.au/renew-magazine/buyers-guides/hot-water-buyers-guide/

Scalzo, M. (2022). Natimuk solar plan back under spotlight. (The Weekly Advertiser, Producer) Retrieved May 2023, from The Weekly Advertiser: https://www.theweeklyadvertiser.com.au/articles/natimuk-solar-plan-back-under-spotlight/

Teron, E. (2021). Yackandandah's community battery may not be 'big' but it's enough to 'petrify' energy providers. (ABC News, Producer) Retrieved May 2023, from ABC News: https://www.abc.net.au/news/2021-05-24/community-battery-yackandandah-ausgrid-electricity-shakeup/100159460

The Local. (2022). Schools saving energy and emissions. (The Local, Producer) Retrieved May 2023, from https://tlnews.com.au/schools-saving-energy-and-emissions/

Totally Renewable Yackandandah. (n.d.). A pivotal step. (Totally Renewable Yackandandah, Producer) Retrieved May 2023, from https://totallyrenewableyack.org.au/watts-happening/yack01-community-battery/

Wallin, C., Hensey, L., & Shue, T. (2022). Neighbourhood Battery Iniative Final Report. Yarra Energy Foundation. Melbourne: Yarra Energy Foundation.


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