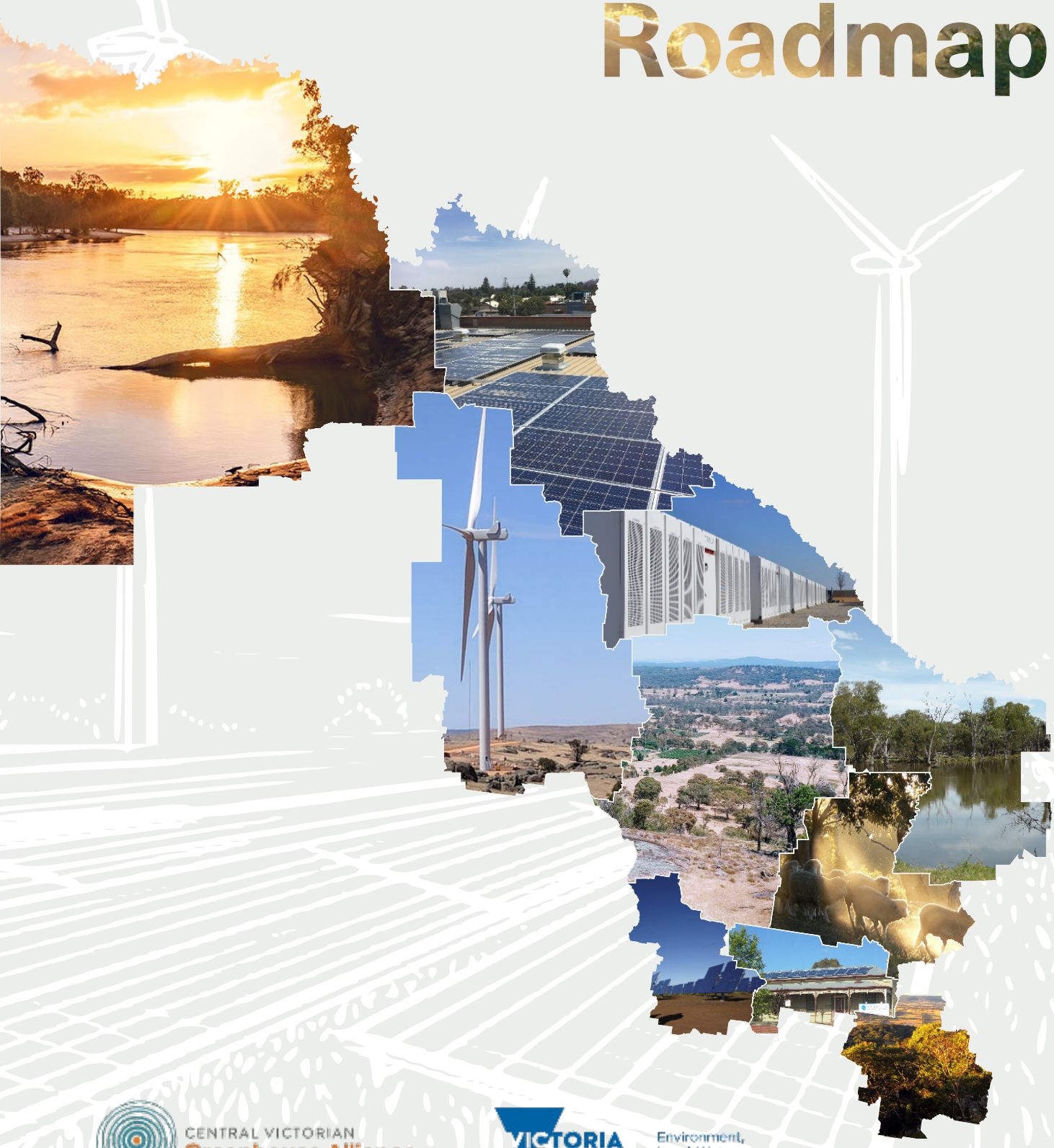
Loddon Mallee Region

Renewable Energy Roadmap



CENTRAL VICTORIAN Greenhouse Alliance

VICTORIA State Government

Environment, Land, Water and Planning

Foreword

On behalf of the Victorian Government, I am pleased to present the Victorian Regional Renewable Energy Roadmaps.

As we transition to cleaner energy with new opportunities for jobs and greater security of supply, we are looking to empower communities, accelerate renewable energy and build a more sustainable and prosperous state.

Victoria is leading the way to meet the challenges of climate change by enshrining our Victorian Renewable Energy Targets (VRET) into law: 25 per cent by 2020, rising to 40 per cent by 2025 and 50 per cent by 2030.

Achieving the 2030 target is expected to boost the Victorian economy by $5.8 billion - driving metro, regional and rural industry and supply chain development. It will create around 4,000 full time jobs a year and cut power costs.

It will also give the renewable energy sector the confidence it needs to invest in renewable projects and help Victorians take control of their energy needs.

Communities across Barwon South West, Gippsland, Grampians and Loddon Mallee have been involved in discussions to help define how Victoria transitions to a renewable energy economy.

These Roadmaps articulate our regional communities' vision for a renewable energy future, identify opportunities to attract investment and better understand their community's engagement and capacity to transition to renewable energy.

Each Roadmap has developed individual regional renewable energy strategies to provide intelligence to business, industry and communities seeking to establish or expand new energy technology development, manufacturing or renewable energy generation in Victoria.

The scale of change will be significant, but so will the opportunities.

Each community has a part to play in embracing cleaner energy and the benefits it brings for a brighter future.

The Hon. Lily D'Ambrosio MP
Minister for Energy, Environment and Climate Change
Minister for Solar Homes

Content

About the roadmap

The Loddon Mallee Renewable Energy Roadmap provides a snapshot of the opportunities and obstacles the region faces as it moves from a centralised to a more decentralised renewable energy system. It builds a picture of how our energy system currently works, and the possibilities this transition will create. In writing the roadmap, we spoke to people across the community, to make sure the region's voices are heard in the plan for new energy future.

The concept for regional renewable energy roadmaps was devised by the Victorian Government's Department of Environment Land Water and Planning and funded through the New Energy Jobs Fund in late 2018. In the Loddon Mallee, the project has been led by the Central Victorian Greenhouse Alliance, with oversight by the Loddon Mallee New Energy Taskforce.

The roadmap is for a broad audience of stakeholders inside and outside the Loddon Mallee region. It will provide value to local and state government agencies, private investors, community groups and individuals in the region who wish to understand what is happening and identify opportunities. The recommended next steps in the roadmap are designed to be broad enough for anyone to pursue. It is not expected that they will be the responsibility of any single stakeholder, but rather, will require strong collaboration across the region.

John Mclinden

Chair, Loddon Mallee New Energy Taskforce, and
CEO of Swan Hill Rural City Council)

Acronyms

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
ARENA	Australian Renewable Energy Agency
CFA	Country Fire Authority
CVGA	Central Victorian Greenhouse Alliance
DER	Distributed Energy Resources
DR	Demand response
EUA	Environmental Upgrade Agreement
EV	Electric vehicle
HVAC&R	Heating, Ventilation, Air Conditioning and Refrigeration
KEWGS	K Englefield Wine Grape Services
MASH	More Australian Solar Homes
PILoR	Payments in Lieu of Rates
PPA	Power Purchase Agreement
PV	Photovoltaic
REZ	Renewable Energy Zone
RIT	Regulatory Investment Test
SAPS	Standalone Power Systems
SWER	Single Wire Earth Return
VRET	Victorian Renewable Energy Target

Riverland in Campaspe (opposite)
Photo supplied by:

Executive summary

The Loddon Mallee region is experiencing an unprecedented and exciting transition to renewable energy. Five years ago, less than 5 per cent of the region's energy needs were generated locally from large and small scale solar, bioenergy and wind. Now, it's 69 per cent. This accounts for nearly 16% of Victoria's current renewable generation capacity.

Within the next five years, the region will be able to meet its own energy needs and export power elsewhere in Victoria and interstate. Our region alone could deliver the Victorian Renewable Energy Target of 40 per cent by 2025, if all of the planned large-scale solar projects go ahead.

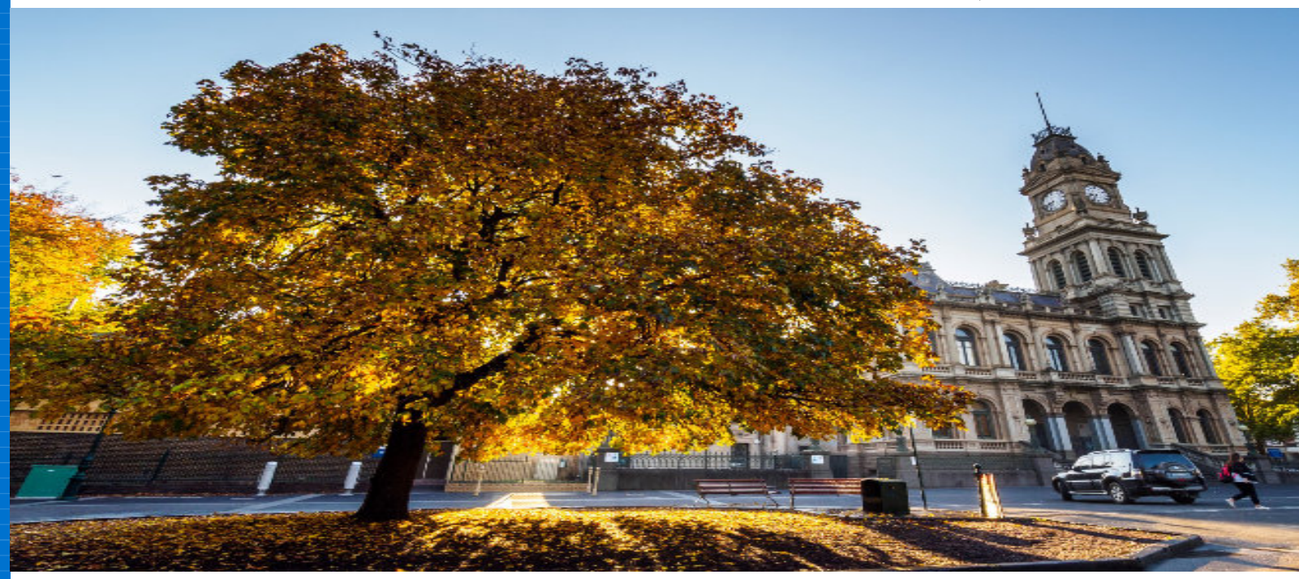
The region is well placed to become a renewable energy powerhouse. By mid-decade, renewables could deliver over $1 billion in supply chain benefits to the region and create over 3200 jobs during construction. However, to unlock the full potential of renewable energy in the region, investment is needed to upgrade the transmission grid.

The Loddon Mallee Renewable Energy Roadmap provides an overview of the opportunities and obstacles the region faces as it continues to move to a more decentralised renewable energy system. It draws upon extensive community engagement, as well as technical studies, to build a complete picture of the region. The roadmap seeks to ensure that the communities' concerns and aspirations are well represented in planning for this transition.

There are many economic, social and environmental drivers for change. New renewable energy technologies, such as wind and solar with storage, now outcompete new fossil fuel generation on cost. All of Victoria's remaining fleet of coal-fired power plants will be retired by

...to unlock the full potential of renewable energy in the region, investment is needed to upgrade the transmission grid.

2050, with scheduled closures starting in 2032. In addition, ongoing investment in renewables will be forced by the need to urgently reduce greenhouse gas emissions to address climate change. In the Loddon Mallee, local governments, businesses and communities are helping to drive the transition.



Bendigo town hall

Photo supplied by Greater Bendigo City Council

There is a strong social license for renewable energy right across the region. Nine out of every ten respondents in our engagement said it is very important to use local renewable energy resources. Likewise, there's widespread interest in becoming more energy self-sufficient and ensuring economic benefits remain in the area. People support large-scale renewable energy development, as long as it provides economic, social and environmental benefits to the broader community.

Energy developments are proving they can improve landscape attributes such as biodiversity or agriculture, but they need to be carefully designed and located, and cognisant of existing land use and values. In most circumstances, large solar farms need to be built within 1.5 kilometres of the transmission line from Mount Alexander Shire to Mildura, through Bendigo and Kerang. If all the currently planned solar was built within this area, it would cover less than 4 per cent of the land.

The Loddon Mallee region also has significant untapped bioenergy resources. With our large agricultural sector, the region has significant opportunities for converting biomass to energy by generating electricity, heat, natural gas or even liquid fuels. Bioenergy technologies can also create other useful by-products, such as water biochar and nutrients. Its estimated that if we utilised all of the biomass resources in the region we could generate an equivalent of 1000 gigawatt hours of electricity. This would be approximately 40% of the electricity consumed in the region, and could be used to displace natural gas in commercial and industrial applications.

The energy transition will be characterised by the rise of Distributed Energy Resources (DER) — small-scale solar, batteries, electric vehicles, bioenergy and other technologies with controllable loads, such as air conditioners and pool pumps. If well managed, these resources will be essential in helping to deliver greater energy security and reliability, and reduce power prices for all users. DER also offers opportunities for remote communities in the region to explore potential for microgrids.

The Loddon Mallee region has a long history of community energy groups who have led renewable energy uptake, often in novel and exciting ways. Community energy groups are important for building the social license for renewable energy and addressing equity by ensuring low-income households are not excluded. The region's community energy groups need more support, particularly to unlock opportunities for medium-scale generation.

The boom in renewable energy in the Loddon Mallee will create significant economic opportunities, if the region is able to coordinate and direct initiatives to benefit the community. Sustaining short-term opportunities will require ongoing investment certainty, supportive government policies, and improvements to transmission and distribution networks. We can try to capture these benefits by preparing local workers and businesses to provide services to the renewable sector.

The roadmap provides a basis for the region to work together to realise these opportunities.

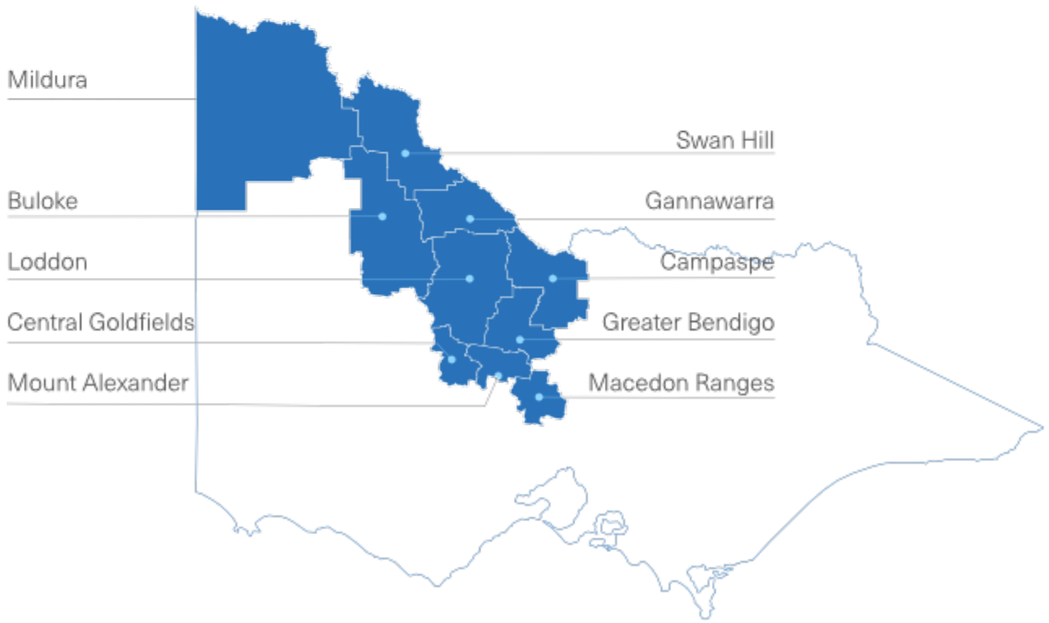
It identifies seven priorities to guide us through this transition:

- **Enhance grid infrastructure and realise the region's solar potential**
- **Maximise community benefit sharing and maintain social license**
- **Coordinate and optimise Distributed Energy Resources**
- **Maximise the potential for bioenergy**
- **Support community energy**
- **Understand the opportunities for emerging technologies**
- **Be proactive about future jobs and training needs.**

The seven priorities

The Loddon Mallee region and it's Local Government Areas

The Loddon Mallee region in central to north western Victoria is made up of 10 Local Government Areas



Loddon Mallee and the energy transition

Australian towns were some of the first in the world to take on a revolutionary new technology—electricity. Victoria's first power station opened on Spencer Street in 1892. Many communities built their own generators and local distribution networks, often sharing the excess from industrial sites, such as butter factories. By the 1920s, larger projects, including the Yallourn power station, were commissioned as smaller networks began to combine to form a statewide grid.

Now, we are in the midst of another energy transition. This time it is driven by advances in technology, policy incentives, community desires and global investment priorities.

Drivers of change

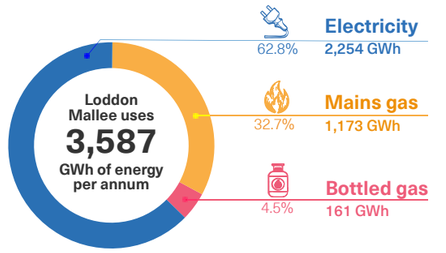
The cost of new renewable energy technologies, such as wind and solar, now outcompetes new coal and gas-fired generation. Combined with storage, these technologies can outcompete fossil fuel dispatchable generation. Rising power prices, along with government rebates for renewables such as rooftop solar, are driving households and businesses to invest in renewable energy technologies. Some consumers are purchasing batteries as a way to protect against grid outages.

Climate change is driving governments, investors and insurers around the world to shift towards renewable energy. Reducing greenhouse gas emissions is also a big motivation for the Loddon Mallee community, who consider climate change and sustainability a key objective of the energy transition. All of Victoria's existing fleet of coal-fired power plants will be retired by 2050, with scheduled closures starting in 2032. The reliability of some of these plants is already declining.

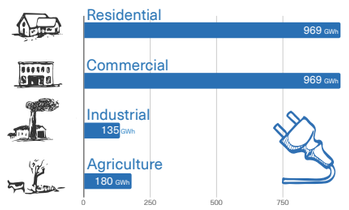
Local and state government policies are driving additional uptake of renewable energy. The Victorian Renewable Energy Target (VRET), 50 per cent by 2030, will stimulate investment in renewables and support the reliability of electricity supply. Local governments across the region also have a range of targets and programs designed to encourage the uptake of renewable energy within their communities.

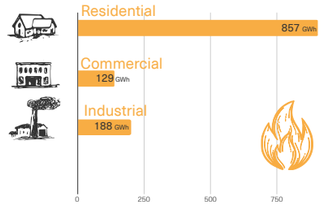
A breakdown of energy use in Loddon Mallee

As energy consumers, we use both electricity and gas. Most electricity is consumed by residential and commercial customers, while the major users of gas are households and industry.



Estimated annual stationary energy demand for Loddon Mallee
Energy sources converted to GWh for comparison
Data source: CVGA analysis

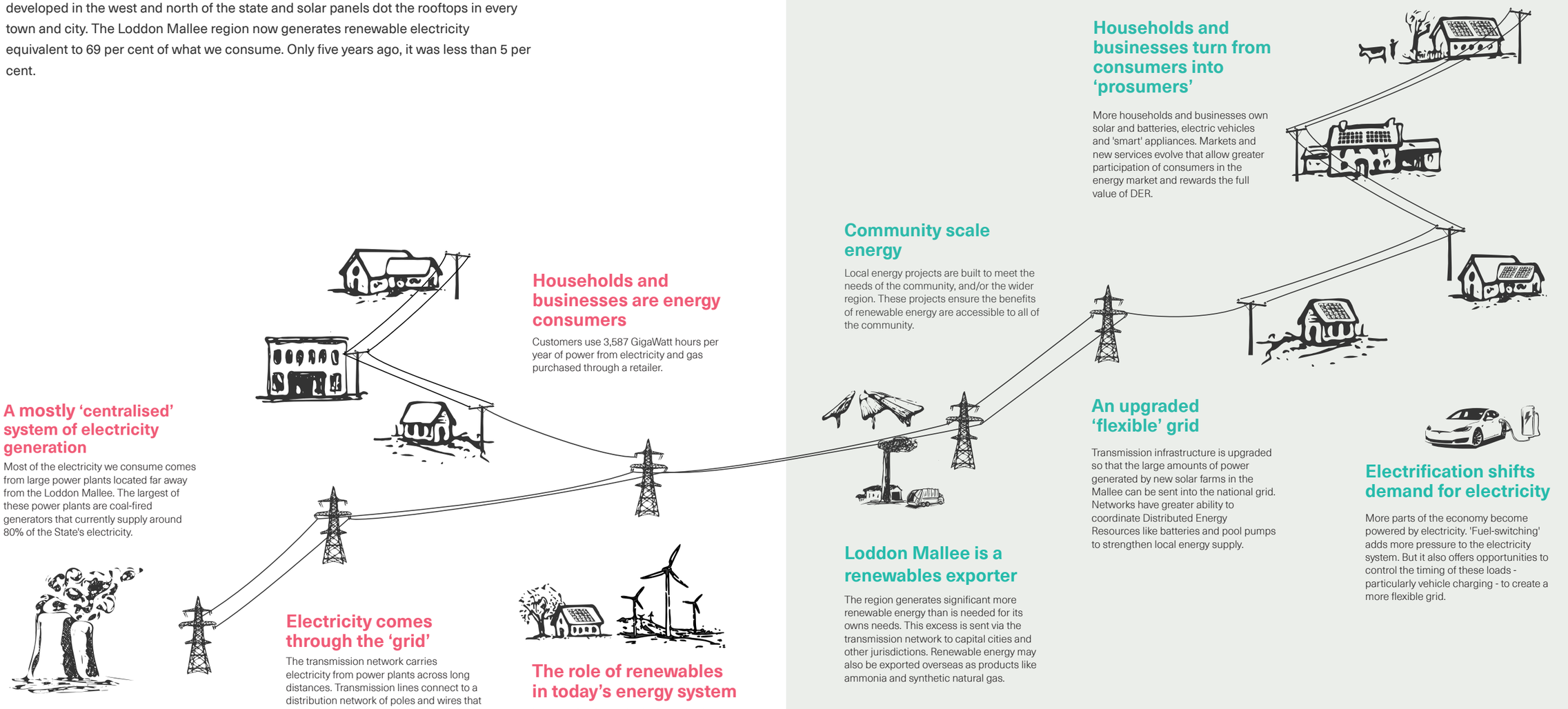




Sector breakdown of electricity and mains gas demand for Loddon Mallee
Data source: 2017 consumption data provided to CVGA by energy networks

Our energy system today and tomorrow

We still rely on the electricity network developed throughout the 20th century. In Victoria, the grid is dominated by the generation hub in the Latrobe Valley. But in the last decade, it has begun to diversify. In our region, solar and wind farms are being developed in the west and north of the state and solar panels dot the rooftops in every town and city. The Loddon Mallee region now generates renewable electricity equivalent to 69 per cent of what we consume. Only five years ago, it was less than 5 per cent.



A mostly 'centralised' system of electricity generation

Most of the electricity we consume comes from large power plants located far away from the Loddon Mallee. The largest of these power plants are coal-fired generators that currently supply around 80% of the State's electricity.

Households and businesses are energy consumers

Customers use 3,587 GigaWatt hours per year of power from electricity and gas purchased through a retailer.

Electricity comes through the 'grid'

The transmission network carries electricity from power plants across long distances. Transmission lines connect to a distribution network of poles and wires that bring electricity into our homes and businesses.

The role of renewables in today's energy system

Large scale wind and solar farms feed electricity into the grid and rooftop solar is installed on houses and business. Renewable electricity generated is equivalent to 69 per cent of what we consume.

Local energy resilience

Maximising local energy generation and storage opportunities help communities become more self sufficient and resilient for their energy needs. Customers and rural communities have ability to 'island' from the main grid and share power locally. Local energy systems become more resilient to climate change.

Households and businesses turn from consumers into 'prosumers'

More households and businesses own solar and batteries, electric vehicles and 'smart' appliances. Markets and new services evolve that allow greater participation of consumers in the energy market and rewards the full value of DER.

Community scale energy

Local energy projects are built to meet the needs of the community, and/or the wider region. These projects ensure the benefits of renewable energy are accessible to all of the community.

Loddon Mallee is a renewables exporter

The region generates significant more renewable energy than is needed for its owns needs. This excess is sent via the transmission network to capital cities and other jurisdictions. Renewable energy may also be exported overseas as products like ammonia and synthetic natural gas.

An upgraded 'flexible' grid

Transmission infrastructure is upgraded so that the large amounts of power generated by new solar farms in the Mallee can be sent into the national grid. Networks have greater ability to coordinate Distributed Energy Resources like batteries and pool pumps to strengthen local energy supply.

Electrification shifts demand for electricity

More parts of the economy become powered by electricity. 'Fuel-switching' adds more pressure to the electricity system. But it also offers opportunities to control the timing of these loads - particularly vehicle charging - to create a more flexible grid.

Renewable resources

Local Governments Areas in Loddon Mallee	Population	Area	Rooftop Solar	Installed Solar	Installed Wind	Total Renewables	Solar resources	Wind resources	Bioenergy resources
Mildura	54,658 people	22,082 square kms	18.3% of roofs have solar (or 4,769 installations)	31.8 MW of rooftop solar 258.2 MW of solar farms	None No wind farms	290.0 MW of renewable energy installed	18.3 MJ per sqm	7.0 to 7.7 metres per second	Almond husks / shells;, straw / chaff and grape marc
Swan Hill	20,896 people	6,115 square kms	22.2% of roofs have solar (or 2,208 installations)	17.3 MW of rooftop solar 190.7 MW of solar farms	None No wind farms	206.0 MW of renewable energy installed	18.4 MJ per sqm	7.0 to 8.0 metres per second	Straw / chaff, almond hulls / shells and grape marc
Buloke	6,284 people	8,000 square kms	24.9% of roofs have solar (or 829 installations)	4.5 MW of rooftop solar	None No wind farms	4.5 MW of renewable energy installed	17.9 MJ per sqm	7.0 to 7.8 metres per second	Straw / chaff, oil seed pods and pig effluent
Gannawarra	10,567 people	3,736 square kms	27.6% of roofs have solar (or 1,580 installations)	10.1 MW of rooftop solar 50.0 MW of solar farms	None No wind farms	60.1 MW of renewable energy installed	17.6 MJ per sqm	7.0 to 7.8 metres per second	Straw / chaff, oil seed pods and pig effluent
Campase	37,095 people	4,519 square kms	28.4% of roofs have solar (or 5,164 installations)	27.4 MW of rooftop solar	None No wind farms	27.4 MW of renewable energy installed	17.7 MJ per sqm	6.9 to 7.9 metres per second	Straw/ chaff, dairy and pig manure; paper cardboard & commercial organics
Loddon	7,558 people	6,669 square kms	28.9% of roofs have solar (or 1,163 installations)	5.9 MW of rooftop solar 0.5 MW of solar farms	27 kW capacity of wind farms	6.5 MW of renewable energy installed	17.6 MJ per sqm	6.8 to 7.9 metres per second	Straw / chaff, dairy effluent and oil seed pods
Mount Alexander	19,097 people	1,530 square kms	31.7% of roofs have solar (or 3,154 installations)	11.8 MW of rooftop solar	None No wind farms	11.8 MW of renewable energy installed	16.8 MJ per sqm	6.6 to 9.0 metres per second	Paper / cardboard, organics (commercial and industrial), and timber (construction waste)
Greater Bendigo	112,267 people	3,000 square kms	20.7% of roofs have solar (or 11,314 installations)	51.9 MW of rooftop solar	None No wind farms	51.9 MW of renewable energy installed	18.1 MJ per sqm	6.7 to 7.9 metres per second	Straw / chaff, poultry litter and pig manure / slurry.
Central Goldfields	13,087 people	1,533 square kms	26.7% of roofs have solar (or 1,881 installations)	9.5 MW of rooftop solar	None No wind farms	9.5 MW of renewable energy installed	16.9 MJ per sqm	6.8 to 8.2 metres per second	Straw / chaff, oil seed pods, organics - (commercial), cardboard and paper
Macedon Ranges	47,480 people	1,748 square kms	25.4% of roofs have solar (or 5,239 installations)	25.7 MW of rooftop solar	None No wind farms	25.7 MW of renewable energy installed	16.0 MJ per sqm	7.9 to 9.2 metres per second	Plantation bark, straw / chaff; and sawmill woodchips
All of **Loddon Mallee**	328,989 people	58,959 square kms	23.4% of roofs have solar (or 37,292 installations)	231.0 MW of rooftop solar and 499.4 MW of solar farms	27 kW capcaity on wind farms	695.5 MW of renewable energy installed	17.9 MJ per sqm	6.6 to 9.2 metres per second	

Data sources: *Demographic data from ABS (2016), Solar installation data from APVI with assessment of renewables by capacity from CVGA, Bioenergy information from the Australian Biomass for Bioenergy Availability Study 2016*

Our community

The Loddon Mallee region is enthusiastic about renewable energy. Nine out of ten respondents to our engagement consider that it is very important that we maximise our local renewable energy resources. The community says it wants the transition to renewable energy to bring more secure, cost-effective power. People want to capitalise on the new wave of technologies, to build local generation that creates local jobs and supports the existing economy. People also want the region to be more self sufficient—producing and using our own power and keeping the profits within our local economies. Underpinning all of this is the desire to tackle climate change and use our key asset, sunshine, to produce clean energy and reduce carbon emissions.

In 2019 we engaged with

OVER 500

community members, local businesses and **regional stakeholders** across the **Loddon Mallee**

Map of consultation locations *coordinated by the Central Victorian Greenhouse Alliance and RMCG*

We ran 25 **workshops** and **focus groups**, conducted **one-on-one interviews**, and **surveyed** 388 members of the community, to understand their **views about the future of renewable energy in the region.**

Community consultation session in Bendigo
Photo supplied by CVGA

Who participated?

Based on 354 responses

84% Local residents

7% Local business or organisation

9% Regular visitor or holiday home owner

Where they live and work?

Based on 338 responses

21% Rural setting

28% Small town centre

51% Regional town centre

LODDON MALLEE SURVEY FINDINGS

WHAT OUR COMMUNITY THINKS ABOUT RENEWABLE ENERGY

How important is it to use local renewable energy resources?

Based on 378 responses

90% Very important

5% Somewhat important

2% Not so important

2% Not at all important

1% Don't know!

Technologies the community would like to see

Based on 378 responses. Percentages shown are the proportion of respondents who selected each technology

1. Rooftop solar 86%
2. Solar farms 80%
3. Waste to energy 63%
4. Residential / business batteries 57%
5. Wind energy 53%
6. Large scale batteries 52%
7. Bioenergy 39%
8. Pumped-hyrdo storage 21%
9. Hydro-electric 19%
10. Other 1%

What we think about increasing renewable energy in the region?

Based on 343 respondents identifying any advantage and 338 respondents identifying any disadvantages. Percentages shown are the proportion of respondents who identified that advantage or disadvantage.

1 in 25 think there are only disadvantages

8 in 25 think there are disadvantages and advantages

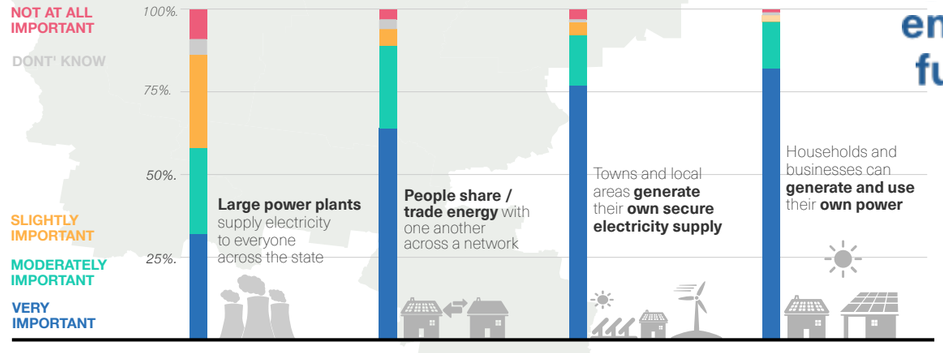
16 in 25 think there are only advantages

The top five most identified advantages and disadvantages

Disadvantages	Advantages
Cost of upgrades / cost of power 8%	1 Local reliability and self sufficiency 43%
Use of agricultural land 7%	2 Local economic benefits 39%
Amenity impacts 6%	3 Reducing emissions / improving sustainability 36%
Inability to provide consistent supply 4%	4 Lower energy prices 16%
Dividing communities 4%	5 Reduced cost and impact of grid infrastructure 14%

What's important for the region's energy future

Proportion of responses by level of rated **importance** for **four energy scenarios**



Opportunities

Action on climate change

Renewable energy is a tangible way to tackle climate change — that is the most common reason people gave about why they are excited about transitioning our energy system. Some discussions touched on local energy as a way of building community resilience to climate change impacts, but mostly, people see it as a way of reducing carbon emissions and improving the future. Some people want to see the region as a leader in making the transition happen.

Reliability

People don't want the power going out. Reliability is particularly important for residents in areas such as Donald and Wedderburn, further away from the larger transmission infrastructure. But some people in better connected locations such as Mildura also say they experience outages because of load-shedding. Citizens are hopeful that locally generated electricity will be more reliable because it could provide more local control and reduce reliance on the broader network. This is also very important for many businesses that rely on consistency of supply.

Local ownership

Citizens in Loddon Mallee are enthusiastic about community-owned renewable energy. They spoke about the potential for keeping profits within the local economy and also, avoiding multinational companies' control over power and the price of power.

Local economic benefits

People think renewable energy generation has the capacity to boost economic prosperity in the region by providing jobs for local people. They also said it could help to diversify farm income, increase rates revenue for councils and increase tourism. If energy costs are lower in the area, that would help to retain and attract new manufacturing.

> ***Through area-specific generation, we hope to see greater employment opportunities and greater stability***
>
> *- Mount Alexander resident*

Cheaper power

People told us they are concerned about power becoming unaffordable and the likely consequences for individuals and local businesses under financial stress. They see household, business and community-scale renewable energy as a great way to limit the cost of power for consumers. People in the Loddon Mallee think grid infrastructure is expensive to upgrade and they are also concerned about the losses created by transporting power long distances across the transmission network.

Case study

Building resilience in grid outages

Hardwicks Meats | On-site solar farm

Hardwick's is shifting to renewable energy so it can guarantee the security of its power supply, cut power costs and make the business viable for the long term. A blackout puts millions of dollars of meat produce at risk—a fact that significantly improves the business case for battery storage. The company had previously averaged one power outage every year, lasting three hours.

The company installed 2.5 megawatts of field-mounted solar panels and a 2-megawatt battery. The first stage, which has been operating since January 2018, included over four and a half thousand north-facing solar panels, set in racks on four hectares at its Kyneton plant. Hardwick's had expected to cut its greenhouse gas emissions by 30 per cent, but the system has exceeded predictions. It generates more than a third of the plant's total consumed power.

The second stage, now under way on the same four hectares, faces east-west to maximise space efficiency and energy generation, and includes another battery. It's expected to cut the company's total power bill by 60 per cent. The system is the company's biggest investment at this site in 40 years. The project was also supported by Powercor and Meat and Livestock Australia.

Hardwick's will be able to continue to generate, store and use energy in a power outage, effectively 'islanding' power supplies. It can also shift its peak load, by accessing battery-supplied electricity.

"We're a long-term business and we're always looking for opportunities to become more efficient," Mark Hardwick explains. "Five years ago it wasn't advisable for a plant like ours to move towards off-grid but now that's become a reality."

Photo supplied by CVGA

Concerns

Land use conflict

Throughout the consultation, it was clear that people are worried that generation plants will conflict with agriculture and natural landscape values. They said that marginal land, not prime agricultural land, should be used for renewable energy; however, the definition of good and marginal land was not clear. There was also some discussion in workshops about the need for generators to be close to grid infrastructure, but no sense of whether this priority outweighs the preservation of agricultural land. Many people asked whether it is possible to establish a solar farm and continue to use the land for agriculture.

To learn more about the use of farmland and solar in action, see the Bannerton and Numurkah case study on page 30

Visual impact

In the survey results (but less so in workshops and direct conversations) people indicated concern about the visual impact of wind turbines, and, to a lesser extent, solar farms. As a solution, they suggested large buffer zones coupled with native vegetation, but noted that while this may work for solar developments on flat land, it would have little effect on the appearance of wind turbines.

Intermittent supply

As the dominant renewable energy sources are intermittent, people are concerned they will undermine the stable and continuous supply of electricity. However, there was not much awareness about how this issue is managed within the energy system. Many people think battery technology will solve this issue in the future, but they aren't sure whether it is currently viable. Biomass and waste-to-energy are also considered a stable supplement to renewable energy. Community members highlighted the large supply of organic waste as an underused resource.

Higher power prices

One in five survey responses about potential disadvantages mentioned the cost of transitioning to renewable energy sources. As well as a general concern that power will be more expensive, people identified the additional cost of generation and grid infrastructure. Similarly, at events and in workshops, participants expressed concern that consumers will bear the cost of the transition.

Equity

In discussions about rooftop solar, people said that the cost of the initial investment excludes some on lower incomes, while renters and homeowners with unsuitable roofs also miss out. They may be left further behind as power prices continue to rise. People are generally concerned that energy should be affordable for everyone.

Community cohesion

When asked in the survey about any disadvantages of having renewable energy development in their local area, a number of people responded that it would likely cause friction in the community. They said that to minimise division, there needs to be good communication and proper consultation whenever developments are proposed.

Waste and recycling

Residents are apprehensive about what happens to leftover construction materials. People also want to ensure that the life-cycle of the equipment is taken into consideration. Over the course of 2019, citizens became increasingly aware of recycling and waste issues. Many responses discussed these issues as a reason to investigate waste-to-energy technologies; or the exact opposite—that waste-to-energy should be ruled out, so that people take more responsibility for consumption.

Other considerations

Support for communities

People who are interested in community or locally owned energy want to learn from the experience of other towns and regions. They want to take advantage of existing partnerships with industry and governments. Some said they need more technical support to properly evaluate local projects and initiatives, so they can make informed decisions about their futures.

Transport and energy efficiency

In workshops, at events, and in the survey, people said that energy efficiency is just as, or even more important than new generation. People often commented that building standards should be improved so that heating and cooling needs are not so onerous. Similarly, several discussions touched on the need to consider transport fuels, because the future is likely to be electric.

View over the riverfront in Mildura

Photo credit: Visit Mildura

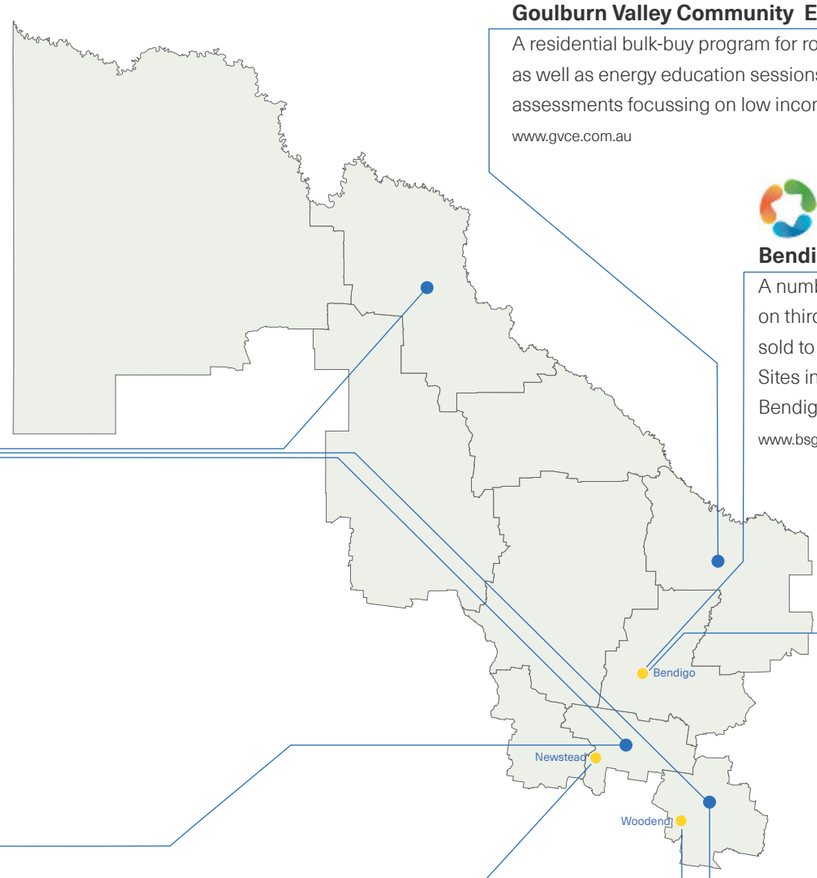
Community energy groups

There are vibrant community energy and sustainability groups throughout the region, formed and run by people with a passion for promoting renewable energy or energy self-sufficiency. Some have a long history of delivering innovative projects encouraging renewables. They often emphasise community benefits, social justice and equity. These groups are working to test and pilot new ways of generating, supplying and sharing energy, and exploring new models of ownership and control.

To date, most community energy projects have focussed on behind-the-meter energy generation in residential, commercial, public or community sector applications. Because they're voluntary, community-based organisations, they often face challenges that limit the speed and scale at which they can develop projects.

Partnerships with local governments can be important for the success of these projects, whether by way of funding for organisations, in-kind facilitation, or other support. For example, Swan Hill Rural City Council is an active partner in the promotion and delivery of the Mallee Sun Solar Bulk Buy, with the CVGA. This partnership confers trust in the program and improves its chance of success.

Where our community energy groups and their projects operate



The People's Solar

A crowd sourcing initiative aimed at delivering rooftop solar to social and community facilities while also delivering a social dividend.

www.thepeoplessolar.com.au

More Australian Solar Homes

A residential bulk-buy program for rooftop solar and batteries in a number of shires. It includes Mount Alexander, Macedon Ranges, and the Mallee Sun Bulk Buy in Swan Hill. Delivered by the Central Victorian Greenhouse Alliance.

www.mash.org.au

Mount Alexander Sustainability Group

Seeks to develop a 'behind the meter' renewable energy facility on commercial third party land and sell the electricity to a commercial tenant.

www.masg.org.au

To learn more about Renewable Newstead see the case study on page 57

Renewable Newstead

A proposal to develop a community-scale virtual power plant to deliver 100 per cent renewable energy to the residents of Newstead.

www.renewablenewstead.com.au

GV Community Energy

Goulburn Valley Community Energy - Campaspe Shire

A residential bulk-buy program for rooftop solar and solar hot water, as well as energy education sessions and free home energy assessments focussing on low income and disadvantaged residents.

www.gvce.com.au

Bendigo Sustainability Group

A number of community energy projects on third-party sites, where electricity is sold to the benefit of community investors. Sites include Bendigo Library and the Bendigo Council Archives.

www.bsg.org.au

Community Power Hub Bendigo

Community-owned solar systems at Eaglehawk Badminton and Table Tennis Centre, and public housing units in Golden Square. Power is sold to the tenants.

www.communitypowerhub.com.au

The Black Forest Timber Mill in Woodend, a behind-the-meter solar facility that sells power to tenants at the mill.

www.mrsg.org.au

Macedon Ranges Sustainability Group

A proposal to develop a Community Energy Park on pine plantations land in Macedon Ranges Shire. This would involve wind and solar generation and battery storage sufficient to power all homes in the shire.

Case study

Communities carving out their own energy future

Bendigo Community Power Hub

Bendigo Sustainability Group started the Bendigo Community Power Hub just two years ago. In three months, it raised $62,000 to fund solar panels for eight public housing units in Golden Square and a sports stadium in Eaglehawk.

But that's not all. The team has designed and scoped a 2-megawatt solar farm model for regional communities and community-oriented enterprises and developed a way for private investors or groups to fund small-scale renewable energy projects.

Chris Corr, Colin Lambie and Chris Weir from the sustainability group say projects could include anything from installing 10-kilowatt solar systems on a local sporting pavilion, to a whole-of-town renewable energy project.

The hub helps communities by acting as an asset manager. Set up as not-for-profit social enterprise network, it pays profits into a trust fund, with a purpose to fund more community-owned renewable energy projects. It shares know-how on:

- project design
- renewable energy equipment (supply and installation) and monitoring systems procurement
- administration, including performance monitoring and remediation
- value assessments
- project performance reporting to hosts, owners, occupants and the general community
- operation and maintenance oversight
- insurance assessment and updates, regulation and legal assessment.

Photo supplied by CVGA

www.communitypowerhub.com.au

Where next?

For community energy

Most community energy groups are now exploring alternative models, such as solar farms, innovative network tariffs, virtual power plants, community-scale batteries and peer-to-peer trading. While the average rates of rooftop solar installations in the region exceed the state average, there are towns where uptake is lower. Rooftop solar bulk buy initiatives can continue to help in those locations, particularly where the distribution grid is not constraining connections.

Existing behind-the-meter installations could continue to expand; for example, by putting rooftop solar arrays on commercial or public roofs, with the asset owned by the community group and the electricity sold to the host site. Although challenging, these projects can deliver solar installations to community facilities that would not otherwise invest in solar arrays.

There is a niche in the local energy mix for medium-scale renewable energy projects. Ten smaller solar farms could make the same contribution as one larger 50-megawatt development, which would need to rely on access to a congested transmission network. Smaller solar farms may not attract project finance, but community groups in the region have expressed interest in supporting these developments. Bendigo Community Power Hub, Renewable Newstead and Macedon Ranges Sustainability Group are all planning medium-scale solar or wind farms. The Coalition for Community Energy argues that part of the VRET should be allocated to support medium-scale community energy projects, with a supportive community feed-in-tariff.

There are some barriers, however. Changes to planning requirements in 2019 require all solar farms over 1 megawatt to be approved by the Minister for Planning, rather than by local governments. Small projects have to undertake many of the same regulatory assessments as large solar farms. Bendigo Sustainability Group has called for these regulatory processes to be streamlined for smaller-scale (1 to 5 megawatt) community-owned projects. Finally, community energy groups often find it difficult to engage with network operators. Operators need to build their capacity to engage with these groups.

Community solar programs in Swan Hill

Photo supplied by Swan Hill Rural City Council

Utility scale generation

With an abundance of natural resources, large amounts of available land, and a spread of small communities, there are a number of paths the region could take in its energy future. This chapter does not aim to set the route, but rather, detail the challenges and opportunities ahead.

Solar farms

Most of Victoria's large-scale solar generation has been built in the Loddon Mallee region, going back over a decade. At Newbridge, Raygen built an experimental solar thermal installation, and near Mildura, Silex Systems established a demonstration concentrated solar plant.

The industry has grown rapidly in the last few years. At the time of writing, over 499 megawatts of large-scale solar farms are located in Mildura, Swan Hill and Gannawarra local government areas. Together with rooftop solar, they account for 3 per cent of the state's electricity generation[1], and 69 per cent of equivalent electricity consumption in the Loddon Mallee region.

These solar developments have also demonstrated technological innovations. Gannawarra Solar Farm's 25-megawatt battery, the largest in Victoria, provides grid stability as well as energy storage. It was installed through a State Government tender, with support from the Australian Renewable Energy Agency (ARENA).

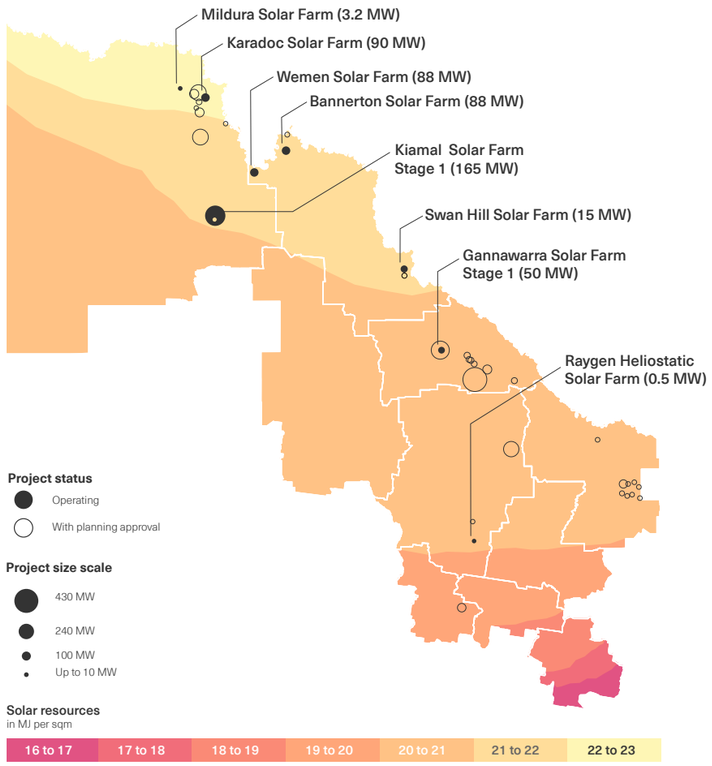
Solar farms have been developed through a variety of contracting and funding sources. The Carwarp and Cohuna solar farms resulted from the auction process for the VRET. Near Ouyen, the Kiamal solar farm is backed by power purchase agreements with large corporate customers and electricity retailers, including Mars Australia, Flow Power and Alinta Energy. The Swan Hill Solar Farm was among the first large-scale solar farms to be developed on 'merchant basis', without an offtake agreement. Instead, it relied on expected wholesale market revenues to support its business case.

[1] *Sourced from DEWLP online* https://www.energy.vic.gov.au/__data/assets/pdf_file/0025/397123/VRET-2017-18-Progress-Report.pdf

Aerial view of the Gannawarra Solar Farm

Photo credit: Wirsol Energy

There are eight solar farms operating in Loddon Mallee and a further 27 projects have planning approval



Map of operating solar farm projects (labelled) and solar farm projects with planning approval
Data provided by DELWP (to November 2019)

Solar resources in the region
Data adapted for use here from the AREMI solar map

The 25 MW battery at Gannawarra Solar Farm
Photo supplied by CVGA

Where next for solar farms

The growth in large-scale solar is continuing — 325 megawatts of solar farms are under construction and planning approval has been granted for over 2075 megawatts more. At peak output, that's 1.4 times the size of the now-retired Hazelwood Power Station in Victoria's Latrobe Valley. A further 2000 megawatts are at earlier planning stages.

Grid connections remain a significant challenge to ongoing investment in the region, both in terms of process and technical requirements. This is leading to major delays on many of the planned projects in our region. Similarly, under-investment in network capacity to address congestion and constraints in the region is creating ongoing uncertainty.

Several groups are interested in pursuing medium-scale solar farms. These 1 to 5 megawatt plants could be connected to the distribution network, rather than the transmission network. They could be located closer to points of demand (such as irrigation or industry) and incur fewer transmission losses. This approach is discussed further in the community energy section.

Given its sunny location, the Loddon Mallee region could soon become an exporter of renewable electricity, generating far more than the region consumes. If all of the planned solar farms are built the region could become 500% renewable.

If all of the planned solar farms are built the region could become 500% renewable

It may even become feasible to export solar energy internationally, using technologies such as hydrogen storage. Japan and South Korea have energy intensive economies and currently import large volumes of fossil gas from Australia, but have also made commitments to reduce greenhouse gas emissions. The emergence of this market would require Australia to generate more renewable electricity than is required domestically

Breaking ground for the Robinvale solar farm project in Swan Hill
Photo supplied by Swan Hill Rural City Council

Wind farms

There's relatively little wind in our region — at least, little of the right kind for turbines. Large-scale wind generation requires a consistent and high quality wind resource in locations with easy access to the distribution or transmission networks. There are some relatively small developments that take advantage of pockets of good wind in the south of Buloke Shire. Coonooer Bridge Wind Farm (20 megawatts) and Yawong Wind Farm (7.2 megawatts) are both located between St Arnaud and Bendigo.

Small-scale wind systems are normally uneconomical due to the high cost of micro-wind turbines relative to solar installations, so micro-wind contributes a negligible amount to energy generation in the region.

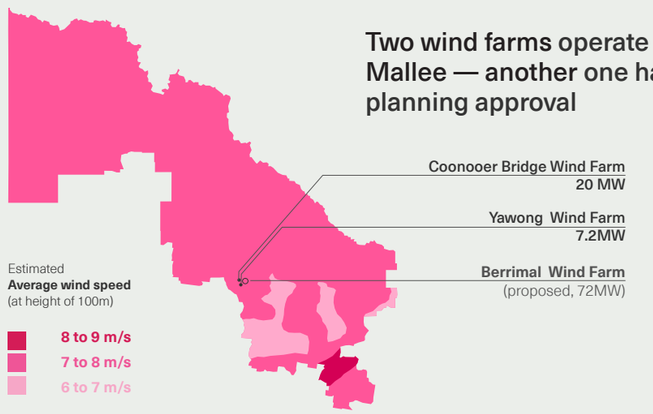
Where next for wind farms

Development of wind energy will rely on localised pockets of strong wind resource near transmission or distribution networks. The Australian Energy Market Operator (AEMO) has identified that the greatest resources are in Macedon Ranges Shire in the very south of the region, and in the southern fringes of Mount Alexander Shire. There's a secondary wind resource of moderate strength in Buloke Shire.

Currently, planning laws prevent the development of wind farms in Macedon Ranges Shire. However, in 2019 the State Government approved a planning scheme amendment to allow a planning permit application to be made for a community-owned wind farm developed by the Macedon Ranges Sustainability Group (MRSG). MRSG is proposing to develop up to eight wind turbines, as well as solar panels and battery storage, with a vision of generating enough electricity to supply every household in the shire. Other land use planning issues are still to be resolved, such as the zoning of the proposed site, a former pine plantation.

In Buloke Shire, a key challenge is the distance to suitable transmission and distribution infrastructure. More investment in the network would be necessary to enable investment in generation in these areas.

Two wind farms operate in Loddon Mallee — another one has planning approval



Local wind farm projects and resource map of Loddon Mallee *sourced from DEWLP and AREMI respectively*

Case study

Locals plug into wind farm benefits

Coonooer Bridge Wind Farm | Sharing benefits with the community

When Windlab set out to build turbines near St Arnaud, the company was sailing into headwinds. Wind farms were a public relations nightmare, with sensitivity high about perceived health issues and the visual impact of turbines.

But consulting the community early, giving neighbours a share, leasing land from hosts and establishing a grants program that promises to give out $500,000 over its lifetime, helped turn the breeze in favour of the Coonooer Bridge Wind Farm.

The $50 million farm has six turbines across four kilometres on one landholding, 90 kilometres north-west of Bendigo. It can generate about 19 megawatt hours of electricity a year—enough to power 14,000 homes. Last year it ran at full power for 49 per cent of the year, making it the nation's best performing wind farm. The Australian Capital Territory buys the equivalent of Coonooer Bridge's power, as part of its target to go 100 per cent renewable by 2020.

Windlab is a CSIRO spin-off company with wind farms in North America, New Zealand and southern Africa as well as in Australia. It co-owns the wind farm with Eurus Energy and locals.

"We offered all the neighbours within three kilometres a parcel of shares, equivalent to 3.5 per cent of the ownership," Windlab's Rob Fisher explains. "Locals could also buy shares. Thirty local shareholders own four per cent."

Neighbouring sheep and cropping farmers Carolyn and Clinton Olive were granted a shareholding and also bought more. "The returns have been excellent—almost 10 per cent," Carolyn says. "And the community grants program, which delivers $25,000 a year, has been a wonderful source of funds for Coonooer Bridge and Yeungroon and the nearby bigger towns of Charlton and St Arnaud."

Recent grants have helped buy a new fire vehicle for Coonooer CFA and improved surrounds at the Yeungroon CFA station.

Photo credit: Coonooer Bridge Wind Farm Pty Ltd.

Land use planning

Often, solar and wind farms are developed on existing agricultural land, and some community members are concerned that they undermine food production. For example, in the Goulburn Murray and Sunraysia irrigation districts, the cost of infrastructure and supplying water is shared between the government and irrigators. If irrigated land is converted to energy facilities, there are fewer irrigators to share those costs. In other cases, however, renewable energy facilities can be co-located with primary production, diversifying farming revenues and providing resilience during droughts.

The Victorian Minister for Planning is responsible for issuing planning approvals for all wind farms and for solar farms over 1 megawatt. Local councils are responsible for assessing and issuing permits for smaller solar farms and for bioenergy facilities.

The State Government has published the Solar Energy Facilities Design and Development Guideline[2] to support the siting, design and assessment of solar farms. The guideline seeks to avoid or minimise impacts on local environments. It stipulates that the impacts on strategically important or high-value agricultural land must be considered in planning applications, and contains provisions protecting declared irrigation districts.

Other land use issues include biodiversity corridors and landscape connectivity, weed and feral animal management, floodplains and water courses, Aboriginal heritage, general amenity, bushfire risk, and impact on national parks or Ramsar wetlands. The guidelines help to ensure that these issues are considered in new planning applications.

Another consideration for land use planning is the need for wind and solar facilities to be located close to transmission and distribution grids. Large facilities—generally above 10 megawatts—often need to be connected to the higher voltage transmission network, whereas smaller facilities can connect to the lower voltage distribution network.

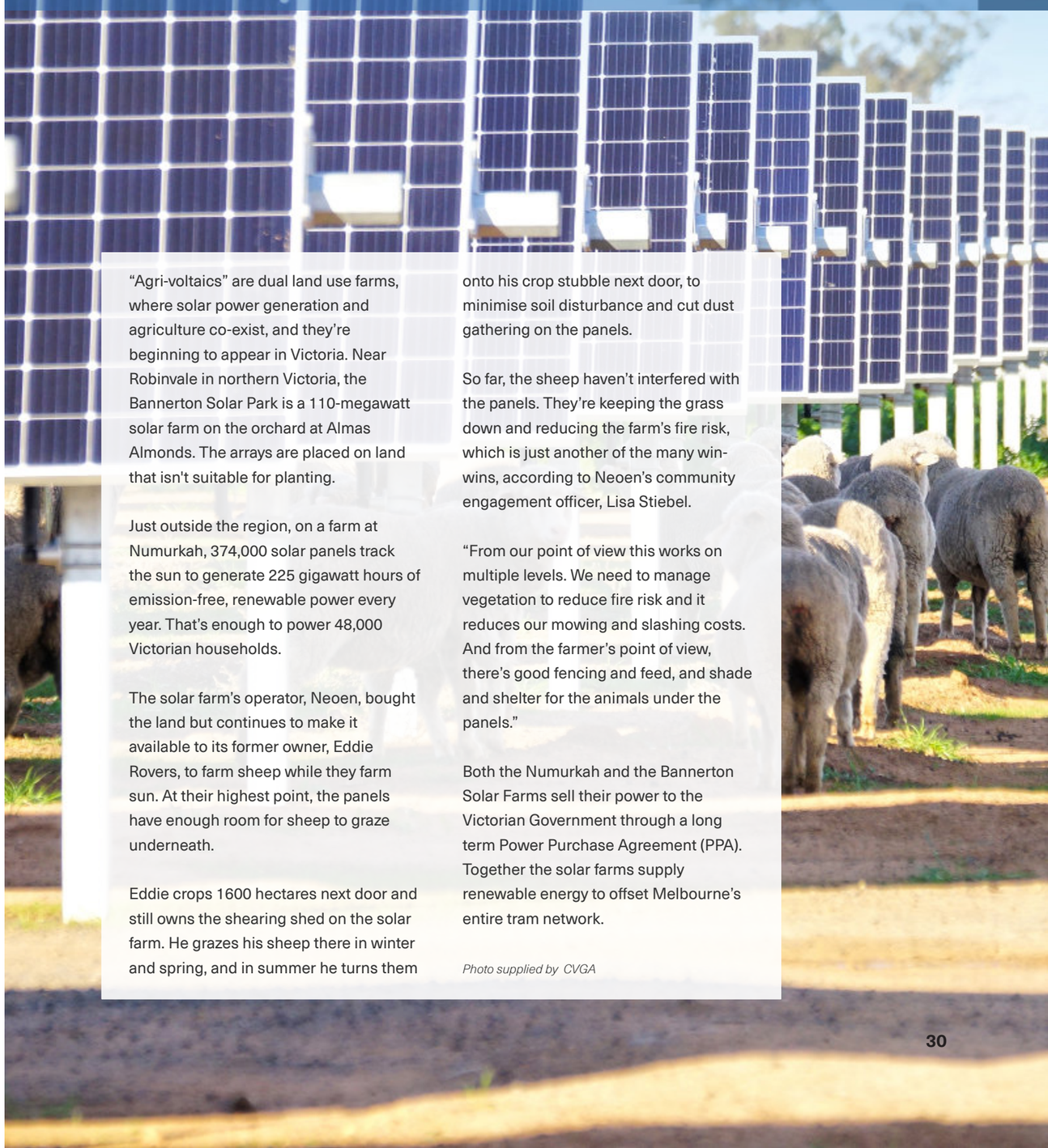
There are currently nearly 3000 megawatts of solar farms constructed, under construction, or with planning approval. If they are built within 1.5 kilometres of the transmission line that runs from Mount Alexander to Mildura, via Bendigo and Kerang (an area of 122,000 hectares), they would require less than 4 per cent of this land.

[2] https://www.planning.vic.gov.au/policy-and-strategy/solar-energy-facilities-design-and-development-guidelines

Case study

Integrating solar farms with agriculture

Bannerton and Numurkah | Agri-voltaic farms



"Agri-voltaics" are dual land use farms, where solar power generation and agriculture co-exist, and they're beginning to appear in Victoria. Near Robinvale in northern Victoria, the Bannerton Solar Park is a 110-megawatt solar farm on the orchard at Almas Almonds. The arrays are placed on land that isn't suitable for planting.

Just outside the region, on a farm at Numurkah, 374,000 solar panels track the sun to generate 225 gigawatt hours of emission-free, renewable power every year. That's enough to power 48,000 Victorian households.

The solar farm's operator, Neoen, bought the land but continues to make it available to its former owner, Eddie Rovers, to farm sheep while they farm sun. At their highest point, the panels have enough room for sheep to graze underneath.

Eddie crops 1600 hectares next door and still owns the shearing shed on the solar farm. He grazes his sheep there in winter and spring, and in summer he turns them onto his crop stubble next door, to minimise soil disturbance and cut dust gathering on the panels.

So far, the sheep haven't interfered with the panels. They're keeping the grass down and reducing the farm's fire risk, which is just another of the many win-wins, according to Neoen's community engagement officer, Lisa Stiebel.

"From our point of view this works on multiple levels. We need to manage vegetation to reduce fire risk and it reduces our mowing and slashing costs. And from the farmer's point of view, there's good fencing and feed, and shade and shelter for the animals under the panels."

Both the Numurkah and the Bannerton Solar Farms sell their power to the Victorian Government through a long term Power Purchase Agreement (PPA). Together the solar farms supply renewable energy to offset Melbourne's entire tram network.

Photo supplied by CVGA

Community benefit sharing

The consultation showed that people want to see the Loddon Mallee taking advantage of the natural resources we have, including by building utility-scale power plants. However, there are differences across the region. Very few objections have been raised to solar farms in the northern councils, but they have proved more controversial in the southern parts of the region.

Community benefit sharing is emerging as an important aspect of renewable energy development. Benefit sharing models have been used around the world for more than forty years, and they are well established for wind energy in Australia.

As the name suggests, community benefit sharing is a way of ensuring the positive outcomes are shared with the local community hosting the project. It is a way for developers and investors to build their social licence, mitigate negative impacts and assist local communities to get the best out of jobs and investment.

- Benefits to the direct neighbours of a project, such as solar installations on houses and community buildings, new or upgraded facilities, free, discounted or priority shares in the project, and once-off or recurring compensation payments.

- Financial support for the wider community, such as sponsorship of local clubs and teams, community grants, and investment in programs tackling social issues such as unemployment or at-risk youth.

- Building skills and the local economy, including opportunities for local contractors and businesses to provide goods and services to the project, and training local people for jobs, either directly or by way of investment in education and training programs.

- In-kind assistance to the local community, such as staff time to support community projects.

- Innovations tailored to local needs, including local energy distribution behind-the-meter, carbon offsets for local businesses, and tourism initiatives.

- Local investment, including community-owned projects, co-ownership (joint ventures), and co-investment (shareholding).

- Optimising compliance for community benefit, such as planting extra vegetation for screening and local ecological benefits, increasing the number of households included in upgrade programs, and improving the aesthetic values of the site.

Which benefits are appropriate will depend on the specific characteristics of the project and the local community. New forms of benefits are likely to emerge as the practice becomes more widespread.

It is crucial that the community benefit sharing strategies are created through a transparent and inclusive consultation process. Two resources offer guidance on best practice: the Victorian Government's *Community Engagement and Benefit Sharing in Renewable Energy Development* [3], and the *Clean Energy Council's Guide to Benefit Sharing Options for Renewable Energy Projects* [4].

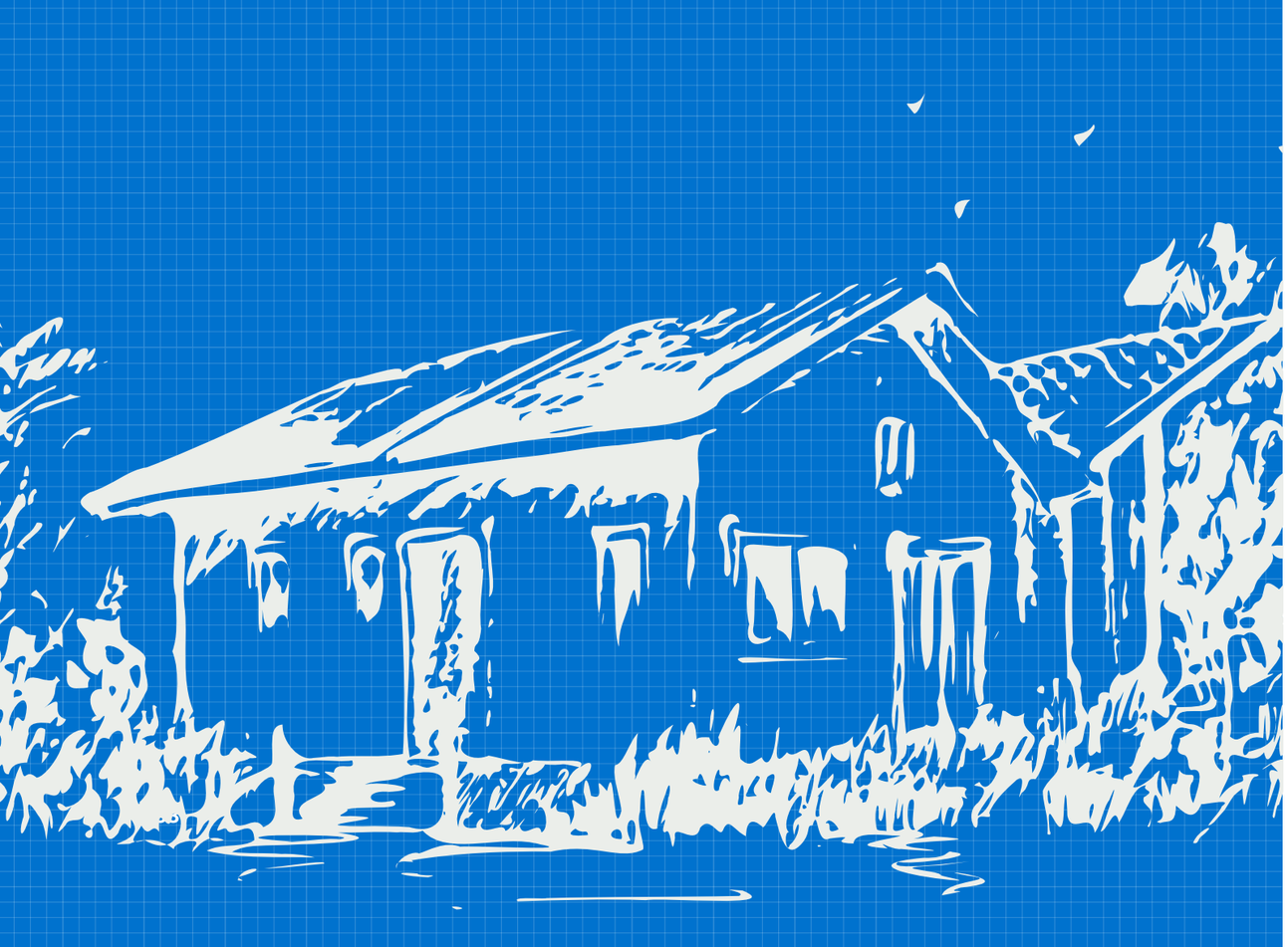
[3] *Resource available online at:* https://www.energy.vic.gov.au/__data/assets/pdf_file/0027/91377/Community-Engagement-and-Benefit-Sharing-in-Renewable-Energy-Development.pdf

[4] *Resource available online at:* https://www.cleanenergycouncil.org.au/advocacy-initiatives/community-engagement/benefit-sharing-for-renewable-energy-projects

View over La Laar Ba Guawa Park, Harcourt

Photo credit: Visit Victoria

Distributed energy resources

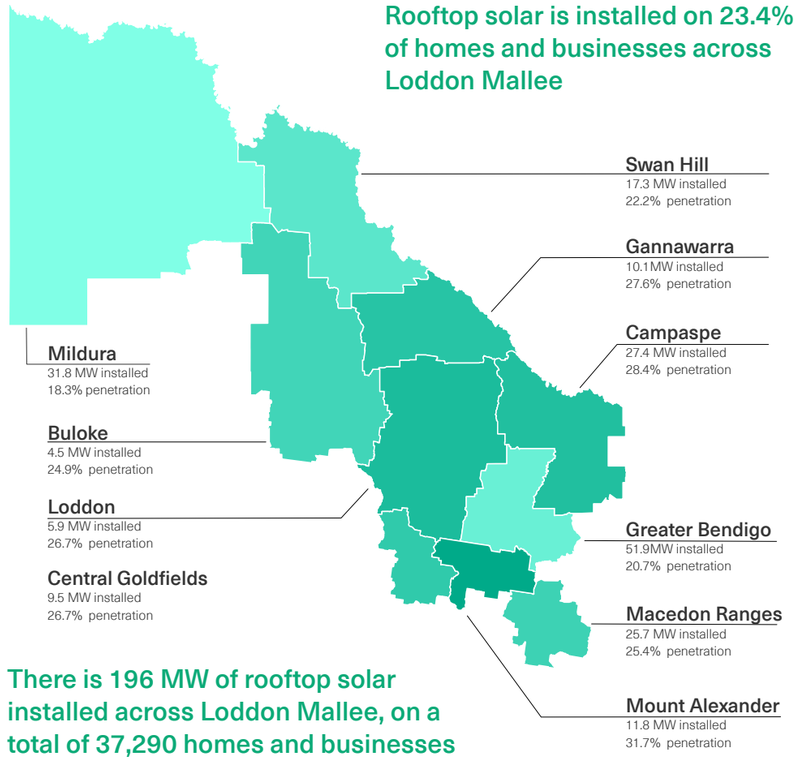


Rooftop solar

The Loddon Mallee community loves rooftop solar. A higher proportion of residents in the region have systems installed than anywhere else in the state. There has also been strong uptake on commercial and industrial roofs. Within the region, Mount Alexander Shire and Campspe Shire have the highest proportion of solar households, and the City of Greater Bendigo and Mildura Rural City have the lowest. In total, there are approximately 150 megawatts of rooftop solar in the region.

Its popularity is due to the abundance of sun and relatively high electricity costs (and therefore, shorter payback periods for solar panels), as well as the relatively insecure electricity supply in some areas. Since 2018, the State Government has offered rebates to residential owner-occupiers who purchase solar panels from an approved installer. The rebates now fund up to half of the system cost, to a total value of $1800.

For businesses, rooftop solar is best suited for industries that use significant amounts of energy during the day, such as manufacturing, refrigeration and supermarkets, because the power they generate offsets more costs. Some



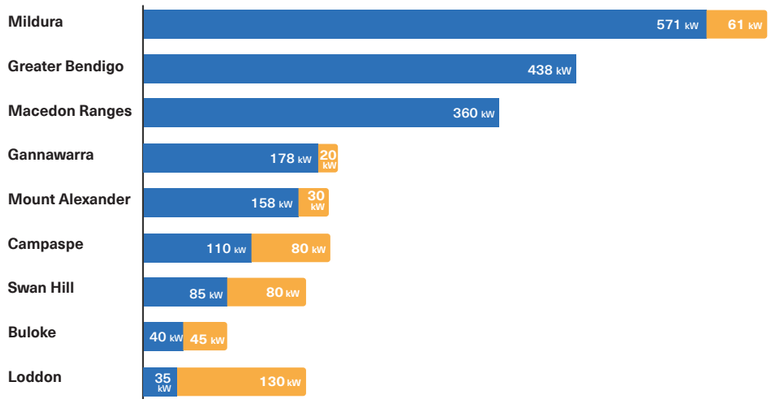
Rooftop solar installed capacity and rooftop penetration

The relative colour represents the rooftop penetration % for each LGA, where a darker shade indicates higher penetration. Data sourced from APVI (to October 2019)

businesses may be able to alter consumption patterns with load shifting appliances, such as hot water systems, or by investing in battery storage. For some primary producers, seasonal consumption means that the business case is more difficult to develop. At certain times of the year, they may not consume the power they generate, and there may be limits on what they can export to the grid.

Local governments have invested significantly in rooftop solar on council buildings, many stimulated by Sustainability Victoria's *Local Energy Savers Program*, which provided funding for energy efficiency audits and matched funding for energy saving initiatives. Mildura Council has installed the most solar, in kilowatts. But as a percentage of net electricity consumption, Mount Alexander and Gannawarra are leading the region, with solar installations accounting for almost 45 per cent of usage. Many Loddon Mallee councils use financial savings from solar systems to fund other energy efficiency upgrades.

There is 2,005 kW of installed on Council buildings across Loddon Mallee, with another 456 kW planned



Installed and planned solar capacity on Council buildings *as of November 2019. Data Collated from Governments in the Loddon Mallee region*

Solar installations on Echuca library (L) and Madden Avenue, Mildura (R)
Photos supplied by Campaspe Shire Council and Mildura Rural City Council

Where next for rooftop solar

In some parts of the region, one in three households has rooftop solar, but in others, uptake remains relatively low. There are significant opportunities for increasing solar penetration for households in the north, and also for agricultural, commercial and industrial customers. As the cost of systems continues to decline, installations will become even more attractive. Powercor expects rooftop solar installations will more than double by 2025, largely driven by the Victorian Solar Homes program[5] and other incentives for business and agriculture.

Many suitable roofs are still empty, especially on rented properties, public, social and community housing, and other low-income households. Large rooftops and vacant land owned or leased by commercial, agricultural and industrial customers could be also used for onsite solar.

The commercial market is more complex than the household market, because there's more variability in size, loads, roof structures, energy tariffs and business cases. Businesses often report that while managing energy costs is important, rooftop solar installations compete for capital budget with other business needs. There are information gaps in this part of the market: the building industry needs to become more familiar with solar; commercial procurement processes could be simplified; businesses could be assisted to develop and assess business cases; and knowledge could be brokered about trusted products and suppliers. Programs addressing these issues would encourage businesses and institutions to take up solar systems.

[5] See Powercor's *Regulatory Reset Draft Proposal 2021-25 available online at:* https://talkingelectricity.com.au/wp/wp-content/uploads/2019/02/Powercor-Draft-Proposal-2021-2025.pdf

Rooftop solar installation in Swan Hill with Gerard Maloney
Photo supplied by: Swan Hill Rural City Council

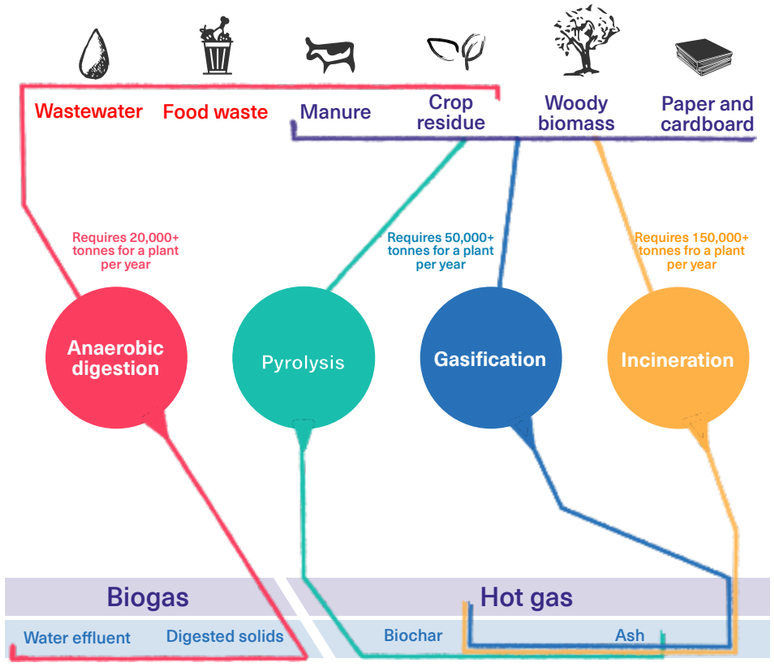
Bioenergy

Biomass is organic matter, usually sourced from plant or animal waste from agriculture and forestry, but also from municipal waste and wastewater. With a large agricultural sector, the Loddon Mallee region has significant opportunities for converting biomass to energy by generating electricity, heat, biogas or even liquid fuels. Bioenergy technologies can also create other useful by-products, such as water, biochar and nutrients.

There are already a number of biomass power plants in the region; for example, using almond hulls to generate electricity and potash, grape crush residues for thermal energy, and effluent from piggeries for gas and electricity.

Bioenergy plants can be scaled to suit the feedstock and the desired use for the heat or electricity. Unlike solar and wind energy, which only generate electricity when the resource is available, biomass can often be stored so it can generate energy when it is needed. When used behind-the-meter by primary producers or industry, bioenergy generation can reduce or avoid the cost of purchasing gas or electricity from the grid. The technology can also contribute to grid resilience by producing synchronous generation, which stabilises local networks.

Types of bioenergy feedstock



Case study

Powered by pigs

Kia Ora piggery | Reducing power bills on farm

Yarrawalla pork producers Jarad and Caleb Smith have reduced their farms power bills by using pig effluent. The brothers run 25,000 pigs across three sites at their Kia-Ora piggery, in northern Victoria. The animals produce 5,000 tonnes of effluent solids every year, which are channelled to three covered anaerobic ponds that hold up to 20 megalitres. As bacteria chew through the effluent, they produce biogas, comprised of 55 to 60 per cent methane and 30 per cent carbon dioxide.

The brothers have modified second-hand Ford Falcon motors, which previously ran on LPG. The motors now provide power for the farm's processing, lighting, heating and cooling. "They're no different to a standard generator, only they run on biogas," Jarad says.

Previously the piggery's total annual power bill was $350,000. Now, part-powered by biogas produced onsite, that bill is more like $230,000.

The co-generation and flaring systems at the piggery use 1.2 million cubic metres of methane a year, reducing equivalent carbon dioxide emissions by 20,000 tonnes. Methane is flared to reduce its greenhouse warming impact.

Jarad believes they can go further. "We have the potential to save a further $15,000 a month on energy if we capture and use the heat from the generators," he says. "We made a lot of mistakes and had to improve things like the gas quality and consistency going to the generators. We've learnt a lot and I'm confident I could do it much better next time."

Photo supplied by CVGA

Loddon Mallee bioenergy resources

Top 3 resources by Local Government Area

Estimates of biomass data for the region in 2015/16
provided by Sustainability Victoria and sourced from the Australian Biomass for Bioenergy Availability Study 2016

Buloke

Straw and chaff	470,000 tonnes
Pig effluent	1,500 tonnes
Oilseed pods	12,000 tonnes

Campaspe

Straw and chaff	185,000 tonnes
Dairy manure	46,000 tonnes
Paper and cardboard	6,000 tonnes

Central Goldfields

Straw and chaff	38,000 tonnes
Oilseed pods	7,700 tonnes
Paper and cardboard	6,700 tonnes

Gannawarra

Straw and chaff	426,000 tonnes
Dairy effluent	24,000 tonnes
Oilseed pods	15,000 tonnes

Greater Bendigo

Straw and chaff	71,475 tonnes
Poultry litter	8,600 tonnes
Pig manure / slurry	5,200 tonnes

Loddon

Straw and chaff	325,000 tonnes
Pig effluent	8,000 tonnes
Oilseed pods	23,000 tonnes

Macedon Ranges

Straw and chaff	7,000 tonnes
Plantation bark	8,000 tonnes
Sawmill wood chip	2,500 tonnes

Mildura

Straw and chaff	550,000 tonnes
Almond husks and shells	80,000 tonnes
Grape marc	16,000 tonnes

Mount Alexander

Paper and cardboard	2,400 tonnes
C&I organics	1,800 tonnes
C&D timber	400 tonnes

Swan Hill

Straw and chaff	30,000 tonnes
Almond husks and shells	60,000 tonnes
Grape marc	3,400 tonnes

Straw bales on farmland in Greater Bendigo
Photo supplied by Greater Bendigo City Council

Case study

A world first

Select Harvest | Bioenergy from hulls

The world's first 'hull to energy' bioenergy plant is within the Loddon Mallee region. For fuel, it relies on almond shells and hulls, as well as nut tree prunings.

The $15 million plant, operating since June 2018, incinerates 30,000 tonnes of almond harvest waste annually to create steam, which is used to produce electricity—about 20,000 megawatt hours per year.

That's more than enough to run Select Harvests' nut cracking plant and the pumps at its nearby dams. The plant completely replaces grid electricity, cutting the company's greenhouse gas emissions by 23,645 tonnes annually—equal to taking 8210 cars off the road. Select Harvests exports one-fifth of the power it generates to the grid.

The combustion process also produces about 30,000 tonnes of potash annually, which is used as fertiliser and spread across the company's 7690 hectares acres of nut orchards around Robinvale, in the Riverina and South Australia's Riverland.

Engineer Mark Davis, from Select Harvests, expects the system will pay for itself within a decade. "The payback period is reasonably good and there's also the potash benefit. In economic terms we're not sure what that is yet, but we're getting good results in terms of tree health and soil quality."

It previously stockpiled waste hulls or sold them as stockfeed. "It's the only plant burning almond shells to create energy in the world," Mark says. "It's been very positive from a sustainability perspective."

Photo supplied by CVGA

Where next for bioenergy

Feedstocks vary across the region, depending on local land use and economic activity. Likely sources are fruit waste (including grape marc), almond hulls, animal waste and effluent (including poultry litter and pig and dairy effluent) and plantation forestry waste. Waste water treatment facilities could be converted to anaerobic digesters, which produce soil conditioner, water and biogas.

Some land-use practices, including old agroforestry techniques, may support the development of biomass industries. For example, Mallee scrub plantings have the potential to provide wind breaks, reduce erosion, restore biodiversity corridors and sequester carbon in their root systems, while also providing feedstock for biomass production. Planting saltbush on marginal and salinity-affected land may present similar opportunities.

The suitability of feedstocks depends on their other applications, location and proximity to the network or other infrastructure. Primary producers would benefit from further work to:

- identify the location and quantity of suitable resources
- provide advice on suitable scale of resource and appropriate plant
- identify opportunities to support demand for electricity and reduce pressure on the grid during peak periods
- showcase technologies and sharing of knowledge about best practices, business case development and implementation processes.

Regional coordination would help to realise bioenergy's potential through the cooperation of local councils, progress associations, distribution network operators, industry peak bodies and state government agencies.

Farmland and livestock in Greater Bendigo
Photo supplied by Greater Bendigo City Council

Emerging technologies

As the electricity system moves beyond fossil fuels, emerging technologies will help manage the stability of the grid, enabling load and generation flexibility. Other technologies will support a shift away from fossil fuels for transport and heating. Many of these technologies are already operating at small scales, while others are still being developed.

'Smart' inverters for rooftop solar systems

Inverters can now respond to conditions on the network to avoid exporting too much electricity and causing voltage issues on the grid. They are already available and are now a requirement for all new solar installations. Over time, electricity networks and retailers may seek to aggregate and control exports from solar inverters as a way of dynamically managing the grid.

Batteries

By using batteries, electricity generated during the day can be stored and dispatched in the evenings or overnight. They help consumers avoid peak prices and assist retailers and network operators to manage electricity demand. Combined with time-of-use pricing, consumers can be paid for providing grid support during peak periods. Batteries are currently being installed by early adopters and businesses that rely on an uninterrupted power supply. Prices remain relatively high but are expected to fall. Powercor forecasts battery uptake will increase fourfold by 2025. The region already has a large-scale battery at the Gannawarra Solar Farm. They batteries will become increasingly important to manage daytime solar generation and peak demand.

Peer-to-peer trading platforms

Using these platforms, consumers will be able to trade excess electricity from home solar and battery systems with neighbours, without relying on electricity retailers. They will give consumers greater choice about which sources of generation they support, and allow electricity revenues to be retained in local communities.

Pumped hydro

During times of low electricity demand, electricity is used to pump water uphill where it can be stored and released to generate electricity. It is a proven technology that will play a growing role in energy storage used to support renewable energy generation. There are three existing pumped hydro plants connected to the National Electricity Market, with several others in development, including the Federal Government's Snowy 2.0 initiative. It is best suited to mountainous or hilly regions. Disused mine shafts around Bendigo have been investigated as pumped hydro reservoirs, but contamination in underground water remains a major barrier.

Hydrogen

When produced from renewable electricity, clean hydrogen can enable the storage and transportation of renewable energy. It can reduce emissions in the transport sector and replace coal in the production of 'green steel'. It could be blended with natural gas supply, used to produce ammonia for commercial and agricultural applications, and exported to trading partners, such as Japan, South Korea and China, as they reduce their dependence on coal and gas.

In Germany, hydrogen fuel cell passenger trains are being introduced to replace diesel trains where there are no electrified lines. Similar trains are being trialled in the Netherlands. Buses powered by hydrogen fuel cells have been demonstrated around the world, including in Western Australia.

The existing technology is expensive and requires large volumes of water. In the Loddon Mallee region, the relative lack of water presents a challenge; however, it may become possible to use other feedstocks, such as biomass, waste water, salt water, or agricultural effluent and waste water from dairies and wineries. Whether hydrogen is produced here or elsewhere, there is potential for electricity from this region to power this emerging industry.

Solar thermal storage

Solar thermal technologies can be used to generate electricity, heat and steam, and provide an alternative to batteries for storage. They include technologies that have existed for a long time, such as solar hot water, and newer systems, such as large-scale concentrated solar plants. Solar thermal collectors can provide energy to drive a cooling cycle that produces chilled water for commercial and industrial cooling. Solar thermal energy can be used to efficiently cool in the summer, and heat domestic hot water and buildings in the winter.

Currently, a significant proportion of peak demand is created by Heating, Ventilation, Air Conditioning and Refrigeration (HVAC&R). Solar thermal storage for cooling and heating applications hasn't been tested in this region, but in October 2019, ARENA announced that it is funding a demonstration project in South Australia, developed by Glaciem Cooling Technologies.

Electric vehicles

Over the coming decade, electric vehicles (EVs) are expected to become common. They will significantly increase electricity consumption and change the way we use it. By way of 'vehicle to grid' technology, they have the potential to smooth out supply and demand, by charging at times when renewable energy resources are abundant and feeding energy back into the grid at times and locations as needed.

Powercor expect a 2000 per cent increase in the number of EVs in the region by 2025. Similar to other forms of DER, it will be important that EVs are integrated into the energy system to avoid creating new network issues. Currently, charging infrastructure is being driven by tourism, because the ability to charge is seen as a selling point for regional towns, but this will change as EVs become more common. Local governments across the region are participating in a statewide project called 'Charging the Regions' aimed at coordinating public charging infrastructure.

Case study

Emerging homegrown technologies

Raygen | Heliostat solar farms

A paddock near Newbridge, 50 kilometres west of Bendigo, is a testing ground for a revolutionary Australian-grown solar thermal technology. The project aims to provide low-cost renewable energy instantly, day and night, using readily available materials.

Its heliostats, or moving mirrors, are each 20 square metres. They reflect light onto a solar panel mounted at the top of a pole. The panel is called 'PV Ultra' and it's 5000 times more powerful than a conventional solar panel.

The light is turned into electricity and heat. Tiny modules in the PV Ultra panel are cooled in a closed loop with water that heats to 92 degrees Celsius and is carried away to be stored. Energy in the hot water can be dispatched when needed.

Raygen's founder and chief technology officer, John Lasich, says: "By-product heat energy from PV Ultra can tap into a range of utility-scale markets, including power storage, hydrogen export, desalination and co-generation for industrial customers."

Currently at Newbridge, three 250-kilowatt towers and their mirrors take up 2.8 hectares, generating 3 megawatts of co-generation. Sheep graze underneath. ARENA has invested almost $8 million to scale the site to an industrial level.

Some of the electricity is used at a nearby mushroom enterprise and the rest goes into the grid. ScatoPlus produces 550 tonnes of inoculated mushroom compost each week, for distribution to 15 mushroom farms around Australia and the Pacific Islands. "We're currently only using the electricity, but we're hoping to use RayGen's energy for heating and cooling to fruit mushrooms on site," director Mick Surridge says.

Photo supplied by CVGA

Case study

Batteries are back to the future for Bendigo trams

Bendigo's first tramway opened in 1890, running through the city from the railway station to the nearby Borough of Eaglehawk—a distance of four miles, or 6.4 kilometres. Built by Brush Electrical Engineering Company, the trams were powered by batteries. At the end of each round trip, the tram would return to the depot, where the bank of batteries was removed from under the seats and a new bank fitted, ready for the tram to go again.

It was not all smooth sailing though; trams made the journey to Eaglehawk comfortably, but their batteries often went flat on the return trip. When that happened, the system reverted to a horse-drawn tramway—and any nearby horse was commandeered to the service.

In 1989, the dilapidated body of an old battery tram was found in Elmore. By 1999 it was back at the Bendigo tram depot, with planning underway to restore it to tourist services as part of the Bendigo Tramways heritage fleet. Much of the work is now complete, but it still needs a solution for its energy storage, propulsion and control system.

Bendigo Sustainability Group, Community Power Hub Bendigo and Bendigo Heritage Attraction are looking for a partner with the technological capability to support the tram's equipment and operating systems design. Given how fast the technology is moving, it may not be long before Battery Tram #3 is once again rolling the rails of Bendigo, under its own power.

Photo credit: Bendigo Heritage Attractions

Energy efficiency

Efficiency reduces the demand for electricity, alleviates pressure on the grid, and minimises the need to build new generation infrastructure. It also eases the load on existing generation assets, and can reduce demand during peak periods when the risk of blackouts is high. These initiatives cut bills for customers and often have very short pay-back periods.

The Loddon Mallee community said that energy efficiency should be the first step in any process of energy transition—it should be considered before installing new generation. There are considerable opportunities for households and businesses to reduce energy bills through simple energy efficiency measures.

> ***Focussing on generation detracts from the other, more important, measure of aiming to increase efficiency and reduce the amount of power household and industry need to use. I would like to see both these areas worked on together as part of a solution***
>
> *—Central Goldfields resident*

Energy demand could be reduced in almost all sectors in the region—residents, businesses and industry. For households, the Victorian Energy Efficiency Target provides a subsidy for efficiency upgrades, by way of a tradeable certificate scheme. So far, it has delivered lighting, weather sealing, insulation and hot water upgrades. The scheme is updated regularly to include new technologies.

Six councils in the region offer Environmental Upgrade Agreements, which enable commercial property owners to access long-term finance for energy efficiency, energy generation or water saving initiatives. These councils are Campaspe, Greater Bendigo, Central Goldfields, Macedon Ranges, Mount Alexander and Mildura Rural City. The loans are repaid through council rates and remain with the title if the property is sold. This means loan terms can be longer than standard, and the resulting lower repayments can significantly reduce energy efficiency payback periods. Under the State Government's Agriculture Energy Investment Plan, primary producers can access free on-farm energy assessments and may be eligible for farm energy grants.

Demand response (DR) is the term for energy users voluntarily reducing their electricity use, and thereby helping to keep the grid stable by balancing supply and demand. It can also offer significant savings, particularly for large commercial and industrial customers with discretionary loads. For example, a water company may be able to shut off its pumping at peak periods a few times per year without affecting its operations. Powercor has also been trialing DR programs with households. The Energy Partner program financially rewards households for reducing energy for a few hours on certain days during summer.

Case study

Financing renewables

K. Englefield Winegrape Services | Finance deal on solar boosts freight company's bottom line

For a Mildura food freight specialist, installing solar power on their truck shed was a no-brainer. That's because they could do it using debt billed along with their rates by the local municipal council.

K Englefield Winegrape Services freights winegrapes, citrus and dried fruit from paddocks to processors with a fleet of 40 trucks. The business sought Environmental Upgrade Finance (EUA), which provides finance for projects that reduce costs by installing renewable energy, water saving, and waste reduction measures.

Englefield's 51.9 kilowatt system, comprising 102 solar panels, slashed their quarterly power bill to$500 from up to $$4000. They reduced their greenhouse gas emissions and boosted their bottom line. They use about 20 kilowatt hours and export more than that. Power bill savings from the solar system exceed their $1100 per month repayments, making the deal cash flow positive. "It more than halved our power bill, which was a significant cost. And because we don't hold the debt, this meant we built equity in our business immediately," Englefields' part-owner and manager Simon Gee says.

Environmental Upgrade Finance became available in 2013. Provided by the privately-backed Sustainable Australia Fund, it's now backing projects in businesses across 35 municipalities in Victoria, offering repayment arrangements through councils. "The quid pro quo is that the municipality has a stronger business in the community and one that's reducing emissions or waste or water use," says EUA Business Development Manager James Wark. "We offer terms of 10 to 20 years and the longer the loan, the greater the benefit to the bottom line."

Photo supplied by Mildura Rural City Council

www.sustainableaustraliafund.com.au

During community engagement process, people consistently identified the need to deliver energy savings to all members of society, not just those who can afford to install solar panels. They also noted that lower income and vulnerable households stand to benefit disproportionately from energy efficiency upgrades that deliver ongoing budget savings. The region needs an increased focus on upgrades for these residents, including those in public, social and community housing.

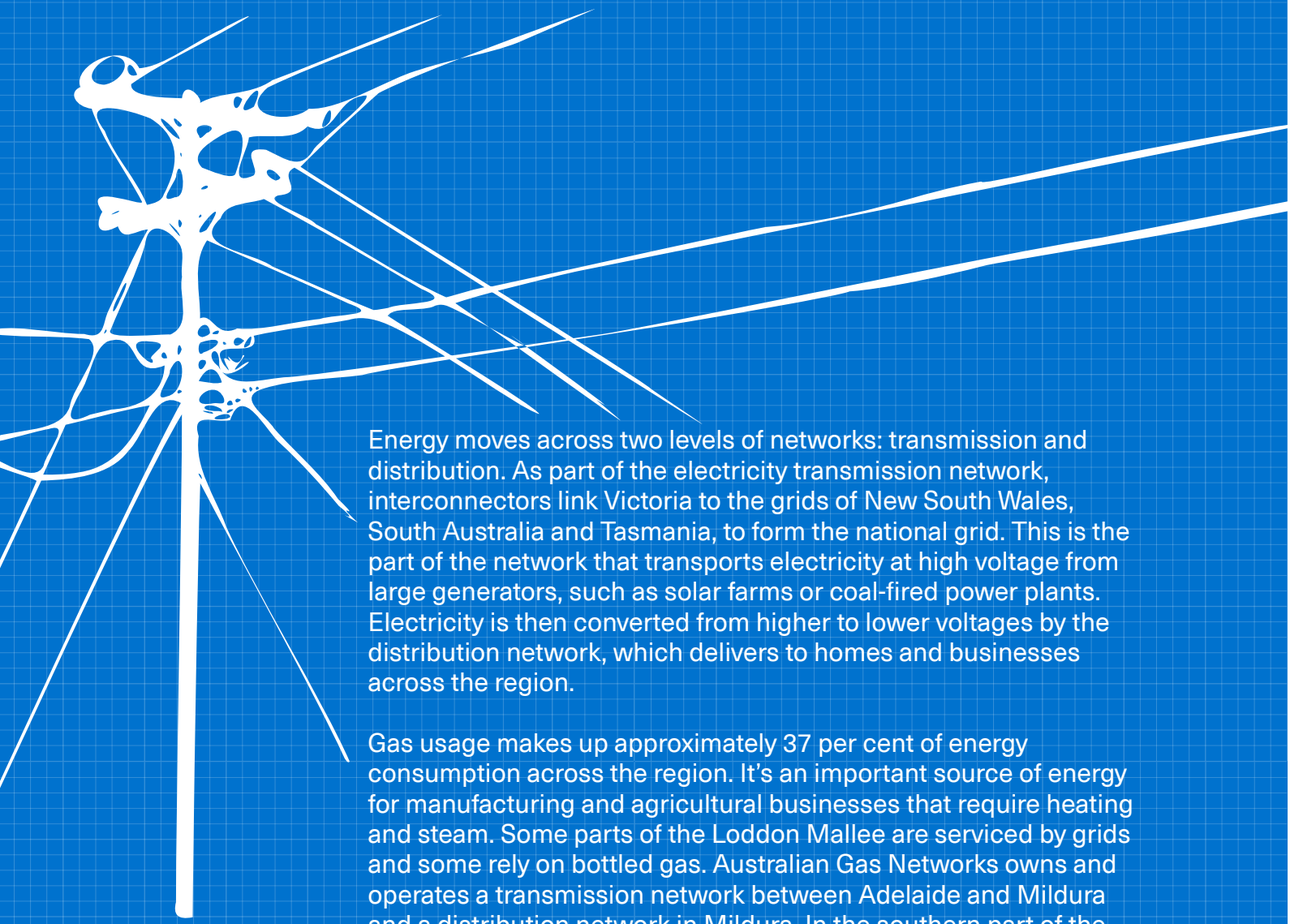
Institutions and the industrial and commercial sectors also need to undertake energy efficiency audits and implement energy management plans. There are a range of government incentives and financial products available today for businesses to undertake energy efficiency measures.

Demand response will also be critical in the shift to renewable energy. The Australian Energy Market Commission (AEMC) is considering a rule change to incentivise energy users to curb electricity consumption during peak demand periods when wholesale prices spike, or there is a shortfall of supply. It would mean that by reducing demand, surplus power could be sold back into the grid, as 'negawatts'. It is expected that by 2020, demand response could remove the equivalent of 2000 megawatts from the grid as needed.

Where next for energy efficiency

Commercial solar installation at Swan Hill (top), home solar at Faye and Maxwell Palmer's residence in Swan Hill (lower right), and the Mildura Eco Village Education Center (bottom left)
Photos supplied by Swan Hill Rural City Council and Mildura Rural City Council

The grid



Energy moves across two levels of networks: transmission and distribution. As part of the electricity transmission network, interconnectors link Victoria to the grids of New South Wales, South Australia and Tasmania, to form the national grid. This is the part of the network that transports electricity at high voltage from large generators, such as solar farms or coal-fired power plants. Electricity is then converted from higher to lower voltages by the distribution network, which delivers to homes and businesses across the region.

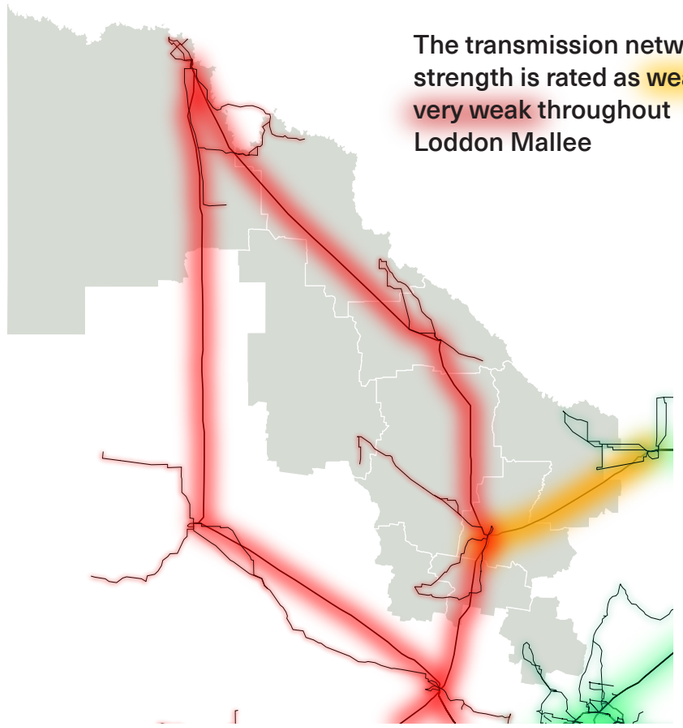
Gas usage makes up approximately 37 per cent of energy consumption across the region. It's an important source of energy for manufacturing and agricultural businesses that require heating and steam. Some parts of the Loddon Mallee are serviced by grids and some rely on bottled gas. Australian Gas Networks owns and operates a transmission network between Adelaide and Mildura and a distribution network in Mildura. In the southern part of the region, the distribution network is owned by Ausnet Services.

Transmission

When electricity is transported over large distances, some is lost to heat. These losses can be large or small, depending on how far energy has to travel, the quality of the powerlines and how much energy is flowing through the line—more energy can lead to more heat and more losses. High voltage lines allow electricity to be transported over large distances without significant losses; on average, about 3 per cent over 1000 kilometres.

Customers only pay for the electricity that arrives. AEMO calculates a measure of the physical losses on the network in different locations, allowing proponents of new generation to factor in the cost of physical losses as they make decisions about where to invest.

In the Loddon Mallee region, more and more generation is being connected to the periphery of the network, where it has to travel further and the grid is weaker and more easily overloaded. The transmission network in the region is becoming increasingly constrained, limiting the capacity of new generators to export energy into the grid. As a result, generators are seeking to move further south in the region, to areas with more grid capacity.



Map of high voltage transmission lines in Loddon Mallee.
Network strength is adapted from the AEMO 2018 Integrated System Plan

Distribution

In the Loddon Mallee region, the distribution network is owned by Powercor. It transports power from transmission infrastructure to large industrial and commercial customers, households and businesses. It also has interconnection points for generation, and a small number of customers requiring high voltage supplies.

First, electricity is transported to a terminal station at 220 kilovolts or higher. From there, it moves via a sub-transmission network at 66 kilovolts. Most of this network is configured in loops to maximise reliability, however some areas are supplied by radial 66 kilovolt lines. Electricity is converted at zone substations, to 22 or 11 kilovolts, and transported across high voltage distribution lines to substations.

Like the transmission network, the distribution network experiences losses as it transports electricity. In 2017-18, Powercor lost nearly 6 per cent of the total energy it procured for the network. One of the causes is SWER lines, usually in remote and sparsely settled rural areas. SWER lines operate at a nominal voltage of 12.7 kilovolts, unlike the rest of the high voltage distribution network, which operates at 22 kilovolts.

Some parts of the network are stronger than others. The Charlton substation zone is subject to outages, because of its remote location. This area services a large portion of the Buloke Shire, as well as small parts of Swan Hill, Gannawarra and Loddon Shires. The zone substation is supplied by one very long radial sub-transmission line from Bendigo. At the time of writing Powercor has not considered it cost effective to upgrade; however, it is considering alternatives to improve supply.

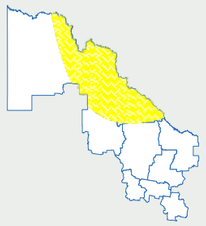
Other vulnerable areas include towns and communities serviced by single radial lines, either three-phase 22 kilovolt, single-phase 22 kilovolt, or SWER lines. Powercor has also identified a number of zone substation constraints, including Eaglehawk, Bendigo and Merbein.

The electricity grid Loddon Mallee
Photo supplied by CVGA

The region's transmission network requires significant investment. Typically, for network upgrades to occur they need to undergo a cost-benefit analysis known as a Regulatory Investment Test (RIT). Both transmission and distribution networks undertake these tests to determine the most cost effective solution. For transmission, these are called RIT-T, and for distribution, RIT-D.

A recent decision by AEMO will see minor augmentations to existing lines in the Murray River Renewable Energy Zone (REZ) in the north, increasing capacity by 10 to 20 per cent. This could allow 400 megawatts of additional generation to connect to the grid.

Other transmission upgrades being considered would connect the network in northern Victoria with transmission lines to South Australia and New South Wales. These upgrades would significantly increase the potential for electricity from northern and western Victoria to be exported to the national grid, and enable the construction of additional generation in Victoria.



Location of the Murray Renewable Zone in Loddon Mallee (yellow).

A RIT-T is underway for a second interconnector between Red Cliffs in Victoria and Buronga in NSW for the proposed Project Energy Connect (formerly known as RiverLink), which will link Robertstown in SA to Wagga Wagga in NSW. It is being considered by the Australian Energy Regulator.

A third option being explored is a new connection between Kerang and NSW, to connect to the planned Snowy Hydro 2.0 project. This is known as the Kerang Link and could unlock a minimum of 2000 megawatts in the Loddon Mallee region.

There are significant challenges in upgrading network infrastructure. One key issue is the length of time for planning approval compared with the pace of energy transition. Already, almost 4000 megawatts of large-scale solar generation is being considered for the northwest Victoria, and nearly half of this has received planning approval. The RIT-T process is important to avoid any real or perceived network 'gold-plating'. However, after all planning processes are completed, it can take up to a decade before upgrades are built. In the meantime, developers may choose to go elsewhere.

The AEMC is reviewing the coordination of generation and transmission investment, to support lowest-cost connections for new wind and solar and increase certainty that generators will have access to transmission capacity.

Another critical issue is how upgrades are funded, whether by consumers, governments, underwriting, or private developers. A combination of all of the above is possible, in which risks and benefits are shared between different parties.

Where next for transmission and distribution

Managing Distributed Energy Resources

Technologies such as solar PV, batteries, EVs, and water heaters and pool pumps with controllable loads are referred to as Distributed Energy Resources (DER).

With the rise of rooftop solar and other forms of small-scale generation, distribution networks must now manage electricity flowing multiple directions; to and from consumers. Solar inverters operate at a higher voltage than the grid, to ensure that unused solar in the home can be pushed back into the network for others to use. As a result, the local network voltage can rise if lots of systems do this at once. If voltages rise too much, solar inverters 'trip' and no longer provide solar to the grid or the customer.

With the roll out of the Victorian Solar Homes program in 2018 and 2019, Powercor has received a 75 per cent increase in solar connection requests.

More and more households across the region seeking to connect solar are either restricted or cannot export energy to the grid at all. This is the case in weak areas of the network, or where there is already a lot of rooftop solar, such as in the Mount Alexander and Macedon Ranges Shires. These export limits are creating equity issues, because they operate on a 'first-in, best-dressed' basis.

Despite the challenges it is creating, solar can also put downward pressure on network costs and wholesale prices. Powercor have proposed measures to enable more solar on the grid, including upgrading some local infrastructure and dynamically controlling inverters, and it anticipates that the benefits of its proposals will triple the costs. The Australian Energy Regulator will decide whether or not these upgrades go ahead.

Where next for Distributed Energy Resources

Nationally, DER are forecast to deliver almost half of all electricity supplied by 2050. Consumers across the region will seek to play a more active role in the electricity system, whether to reduce energy bills, seek independence, or reduce greenhouse gas emissions. Some technologies, such as EVs, will also change energy consumption patterns, because households and fleets will plug into the grid to charge and discharge.

DER can provide significant benefits to the network and customers, but the energy system will need to adapt to ensure it is clear how and where DER are being used, and that they can be aggregated and controlled. There is potential for different market participants to emerge. For example, third party businesses may work with households and businesses to provide new energy management services. Solar systems, batteries and other technologies could be rolled into a portfolio of assets that can be traded in real time, delivering energy market and network benefits.

Case study

Farm group ventures into solar power research

Birchip Cropping Group - demonstration microgrid

Early in 2019, Birchip Cropping Group switched on a solar-powered, electric microgrid at its on-farm laboratory in the Mallee. The group is a leader in farmer-driven, practical and innovative agricultural research.

The microgrid includes more than fifty 1-kilowatt solar panels spread across three buildings, facing different directions, four inverters and a 137-kilowatt battery to store energy, plus a remotely managed Energy Management System. It's connected to mains power.

BCG's Cameron Taylor says that on current trends, BCG's annual power bill will drop from $13,000 to $1000. The system demonstrates what's possible as farmers seek to diversify incomes amid rising climate variability.

"We want to show how energy can be generated, stored and used on site and the technology that's required to do this, so farmers and others businesses can see for themselves how it works," Cameron says. "We are in a really good spot for solar, and if a farmer can generate an income from that, it diversifies their risk."

Different roof slopes and orientations demonstrate how to maximise solar capture. At night, the battery powers BCG's laboratory, where grains and other fodder are dried to test for nutrient and dry matter content. The lab runs over summer for six months a year, post-harvest.

BCG invested $126,000 and received a $210,000 grant from the Victorian Government's Microgrid Demonstration Initiative. Based on reduced grid energy use and rising power costs, it's expected to pay for itself in seven years, but Cameron thinks it might happen even sooner. "We'll see, given that prices are expected to rise further," he says.

Photo credit: Birchip Cropping Group

Climate change

In coming decades, the Loddon Mallee is projected to experience hotter and drier conditions and more extreme weather events, such as storms, flooding and bushfire, due to climate change. It will undermine the security and reliability of energy supply. Now, at this time of transition, we have an opportunity to consider how to improve energy resilience across the region.

Climate change will affect the grid by shaping energy demand and also by directly impacting electricity infrastructure. For example, as both temperatures and the frequency and length of heatwaves rise, increased air conditioning will lead to higher summer peak demand consumption. This, in turn, could lead to higher energy prices and network outages.

Extreme weather undermines the operation of the grid. For example, in January 2018, about 48,000 households in Victoria were left without power after a heatwave caused network faults such as blown fuses and failed transformers. Under extreme temperatures, electricity infrastructure can also worsen bushfire risk; transmission lines can sag below height limitations in hot weather as they expand and become heavier, and thereby increase the risk of grass fires.

As the region transitions to more renewable energy, there are opportunities to improve energy resilience. Generally speaking, a more distributed energy system can reduce its vulnerability to severe weather events by reducing reliance on long lines and multiple poles. However, severe localised weather events, such as floods and bushfires, still pose risks. In the most resilient system, any particular household or business would be able to operate independently, while being connected to a local grid, which itself can function independently from a centralised system when necessary.

A number of communities expressed interest in microgrids to deal with local energy supply issues, including in the Buloke Shire and more remote regions of Gannawarra. A microgrid could continue to operate independently when there is a threat to the grid supply. It not only increases energy security for customers within the microgrid, but also reduces the burden on the main grid.

Etiwanda wetlands, Mildura
Photo supplied by Mildura Rural City Council

Case study

Clean and secure energy to build climate resilience

The small town of Tarnagulla, in Loddon Shire, recently developed a climate resilience action plan. Like many other rural and regional communities, Tarnagulla faces ongoing challenges—unreliable electricity, long distances from business opportunities, and a lack of adequate public transportation and medical facilities. It has a high risk of bushfires, as well as occasional floods, droughts and storms. Its population is getting smaller, and those who remain are getting older.

Climate change will exacerbate many of these challenges, by way of harsher and longer bushfire seasons, longer and more severe heat waves, and flooding. Secure and reliable energy infrastructure is critical in emergencies, because it supports other essential services, such as telecommunications, health care, and water pumps.

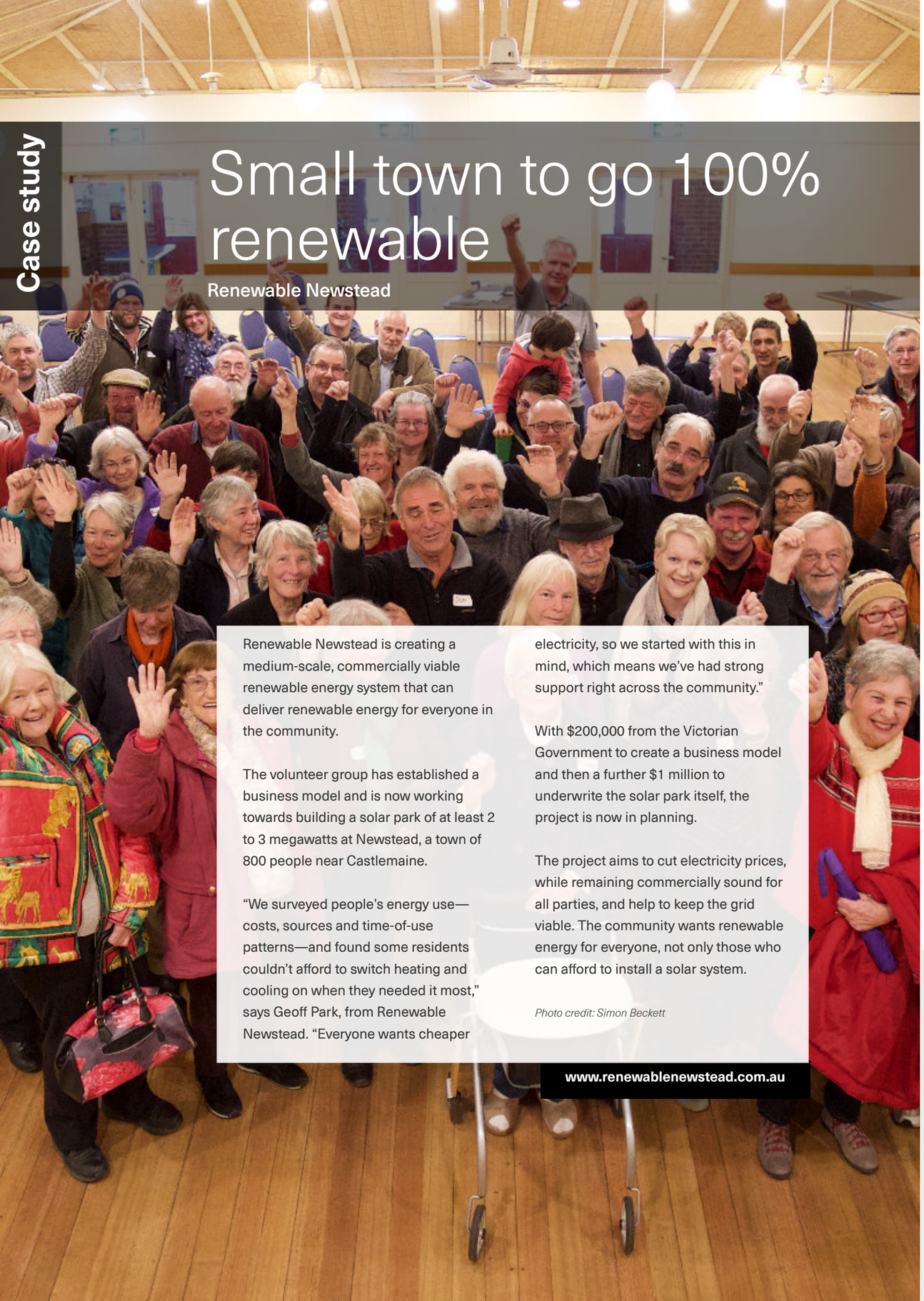
As part of its long term vision, the community identified a desire to become more energy self-sufficient and to achieve this through renewables. To do so, it will need to collaborate with local and state government and electricity networks.

Photo credit: Linda Kennedy

Case study

Small town to go 100% renewable

Renewable Newstead



Renewable Newstead is creating a medium-scale, commercially viable renewable energy system that can deliver renewable energy for everyone in the community.

The volunteer group has established a business model and is now working towards building a solar park of at least 2 to 3 megawatts at Newstead, a town of 800 people near Castlemaine.

"We surveyed people's energy use—costs, sources and time-of-use patterns—and found some residents couldn't afford to switch heating and cooling on when they needed it most," says Geoff Park, from Renewable Newstead. "Everyone wants cheaper electricity, so we started with this in mind, which means we've had strong support right across the community."

With $200,000 from the Victorian Government to create a business model and then a further $1 million to underwrite the solar park itself, the project is now in planning.

The project aims to cut electricity prices, while remaining commercially sound for all parties, and help to keep the grid viable. The community wants renewable energy for everyone, not only those who can afford to install a solar system.

Photo credit: Simon Beckett

www.renewablenewstead.com.au

Fuel switching

There is a significant trend away from gas, as households and businesses are shifting energy usage to electricity. Gas prices have been increasing and the cost of efficient electrical appliances is decreasing. Among local governments, this trend is also driven by the need to reduce greenhouse gas emissions from fossil fuels.

However, for some businesses, gas is critical to produce heat and steam, and there are few equivalent electric technologies. As fewer consumers connect to the gas grid, there is a risk that remaining customers are left to pay higher network charges. It is critical that these businesses are supported to transition from gas to renewable energy technologies, such as bioenergy and solar thermal.

Off grid and microgrids

The Loddon Mallee region is a vast area, covering remote locations. As a result, many residents are entirely off grid. They have Stand Alone Power Systems (SAPS), typically comprised of solar and batteries, with a diesel generator for backup. Similarly, because the gas network is limited to Mildura and the southern part of the region, many consumers rely on bottled gas.

Across the region many areas are serviced by long Single Wire Earth Return (SWER) lines, which incur higher distribution losses than other lines. Off grid systems in these areas would improve energy reliability for customers and reduced network costs for everybody else.

Communities in rural areas are very interested in the development of microgrids and more localised energy supplies. Microgrids vary, but in general, the term refers to the ability to separate, or 'island', a consumer or group from the main electricity grid, either permanently or temporarily.

Stakeholders in the region need to understand how microgrids could work for remote and fringe-of-grid customers and towns. Developing and sharing this knowledge will require collaboration with Powercor, energy market bodies, local and state governments and the communities themselves.

The AEMC has proposed a range of regulatory changes to enable distributors to supply customers with SAPS where it is cheaper than maintaining grid connection. If the Australian Energy Regulator approves these changes, it may create opportunities for change in the Loddon Mallee region.

Where next
for off grid and microgrids

Supporting local economies

A growing renewable energy sector creates a range of economic benefits for the Loddon Mallee region. It brings short-term and long-term jobs and stimulates the local supply chain during construction. It could also deliver a cheaper and more reliable electricity supply. For councils, there's another plus—large-scale renewable energy projects add to the rates base.

Employment

The renewable energy industry has the potential to become a major driver for employment growth in the region, particularly during construction, but also by creating ongoing direct and indirect jobs.

In 2016, there were 372 people employed in the energy sector in the Loddon Mallee region. In recent years, the number of jobs has grown as development has increased. Completed renewable energy projects are estimated to have created 898 jobs in the region during construction, with a further 2601 supply chain and support jobs created elsewhere in Victoria.

While some employees and contractors engaged in the development of large-scale wind or solar farms live locally, the workforce also comprises transient and drive-in-drive-out workers. They boost the local economy by eating out and purchasing accommodation, groceries, cleaning and other services, which in turn, creates a multiplier effect via their local suppliers. Modelling estimates that during construction, completed renewable energy projects have contributed over $300 million to local economies. The solar and wind farms approved or currently under construction are projected to create more than $500 million for local economies, and over 1500 local jobs during construction, and over 7000 jobs across the state.

Renewable energy power plants require ongoing maintenance and operational staff. Although there are fewer ongoing roles, these employees are more likely to be based in the region. Economic modelling indicates that existing projects in the Loddon Mallee are already contributing nearly 400 ongoing jobs across Victoria, nearly half of which are in the region. It is estimated that the currently approved solar and wind farms, together with a doubling of rooftop solar in the region, will create nearly 500 more ongoing local jobs and more than 500 elsewhere in the state.

The rooftop solar industry has experienced inconsistency in demand in 2019. The Victorian Government's 'Solar Homes' program, has resulted in to spikes and troughs as homeowners anticipated the release of subsequent grant rounds. The State Government is taking action to mitigate this instability. Reports suggest there has been a downturn in employment in this sector.

Building the workforce

The renewable energy sector faces difficulties hiring suitable construction staff, particularly electricians, roofers, site supervisors, PV designers and electrical trade assistants. Shortages in these trades are likely to continue, because unemployment is relatively low in the Loddon Mallee region. In smaller communities in particular, there are few available local workers. However, targeted employment initiatives have the potential to deliver meaningful and lasting change to people's lives. Engaging young people, traditionally disadvantaged groups, and the long-term unemployed can increase workforce participation, while teaching people new skills and improving their prospects for ongoing employment.

At the Karadoc Solar Farm near Mildura, of the 200-strong workforce engaged to build the project, 90 people had been long-term unemployed, 38 were Aboriginal, 14 were from other culturally and linguistically diverse backgrounds, 12 were on community corrections orders, and four people had a disability. Out of 25 new electrical apprenticeships, nine places were filled by Aboriginal people. Many of the employees who had been long-term unemployed went on to find other work after the completion of the project. Building the workforce in this way not only provides opportunities for people, but also establishes the skills required for future construction projects and ongoing maintenance and operational roles.

View over the Echuca Business District (opposite)

Photo supplied by Campaspe Shire Council

Example

Payment in Lieu of Rates (PiLoR)

Contributing revenue to local Council budgets

Electricity generators contribute revenues to local governments in the form of 'Payments in Lieu of Rates'. These payments apply to coal, gas, hydro, wind and large-scale solar generation. PiLoR revenues can be negotiated between councils and generators, but a methodology exists for calculating the applicable charges. Payments vary according to the scale of generation. For example:

Capacity	Estimated annual payment
50 MW	$115,650
100MW	$176,900
200MW	$299,400
250MW	$360,650

These payments are significant. In the case of a hypothetical council with a total annual revenue of $29 million and rates revenue of $13 million, a 100-megawatt solar farm would contribute nearly 1.4 per cent of rates revenue. Five 100-megawatt solar farms would contribute 3 per cent of the council's total revenues.

Annual increases to Victorian councils' rates are capped, but PiLoR is outside the cap. They are an opportunity for councils to increase revenues during difficult operating environments.

Taking advantage of the boom in renewable energy will depend on the region's ability to coordinate economic engagement and direct programs and initiatives to benefit the community. Sustaining short-term opportunities will require ongoing investment certainty, supportive government policies, and improvements to transmission and distribution networks—which themselves would also create more employment.

The Loddon Mallee should try to capture these supply chain benefits locally by preparing workers and businesses, so the industry doesn't depend on external suppliers. A stronger local service and materials supply chain will also add value for project developers, by reducing delays and transport costs and giving them access to local knowledge. There are opportunities for local governments, progress associations, chambers of commerce, or industry peak bodies to collaborate and establish renewable energy service hubs in regional centres such as Mildura, Bendigo and Swan Hill.

This may involve engaging with the business sector to identify opportunities for training and skills development, and raising awareness about the skills and capabilities the industry requires. Industry associations may be able to promote open tenders and opportunities to supply services to projects when they are announced, as well as liaise with developers to identify project needs and communicate these to local suppliers.

Where next
for local employment and workforce

Renewable energy employment opportunities

Large scale project development and grid upgrades

- Electrical engineering
- Civil engineering
- Surveying
- Linesmen
- Project managers
- Civil contractors
- Earth moving
- Labourers
- Technicians
- Electricians
- Electrical commissioning
- Planning and environment managers transport
- Road construction
- Fencing hire,
- Crane hire
- Security services
- Water supply
- Revegetation

Operation, maintenance and repair

- Supply of parts
- Maintenance technicians
- Site and environmental management and care (pest control, fencing, road maintenance, lighting, etc)
- Panel cleaning
- Monitoring and control
- Energy performance contracting
- Mechanical,
- Minor site construction
- Security services
- Community and stakeholder relations,
- Regulation and policy
- Road maintenance
- Storage and warehouse management
- Professional services (human resources, finance, regulatory, management)

Raygen Heliostat Solar facility in Newbridge (top) and construction work on Potts Road in Taradale (bottom)

Photos supplied by CVGA and Mount Alexander Shire Council

Rooftop solar

- Installers
- Cabling
- Warehouse
- Office management and office accommodation
- Sales
- Distribution and logistics
- Materials and supplies
- Retail
- Catering
- Cleaning
- Security
- Professional services (management, finance, Human resources, etc)

Supply chain benefits for large scale developments, grid upgrades

- Quarries
- Concreting
- Road construction
- Bridge works
- Accommodation services
- Catering
- Cleaning
- Transport
- Groceries and local retail
- Building maintenance and repairs
- Construction
- Fencing
- Security services,
- Traffic control
- nurseries
- Gardening
- Communication and Promotional (graphic design, videography, printing etc)
- Professional services (finance, consulting, town planning, stakeholder management, policy and regulation, etc)
- Materials (cabling, lighting, fencing, quarried supplies, temporary buildings, cabinetry, plumbing, site management, civil works etc)

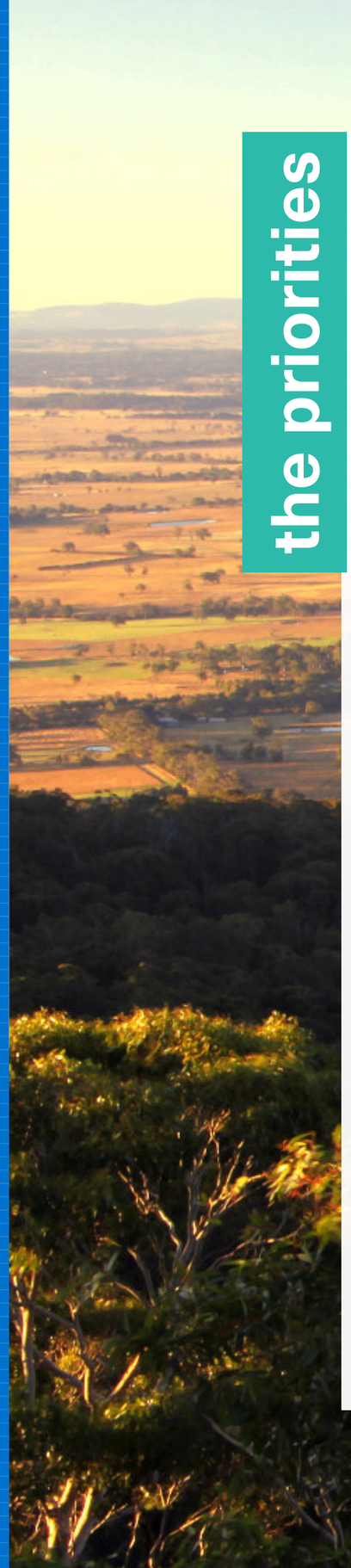
Installing solar in Loddon Mallee (top), outside the Red Cliff Country Market (middle) and the Bendigo wholesale food market (bottom)

Photo credits: CVGA (supplied), Visit Mildura and Visit Victoria

Next steps

The renewable energy transition is both a tremendous opportunity and great challenge for the Loddon Mallee region. We are well placed to become an energy powerhouse – our region alone could deliver on Victoria's Target of 40% renewable energy by 2025. Our community is looking forward to the economic prosperity this could bring. With changing generation technologies, we can also take charge of our own power through community energy and town-scale projects.

There are seven priorities for the Loddon Mallee region to take advantage of this transition.



the priorities

1

Upgrade
grid infrastructure
to realise the region's solar potential

The Loddon Mallee is a leader in large-scale solar. With over 4000 megawatts of projects in planning stages, more can be achieved. Grid connections remain a significant challenge to ongoing investment in the region. This leads to major delays on planned projects. Under-investment in solutions to network congestion and capacity constraints is creating ongoing uncertainty.

Accelerating investment in transmission network upgrades is a high priority for the region.

In addition to advocating for grid upgrades, the region can work to:

- Support customers, communities and towns on the fringe of the grid to understand and develop local energy solutions such as microgrid opportunities
- identify strategic locations in the transmission and distribution grid where small and large scale batteries and other forms of storage can help stabilise energy supply and shift high daytime electricity generation to peak periods.
- identify locations suitable for renewable Stand-Alone Power Systems to improve the grid's strength, reduce emissions and increase energy efficiency
- align local and regional energy programs with local distribution network challenges

2

Maximise
community benefit sharing and maintain
social license

The Loddon Mallee community is enthusiastic about renewable energy and supports renewable energy development. It is important to maintain social license to operate through ongoing benefit sharing and best practice community engagement.

The region can:

- more formally facilitate and coordinate negotiations between communities and large-scale energy developers to achieve mutual community benefits
- understand how large-scale renewables can contribute to existing land-uses and avoid land use conflicts, following the Solar Energy Facilities – Design and Development Guidelines
- ensure communities are adequately engaged and have opportunities to define local benefits for any energy infrastructure upgrades

3

Coordinate and optimise

Distributed Energy Resources

Households, businesses, towns and communities can become more resilient and self-sufficient through the uptake and coordination of Distributed Energy Resources (DER), while also reducing greenhouse gas emissions. To realise this vision, the region can:

- drive greater uptake of batteries and other DER to address high levels of rooftop solar penetration through engagement and support programs
- work with large and aggregated energy users to deliver behind-the-meter generation, demand response and energy efficiency
- work with government, networks and industry to better coordinate DER to benefit all users in the system to strengthen and support the grid
- integrate DER into new precincts, estates and suburbs through planning for energy self-sufficiency

4

Maximise the potential for

bioenergy

Bioenergy can support large-scale solar and DER, and enable commercial and industrial customers to shift away from fossil fuels. To make the most of our comparative advantage, we can:

- identify the location and quantity of suitable feedstock resources
- provide advice on suitable scale of resources and appropriate bioenergy plants
- identify opportunities to support demand for electricity and reduce pressure on the grid during peak periods
- showcase technologies and share knowledge about best practices, business case development and implementation processes
- facilitate regional coordination through the cooperation of local councils, progress associations, distribution network operators, industry peak bodies and state government agencies.

5

Support

community energy

Community groups in the Loddon Mallee have a long history of leading renewable energy uptake. To enable citizens to continue to lead the transition, the region can:

- support community energy groups to develop and test new energy models
- work to unlock barriers to medium-scale community energy projects
- support communities to work collaboratively with electricity networks to realise local energy visions

6

Understand the opportunities for

emerging technologies

The region could be well placed to further advance its energy potential through emerging technologies such as hydrogen, solar thermal and electric vehicles:

- Undertake further research to understand the potential for hydrogen technologies particularly in the northern part of the region
- Explore potential applications for solar thermal storage technologies to address regional energy needs such as commercial heating and cooling
- Support the uptake of electric vehicles to soak up high daytime solar generation and provide grid services

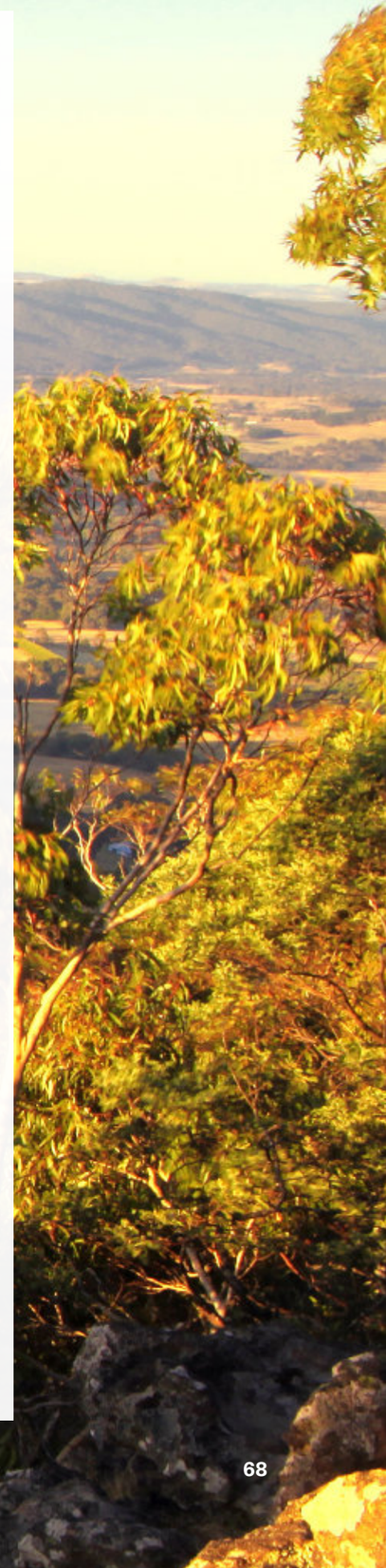
7

Be proactive about

future jobs and training needs

The renewable energy industry has the potential to become a major driver for employment growth, particularly during construction. To make the most of these jobs, the region can:

- identify and understand the opportunities and gaps for skills development and job creation
- work with schools and training institutes to increase understanding of new energy jobs
- help to position the solar industry to maximise local job opportunities and manufacturing capabilities
- raise preparedness and awareness among suppliers to the renewable energy sector to take advantage of local supply chain opportunities.



View over the Macedon ranges

Background photo supplied by CVGA