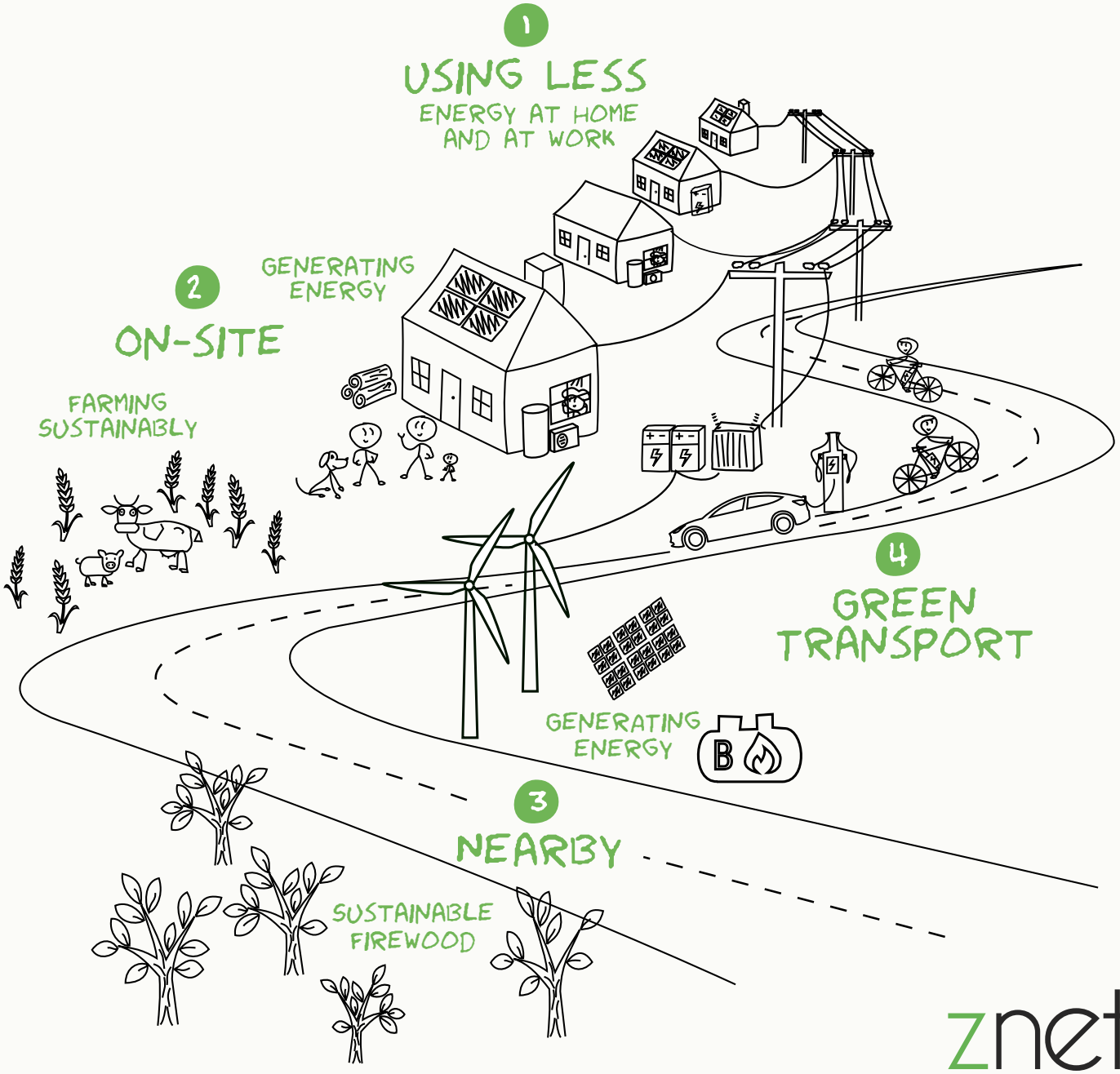
Community Transition Plan

A 10-year Masterplan for the Hepburn Shire to reach 100% renewable electricity supply, zero-net energy and zero-net emissions 2019 - 2029



znet
HEPBURN SHIRE

This project is a strategic initiative of the Coalition for Community Energy

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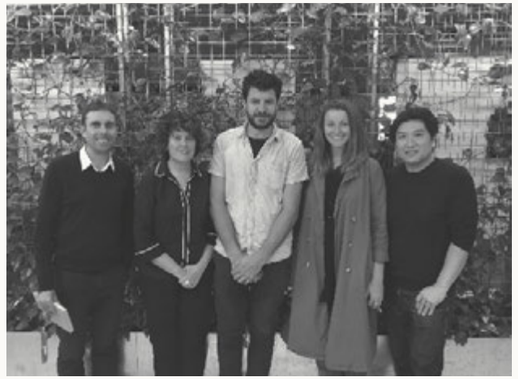
Meat and Livestock Australia
Central Highlands Water
Farmers for Climate Action

The project team would like to recognise and thank the seventeen members of the local community advisory panel who helped to guide the CTP.

Abbreviations

CTP	Community Transition Plan
tCO2-e	Tonnes of carbon dioxide equivalent
MW	Megawatt
kW	Kilowatt
kWh	Kilowatt hours
MWh	Megawatt hours
kV	Kilovolt
CAP	Community Advisory Panel



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Sustainability Victoria CEO Foreword

Victoria is establishing itself as a climate change leader, becoming the first state government in Australia to legislate for net zero greenhouse gas emissions by 2050.

Sustainability Victoria's social research on climate change highlights that 78% of Victorians' support the 2050 net zero emissions target and believe climate change needs urgent action now. 79% of Victorians said they'd be proud to live in a state that's leading the way on climate change.

Victorians overwhelmingly told us that all sectors should be contributing to action on climate change. To help Victoria on the pathway to achieving the 2050 target, Sustainability Victoria is delivering TAKE2, the state's collective, multi-sector climate change pledge program. We're supporting individuals, local governments, businesses, community groups and other organisations to reduce their emissions.

Over 1,000 organisations in Victoria have pledged to act on climate change through TAKE2. This includes local governments that represent more than 80% of Victoria's population, businesses that employ more than 404,000 people and have close to 16.5 million customers, and community organisations with more than 187,000 members. These organisations represent a combined annual turnover of approximately $283 billion nationwide.

In the spirit of engaging whole communities to realise their ambition to act on climate change, Sustainability Victoria has supported the Zero Net Emissions Transition (Z-NET) pilot with the Hepburn Shire community. It includes the development of this 10-year Community Transition Plan for the Hepburn Shire to reach 100% renewable electricity supply, zero-net energy and zero-net emissions by 2029.

Sustainability Victoria saw the potential of this project to provide guidance on a pathway for communities across the state, because of its highly collaborative, partnership driven approach, that applies a social justice lens to the Hepburn community's transition to net zero emissions. It couples Hepburn's aspiration to be a 'lighthouse community' for community-owned energy, with a transition pathway that supports a fair distribution of benefits and seeks to mitigate potential challenges for vulnerable community members.

The aspirations of the Hepburn Z-NET Community Transition Plan align with Sustainability Victoria's approach to working with the community to support a thriving, sustainable Victoria. Working together we are sharing ideas, knowledge and connections, to save both money and the environment. Victoria is an amazing place to live and we want to keep it that way. It's up to all of us to help shape the state of the future.

We look forward to continuing our work with Victorian communities to support pathways to achieving net zero emissions for the state by 2050.

Stan Krpan
CEO, Sustainability Victoria

Hepburn Shire Mayor's Message

In December 2018, Council formally endorsed support for the Z-NET Community Transition Plan as the masterplan for reducing energy use and emissions across the Hepburn Shire.

Hepburn Shire Council strongly supports the community to develop and implement a 100% Community Renewable Stationary Energy Plan, as stated in the Council Plan (2017-2021). We are also aware that emissions extend far beyond stationary energy to sectors such as transport, industry, agriculture, waste and tourism. By acknowledging this fact and planning for a well structured transition in practices, it will be possible to achieve improved economic and environmental outcomes for our Shire both now and into the future.

This Community Transition Plan is the work the Z-NET team of experts; there has also been extensive consultation with community, industry and government. Our Shire's strong history of community led sustainability action means that there has been no shortage of engaged and knowledgeable stakeholders throughout the process. The increasing interest shown by industry and the broader community is also encouraging, as it is evidence of a desire for direct action across all sectors. The background work in developing this Plan has already provided invaluable insight into what is possible at the community level and what the challenges for our Shire may be. Council is actively working to make this transition possible and a number of projects have already been delivered. This Plan will assist Council and community in delivering suitable projects into the future.

We know that the Plan will be continually reviewed and adapted as parameters change, but it is an impressive and comprehensive first step. Based on what has already been delivered in a few short months, we at Council are excited about what can be achieved in the coming years.

Cr Don Henderson
Mayor – Hepburn Shire Council

Executive Summary

Baseline year emmissions

262,041

Tonnes of carbon dioxide equivalent in 2018

The vision for the Hepburn Shire is a three phased roadmap

Phase 1: 2019 - 2021
(quick wins)

Phase 2: 2022 - 2024
(zero-net energy)

Phase 3: 2025 - 2029
(zero-net emissions)

Z-NET is Zero-Net Emission Transition, an open-source pathway for a local community to set targets and achieve zero-net emissions.

In February 2017 an ambitious target was requested by the Hepburn Shire community.

In August 2018 Hepburn Shire Council and Hepburn Wind, with the support of the local sustainability groups: SHARE, Hepburn Relocalisation Network, Trentham Sustainability Group, Transition Creswick and Clunes Sustainability Group formally declared an ambition to be the first Shire in Australia to achieve 100% electricity generation from renewable sources.

This declaration sets out the aspiration to be a 'lighthouse community' for community-owned energy facilities, demonstrating the economic, social and environmental benefits of locally community owned, local renewable generation infrastructure. Further, it lays out a target of zero-net energy by 2025 for the Hepburn Shire, with an aspirational target of 100% renewable by 2021.

Currently Hepburn Shire's emissions are 262,041 tonnes of carbon per year. This document explores how Hepburn Shire - with a population of 15,000 residents will meet the zero-net energy target by 2025 and then zero-net emissions by 2030. This is the first community in Australia to declare these ambitious targets and implement a plan to achieve them. There has been much work done to identify how the community can achieve this, and provide a roadmap for others to follow.

With support from Sustainability Victoria's Take2 Community Transition Pilot, Hepburn Shire was selected to conduct Victoria's first Z-NET pilot. Hepburn Shire was selected because of its demonstrated track record in community energy with Hepburn Wind strong support shown by the Hepburn Shire Council, local sustainability groups, community members and business to pursue 100% renewable energy. The pilot aims to act as an incubator for locally appropriate best practice actions and strategies to meet a target of zero-net emissions, then to take strategies from pledge to action and implementation.

The project is an initiative of the Coalition for Community Energy and was led by Renew and Little Sketches, with support from Starfish Initiatives, Moreland Energy Foundation, Hepburn Shire Council, Hepburn Wind and many other local and sector partners. The Z-NET Community Transition Pilot was funded by Sustainability Victoria, Hepburn Shire Council, Hepburn Wind, Samsø Energy Academy (Denmark) and Diversicon Environmental Foundation.

The purpose of this project was two fold. Firstly, to provide an expanded blueprint for how rural communities can firstly satisfy all of their own energy needs at all times from renewable energy sources in a way which is competitive with the current system of energy (in terms of price, quality, reliability, security of supply and so on). Secondly, to create a holistic masterplan – The Hepburn Community Transition Plan (CTP).

The project was conducted from February through to October 2018. It is the most in-depth, place-based carbon emissions profile yet created in Australia. It is also the first local government area CTP for zero-net energy and zero-net emissions.

This CTP has been co-developed with the local community and is written for them, as well as stakeholders from important sectors to engage on the journey, all levels of government, technical experts and industry.

The following opportunities have been identified to progress towards the goal of zero net energy and zero net emissions. These opportunities are grouped as:
- Using less energy
- Generating energy onsite
- Fuel switching
- Generating energy nearby

These opportunities respond directly to emissions associated with the following sectors which are detailed below:
- Stationary Energy
- Transportation
- Agriculture
- Waste and Waste water
- Land use change

The project has delivered:
- A Z-NET Blueprint for the Hepburn Shire (including carbon emissions inventory)
- A co-developed CTP
- Feasibility analysis and business cases for local energy options
- Energy and emissions related resources and capacity building within the community

It should be noted that some elements of the CTP are easier and harder to control than others. To make the CTP as meaningful and real as possible it was necessary to pioneer new approaches to tricky problems. As a living document that will need to be updated in the future it should be considered as the first iteration.

Through development of the CTP it was found that in Phase 1 - the focus can be largely on further supporting the activities that were in progress (quick wins) as well as building the momentum for Phases 2 and 3.

The three phases are explored below and accompanied by flow charts representing the conceptual journey to implement these three phases. The cross-hatching in the bars represent sources of emissions, clear bars represent zero emission sources, and solid bars represent carbon 'sinks'. Size of the bars represents the relative sizes of stationary energy sources (or emission sectors) within the Shire.

Zero-net energy for this CTP is defined as a community that reduces and matches its local energy needs with a 100% renewable energy supply. Practically, that means that energy can be imported from the grid or elsewhere, but this needs to be matched with local renewable generation. This calculation is averaged over an annual period of time.

Zero-net emissions for this CTP is defined as reaching carbon neutrality, in that the local carbon emissions are reduced, sequestered or offset.

Key Elements of Phase 1 2019-2021

The first stage celebrates Hepburn's leadership in sustainable energy, with a concentration on energy efficiency opportunities and energy generation on-site. This is consistent with adopting the least-cost approach, which will help to reduce the amount of 'nearby' renewable energy projects required to achieve a 100% renewable energy supply. These options are also based on proven technologies which have a high level of social support.

This phase includes the delivery and celebration of a second stage solar farm at the Hepburn Wind site to complement the existing 4.1MW capacity of Gale and Gusto (wind turbines). It also includes the delivery of a local bioenergy demonstration project of 65kW capacity.

The first phase helps lay the development work for mid-scale renewable energy projects via Hepburn Wind's leadership and local sustainability group engagement, as well as a micro-grid / virtual power plant project (VPP), which would then be delivered in Phase 2. This project is essential to allow continued growth in on-site generation.

Similarly, this first phase is also proposed to develop capacity and commence delivery of reforestation, capable of balancing a renewable, sustainable supply of firewood and ultimately creating the land use change required to offset agricultural emissions. Further, improvement in detailed knowledge around opportunities to reduce transport, agricultural and land use emissions will ready the community for a shift in focus away from stationary energy towards other emissions sectors in the later two phases.

The first phase includes improving upon knowledge and delivery of early transport actions, with an early focus on improving fuel efficiency at vehicle replacement, rideshare and active transport. A waste to energy project would be delivered by Council, capturing a portion of emissions associated with organic waste; Council's commitment to meet zero net emissions from waste would be met during the latter part of this phase.

The Central Highlands Water plan to reduce emissions from wastewater commences in earnest.

These listed actions are considered 'quick wins' that are largely underway through various initiatives with different stakeholder groups.

Key Elements of Phase 2 2022-2024

Phase 2 includes delivery of significant investment in mid-scale renewable energy projects (40MW of new capacity) to create a 100% renewable electricity supply and achievement of zero-net energy. The potential of battery storage should be considered for some of the mid-scale projects as this will allow higher levels of generation to be achieved, without network capacity constraints. Delaying delivery of these projects to approximately 2022 - 2024 will also allow for costs of solar and wind generation to further decline (somewhat absorbing the cost of battery storage required). Should the level of required mid-scale community wind and/or solar projects not be pursued (due to financial viability or network constraint reasons), the option of procurement from larger solar or wind farms outside the Shire will need to be considered.

The output from these mid-scale 'nearby' projects would involve some export of electricity to other communities when solar or wind production is high and usage in Hepburn Shire is low. The delivery of a local micro-grid / Virtual Power Plant (VPP) project is required during this phase to maintain growth in on-site electricity generation.

Waste reduction measures would continue to further reduce reliance on waste offsets. The emissions reduction actions by Central Highlands Water are proposed to continue.

Knowledge and capacity would be further built around key agricultural production changes required to reduce emissions; including 'climate smart' farms, with pilots occuring for a number of strategies designed to reduce emissions associated with meat and dairy livestock and carbon sequestration into soil. These are scheduled to be piloted in 2024, informed by industry research that improves the animal welfare associated with responses to reduce enteric emissions. Programs will be designed in this phase which can forge a new kind of leadership in Hepburn around reduction of agricultural emissions.

Significant sector partnerships (see Section D) will need to be established to usher in this phase, as well as financing to actualise it.

Key Elements of Phase 3 2025-2029

During Phase 3, the electric vehicle transition will commence in earnest. It is proposed that this is matched with increasing deployment of renewable electricity generation to meet the charging requirements. Programs involving on-site energy actions come to fruition with the transformation of building stock through energy efficiency and on-site solar investments.

Through a combination of further efficiencies and reduction in travel demand, but predominantly as a result of electric vehicle transition, transport related emissions decline to approximately two-thirds of the 2018 benchmark. The Hepburn Shire is forecast to continue to be a net exporter of renewable electricity, which offsets the remaining balance of transport emissions.

Agricultural emissions are forecast to reduced to approximately half of the 2018 benchmark, through soil carbon actions and livestock initiatives. The remaining agricultural emissions are offset through land use change (reforestation) within the Shire, resulting in zero net emissions by 2030. Reforestation also supplies (above and beyond land use change) a local 'renewable' firewood supply.

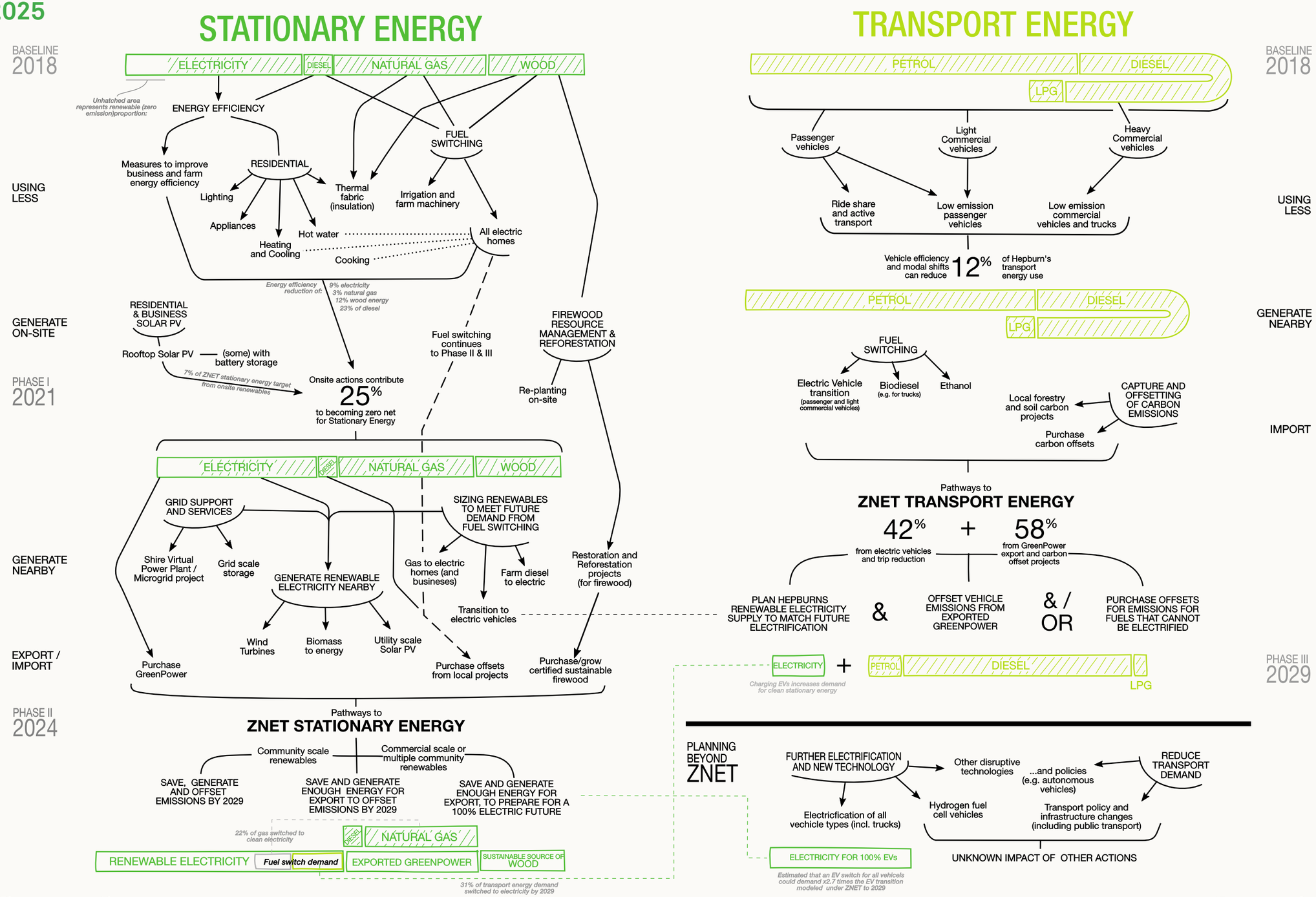
The commitment from Central Highlands Water will be met in 2029. Council and community actions continue to reduce waste emissions. The combination of these activities can reduce total waste emissions to a negligible level by the 2030 target.

There are hundreds of operating 'energy towns' around the world, and a desire or official mandate from several communities across Victoria. However, there is only one operating zero-net energy town example as yet in Australia - Hepburn Wind which generates enough renewable energy to offset Daylesford. As yet, there is no local government area. This project has established clear targets and pathways to answer the question of 'what will it take' for the Hepburn Shire to reach and go beyond zero-net energy and how to tackle the broader objective of zero-net emissions.

This CTP provides a holistic and workable blueprint for the Hepburn Shire that is grounded in technical and financial rigour. Section A of the CTP explores Hepburn Shire's local context and grounds it within the global perspective. Section B details the approach taken to create Hepburn's Place-Based Carbon Emissions Inventory and the findings that emerged. Section C explores the transition options and local electricity network capacity, to understand what's possible and how it will it work. Section D looks to 'how might it work?' The role of enablers section considers the role of key stakeholders as well as tracking the progress of the CTP. Section E lays out the Pathway to Hepburn Z-NET through an implementation action plan.

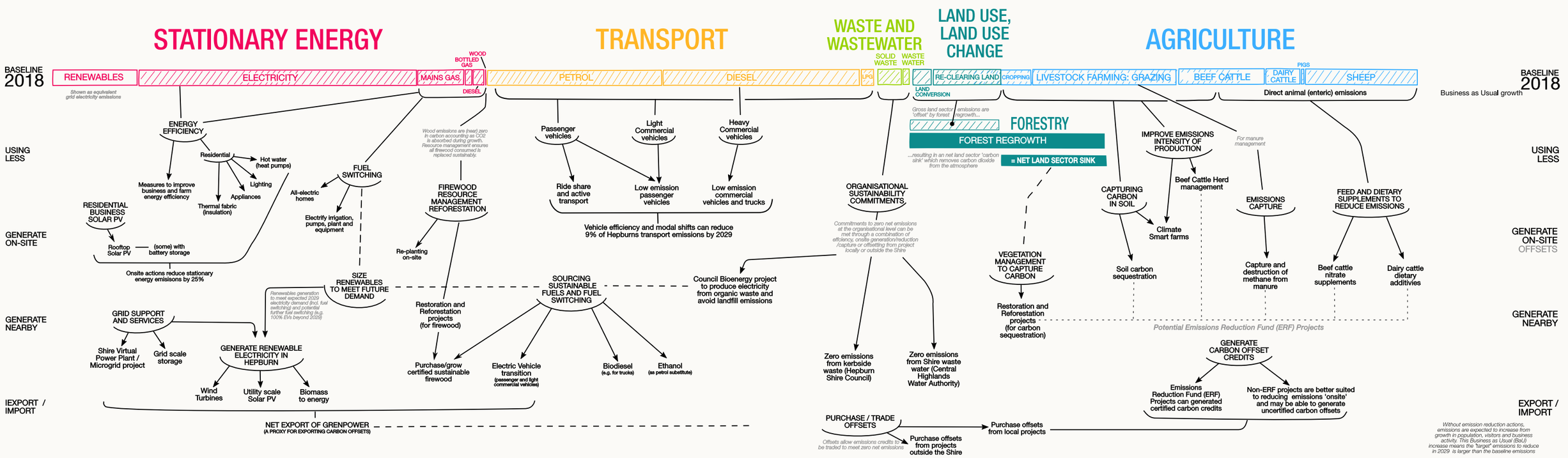
Meeting zero-net energy by 2025

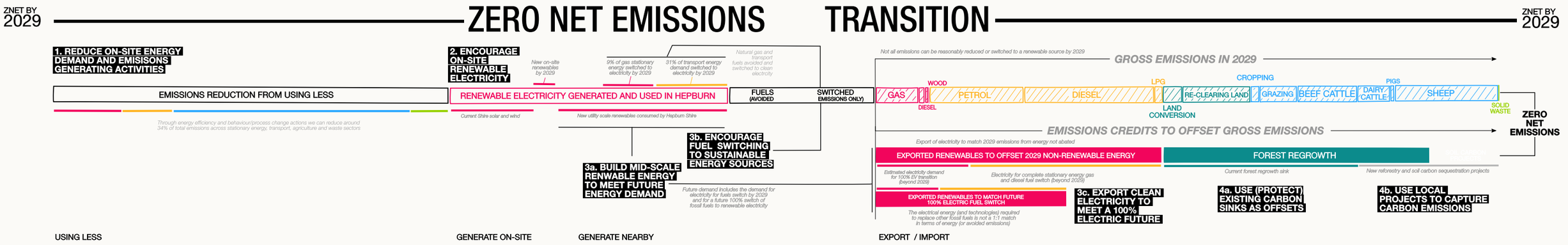
Chart 1: Meeting zero-net by 2025



Meeting zero-net emissions by 2030

Chart 2: Meeting zero-net emissions by 2030





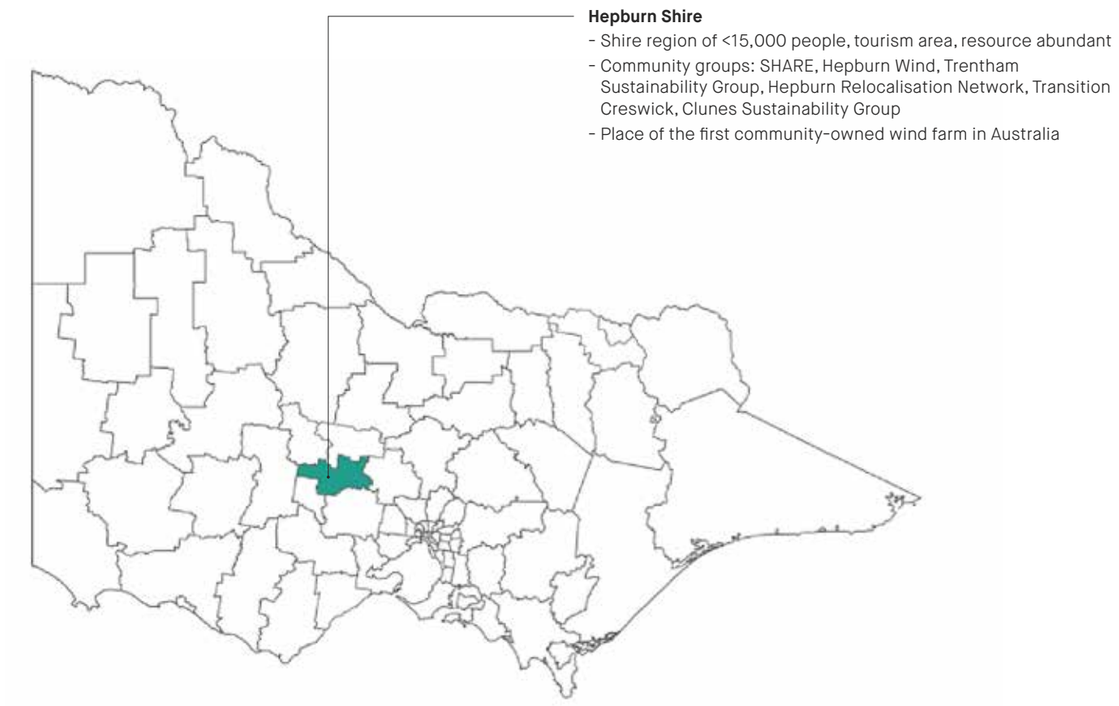
A

What's the Context?

Local Historical Context

Hepburn Shire is located in Victoria's Central Highlands, about one and a quarter hours drive northwest of Melbourne. The Shire is in the heart of the Goldfields region of Victoria and abuts the Central Goldfields Shire to the northwest, Mt Alexander Shire to the north, Pyrenees Shire to the west, City of Ballarat to the south, Moorabool Shire to the southeast and Macedon Ranges Shire to the east. It covers an area of 1,470 square kilometres. The Dja Dja Warrung people are the Traditional Owners and the original inhabitants of the Hepburn Shire. The location of Hepburn Shire in regards to broader Victoria can be seen in the following map.

Map 1: Hepburn Shire within the State of Victoria



Hepburn Shire
- Shire region of <15,000 people, tourism area, resource abundant
- Community groups: SHARE, Hepburn Wind, Trentham Sustainability Group, Hepburn Relocalisation Network, Transition Creswick, Clunes Sustainability Group
- Place of the first community-owned wind farm in Australia

Hepburn Shire is a resource and biodiversity rich area and renowned as the home of Hepburn Wind – Australia's first community-owned wind farm. Over 2,000 people, most of whom are local, pooled $10m to build a two turbine, 4.1 MW wind farm at Leonards Hill. On average, the wind farm produces more energy than required by the houses in nearby Daylesford and much of the surrounding area. It is one of the first examples of an Australian town-scaled zero-net energy project. At the project's core is the shared desire to take constructive action to mitigate climate change and in the process directly benefit the community. The project has demonstrated that, under the right conditions, communities will overwhelmingly support renewable energy and the benefits can be spread widely throughout a community.

Council

Hepburn Shire Council has committed through the Council Plan 2017-2021 to delivering a sustainable, vibrant and economically active community. The Plan focuses on five key strategic areas of Quality Community Infrastructure, Active and Engaged Communities, Sustainable Environment, Vibrant Economy and High Performing Organisation. In August 2017 Council endorsed a Towards Zero Emissions Roadmap that outlines the actions required to achieve zero net emissions for Council's operations. These endeavours follow through on a long-standing (2009) commitment to drive towards a completely renewable energy base across the Council organisation and the broader community. After a period of feasibility analysis, Council is now actively pursuing a waste-to-energy facility.

Local sustainability groups

Hepburn Shire is remarkable for its high level of sustainability activity. Significant historical work in sustainability has been undertaken by the following organisations:
- Hepburn Wind
- SHARE (originally Hepburn - Renewable Energy Association) the founding organisation for Hepburn Wind
- Hepburn Relocalisation Network
- Trentham Sustainability Group
- Transition Creswick
- Clunes Sustainability Group

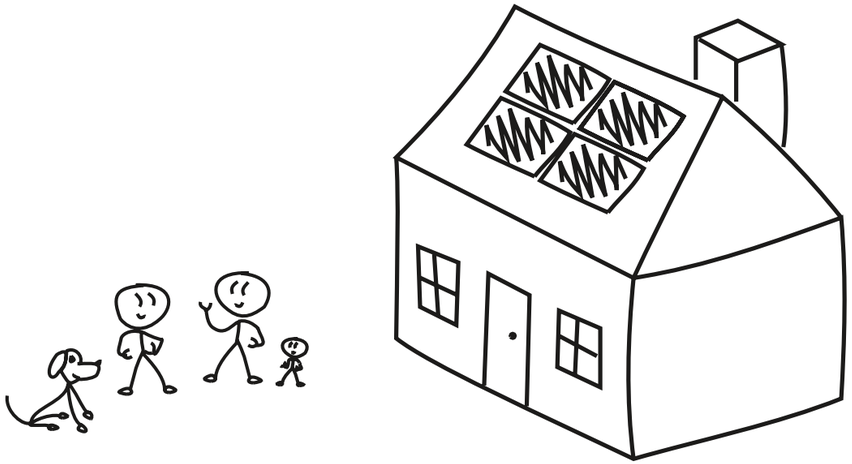
During the Council planning period in 2017, all of these sustainability groups requested Council endorsement of a Zero-Net Energy Target by 2025 for the whole Shire. This was confirmed in August 2018 via a Memorandum of Understanding between Council and Hepburn Wind. There is also a new emergent group - the Mollongghip and District Community Power Hub - that is actively pursuing a local community energy project across the Hepburn and Moorabool Shires.

Documentation going back to 2009 was reviewed by the project team to inform this CTP, harvesting historical ideas and avoiding reinventing the wheel. Pivotal documentation included an Energy Descent Action Plan (2011) and the most recent Carbon Free Conversations (2017.

Carbon Free Conversations

The Hepburn Shire Carbon Free Community Conversations were held across the Shire in mid 2017. Focussed sessions were held in the four largest towns of Daylesford, Trentham, Clunes and Creswick. Around 80 participants attended and some 90 project or program ideas were generated.

The workshops showed that while participants expressed a desire for action, their focus was on setting a vision for the community around renewable energy and exploring viable models for engagement and funding. This was reflected in the high level of interest in developing a 'lighthouse community model' to identify resources and criteria for potential projects, and to equip the community to better understand the steps required to implement projects. The CTP incorporates these intentions.



Global Context

To avoid dangerous climate change the world must transition from emitting high amounts of greenhouse gases (GHGs) to emitting very low, zero, or even 'negative' emissions or sequestration. The transition has already begun but needs to expand and speed up considerably if the world is to meet its global emission targets. The majority of the world's countries have, by signing the 2015 Paris Agreement, endorsed the common goal of keeping global temperature rise below 2°C. For the first time, local government through the Compact of Mayors had a significant impact on global negotiations.

The Intergovernmental Panel on Climate Change (IPCC) Global Warming of 1.5 °C Report released in October 2018 sets the scene for a necessary drop to zero-net emissions within a 12 year period, to remain within 1.5°C, which would significantly limit the impact in comparison to a 2°C target. The following chart from the report shows the level of actions required to meet zero-net globally within the next 12 years. This sets the impetus for the Hepburn Shire to have a Community Transition Plan that is achievable in 10 years.

However, even with an emissions transition, Australia is particularly vulnerable to the impacts of climate change that are already underway. This is particularly apparent in rural and regional Australia. Further, there is the question of how state and local governments can contribute to achieving the emissions reductions committed to in the Paris Agreement.

The Victorian Government's response to the Paris Agreement has been to align with the zero-net emissions by 2050 target, to establish renewable energy targets for 2020 and 2025 and to establish the Take2 climate change pledge. Understanding the role and potential of community led energy transitions will greatly enhance local efforts. Communities taking control of their own pathway to zero-net emissions can greatly assist these ambitions to become reality.

The overarching Climate Change Framework is its long-term plan stating:

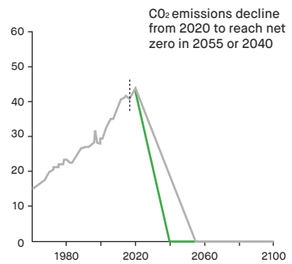
- vision for a net zero emissions, climate-resilient Victoria in 2050;
- how action on climate change aligns with jobs, cost of living and health;
- the steps required by Government to commence the transition;
- how the Climate Change Act 2017 will drive action to 2050;
- the challenges to be addressed for a net zero emissions economy; and
- how Victoria is preparing for a changing climate.

One of the key strategies for communities to reach a target of zero net emissions is to transform their energy system to become 100% renewable. This is already a global movement with more than 300 cities, municipalities and regions setting targets for 100% renewables and implementing strategies to ethically address climate change.

The emergence of competitive distributed renewable generation and energy technologies offers a genuine sustainable development opportunity for regional villages, towns and shires to create energy systems that can affordably meet their needs in a way that also creates economic, social and environmental benefits.

The following figure illustrates the magnitude of the challenge required to achieve zero-net emissions by 2040, relative to the 3x buildup in emissions from 1960 to 2020.

Figure 1: Net global CO_2 emissions pathways



Definitions

Community

'The community' in this Community Transition Plan (CTP) refers to the local government area of the Hepburn Shire. The CTP recognises that people within this geographic boundary may identify with different regions within this area e.g. specific townships within the Shire. Significant data collection and analysis has been carried out to provide insights into the carbon emissions footprint of the individual local government Wards as well. This provides the localities and townships of Trentham, Clunes, Creswick, Glenlyon and Daylesford and Hepburn Springs with their own context and opportunities for tailored solutions.

A Community Advisory Panel (CAP) of 17 local representatives helped to guide the project and ensure it was locally appropriate. The CAP assisted the project team to develop key areas of understanding, relationships and networks for Z-NET Hepburn, particularly to inform and guide: the analysis of the initial options and projects for implementation; drafting of the CTP; and design of the governance arrangements.

Uralla Z-NET 1.0 to Hepburn 2.0

The first Z-NET program in Uralla stood for Zero-Net Energy Town. The Uralla Z-NET team focussed on building a framework for addressing stationary energy. Additionally, as there were no existing sustainability groups in Uralla at the time, the team needed to engage the local community and build energy literacy.

In the Hepburn Shire, there is a long-standing history of environmental leadership, as evidenced by Hepburn Wind and various renowned individuals, such as the long-standing work of David Holmgren (and Su Dennett) in co-founding and expanding the permaculture movement, and the Shire's five sustainability groups. Hepburn Z-NET therefore had a significantly different starting point. The acronym was adjusted for Hepburn to represent the broader scope of the second Z-NET program to instead mean Zero-Net Emission Transition. The Z-NET project team, under this new definition, has developed a detailed roadmap for transition to renewable energy and a high level strategy for emissions.

The Z-NET Blueprint has evolved to encompass a wider carbon emissions inventory than stationary energy. It also considers transport, agriculture, waste and land use. Due to the significant tourism sector in the Hepburn Shire, the tourism profile has also been communicated to bring awareness to how significant the impact this sector has. However, tourism is not considered within the boundary for emission reduction opportunities. This approach allows for future programs to be designed to engage and work with the tourism sector to mitigate their environmental impact.

Social Justice

The CTP applied a social justice lens to better enable fair distribution of benefits and mitigate potential burdens on vulnerable community members.

Such an assessment is important to bring awareness of who benefits, and who is burdened, by the particular transition path taken. Energy choices must be justified not only in terms of how they will help mitigate climate change, but also in terms of their fairness to those already disadvantaged. In this sense, addressing questions of justice is essential, and ought to play a central role in planning climate mitigation. Moreover, such an assessment can play a key role in determining social acceptance of transition plans.

The most appropriate infrastructure and technologies have been assessed to ensure that the needs of all community members, and especially those who are vulnerable, were considered. This combined focus is key to achieving a fair sharing of the benefits occur from climate mitigation. Climate mitigation involves significant changes to the generation and delivery of energy, the organisation of infrastructure and social practices (lifestyles) of communities.

More specifically, social justice considerations were integrated into the project assessments and CAP engagement.

'The energy transition means huge change as well as huge potential benefit for the community. We need to ensure that all people, rich and poor are included in decision making and future benefit programs.'

'It's all integrated into the one eco-system, which requires balance. I think social justice is the framework from which all goals relate to.'

'Climate Change and energy poverty are two great issues of the modern age.'

(Community Advisory Panel members June 2018)

'There are hundreds of operating 'energy towns' around the world, and an expressed desire or official mandate from several communities across Victoria to become one. However, there is only one operating zero-net energy town example in Australia - Daylesford. Hepburn Wind generates enough renewable energy to offset the town.'

B

A Place-based Carbon Emissions Inventory

Global Standards and Going Beyond

Primary to the purpose was to meet global standards for quantifying emissions whilst creating a pioneering approach relevant to local communities that sought to find meaningful data sets and ground truth the baseline.

The 'baseline' emissions inventory or 'profile' provides an estimate of Hepburn Shire's current (2018) emissions and their sources.

The purpose of the baseline emissions profile is to identify, quantify and report on Hepburn Shire's distinct greenhouse gas emissions (GHG). The baseline emissions can also help guide where action must be taken to have the greatest impact. Whilst there are global standards for emission profiles, methods for meeting the global standards are often based on aggregated data sets (scaled down data from Victoria for example). This reduces duplication and gaps with other communities, but can lack meaning for community members and makes it difficult to measure progress in emissions reduction.

This project has created a bespoke profile, which not only meets the global reporting standards, but uses more granular data when available. It has brought together household survey data, local farming data sets, inputs from Hepburn Shire Council and significant data from Powercor, the electricity network distributor.

The origins of Hepburn Shire's emissions have been categorised into:

- Stationary Energy
- Transportation
- Agriculture
- Land Use Change
- Waste

Bottom-up and Top-down approach

The general approach applied for the emissions baseline profile was to:

1) Identify all emission activities
2) Apply methodology to activities as required
3) Apply scaling factors
4) Apply GHG emissions factors to convert all emissions to a CO2 equivalent

A combination of top-down and bottom-up approaches was used to calculate the emissions from each key sector.

A top-down approach was utilized when the available activity data did not perfectly align with the boundary of Hepburn Shire. This was the case for the following area of activity:

- Land Use Change

A bottom-up approach was utilised when 'on the ground' activity data for Hepburn Shire was available. This was the case for the following sectors:

- Stationary Energy
- Agriculture
- Wastewater
- Solid waste
- Council
- Transportation
- Tourism

Localised data collection was supported by the five sustainability groups: SHARE, Trentham Sustainability Group, Transition Creswick, Clunes Sustainability Group and Hepburn Relocalisation Network as well as Hepburn Wind. This enabled 500 households to participate in the Household Survey.

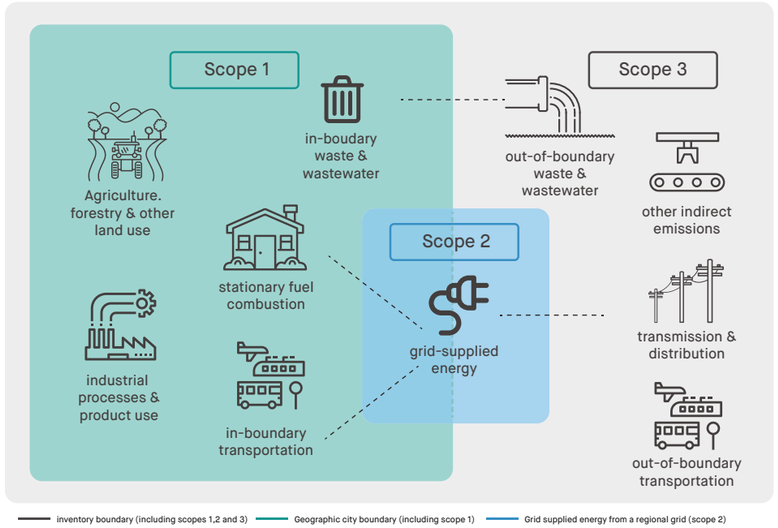
Z-NET emissions boundary

The emissions profile maps activities that mainly occur within the boundary of the Hepburn Shire. However, some activities also create emissions that need to be mapped outside of municipal boundaries. Methodologies and approaches used for the baseline emissions profile are in accordance with the Greenhouse Gas Protocol which offers a detailed framework for calculating GHG emissions.

As shown in Figure 2, emissions can occur within (Scope 1) and outside (Scope 3) of the Shire boundaries as well as a consequence of the consumption of grid-supplied energy (Scope 2).

The analysis undertaken was based on a production-based method of emissions accounting (as this is more established and consistent with global reporting). However, if a consumption-based method was applied, much of the emissions associated with agricultural activity in particular would apply where the food was consumed.

Figure 2: Sources and boundaries of GHG emissions [1]



[1] Greenhouse Gas Protocol: Global Protocol for Community-Scale Greenhouse Gas Emission Inventories. An Accounting and Reporting Standard for Cities.

Whole of Shire findings

The 2018 baseline year shows that agriculture, stationary energy and transport dominate the sources of the Shire's emissions.

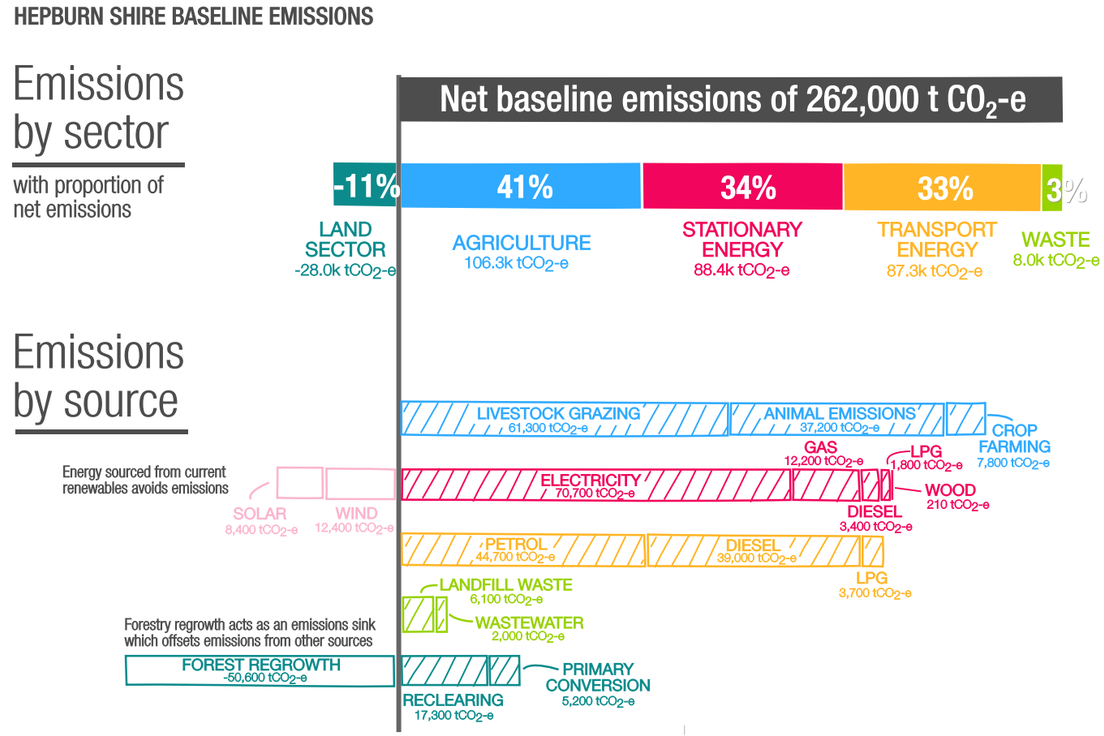
More than 20,000 tonnes of emissions are offset through renewable energy (solar and wind). The land sector provides a net carbon sink with forestry activities in the Shire estimated to draw down 11% of gross emissions (i.e. emissions prior to carbon credit activities).

Baseline year emissions

262,041

Tonnes of carbon dioxide equivalent in 2018

Chart 3: 2018 baseline year emissions



Farming sector emissions (i.e. associated with agriculture activities) is the largest source of emissions (41% of net emissions), this is followed by residential (34%), commercial (26.2%) and industrial (4.4%) sector emissions. The municipal sector includes all Council emissions, public land (including land use sector) and other emissions unable to be allocated from source data. Electricity is the main contributor of emissions in the residential, commercial, industrial, municipal sectors. Transport fuels (petrol, diesel and aviation gas) are the highest contributors of emissions in the tourism sector, but these are not within the defined emissions boundary. Emissions breakdowns by economic sector are shown in the following table and chart.

Table 1: Baseline by
The 'Sectors'

	Economic sector						
Emissions sector	**Residential**	**Commercial**	**Industrial**	**Farming**	**Municipal**	**Total**	
Agriculture	0	0	0	106,325	0	106,325	(40.6%)
Stationary Energy	48,739	25,242	2,006	5,906	6,464	88,357	(33.7%)
Transport	34,963	41,272	9,097	1,396	602	87,330	(33.3%)
Waste	5,442	2,164	437	0	0	8,043	(3.1%)
Land use, land use change and forestry	0	0	0	0	(28,014)	-28,014	-(10.7%)
Total emissions in tonnes	**89,143**	**68,679**	**11,540**	**113,627**	**-20,947**	**262,041**	**tCO2-e**
	(34.0%)	(26.2%)	(4.4%)	(43.4%)	-(8.0%)		

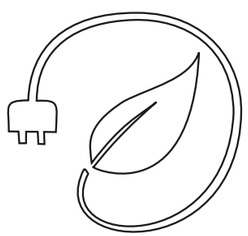


Table 2: Baseline by
Emissions Source

	Economic sector						
Emissions sector and source	**Residential**	**Commercial**	**Industrial**	**Farming**	**Municipal**	**Total**	
Stationary energy							
Electricity	38,409	21,439	1,982	2,487	6,398	70,715	(27.0%)
Gas (mains)	8,353	3,803	24	-	67	12,246	(4.7%)
Gas (bottled)	1,767	-	-	-	-	1,767	(0.7%)
Wood	210	-	-	-	-	210	(0.1%)
Diesel	-	-	-	3,419	-	3,419	(1.3%)
Transport							
Petrol	28,958	12,833	2,838	-	46	44,675	(17%)
Diesel	4,186	26,914	5,922	1,396	556	38,974	(14.9%)
LPG	1,819	1,525	337	-	-	3,682	(1.4%)
Agriculture							
Cropping	-	-	-	7,788	-	7,788	(3%)
Grazing	-	-	-	98,537	-	98,537	(37.6%)
Waste						-	
Landfill waste	3,661	1,977	437	-	-	6,075	(2.3%)
Waste water	1,781	187	-	-	-	1,968	(0.8%)
Land use, land use change and forestry							
Forestry (carbon sink)	-	-	-	-	-50,551	-50,551	-(19.3%)
Land use (change)	-	-	-	-	22,537	22,537	(8.6%)
Total emissions in tonnes CO2-e	**89,143**	**68,679**	**11,540**	**113,627**	**-20,947**	**262,041**	**tCO2-e**

Chart 4: Modelled activities by economic sector

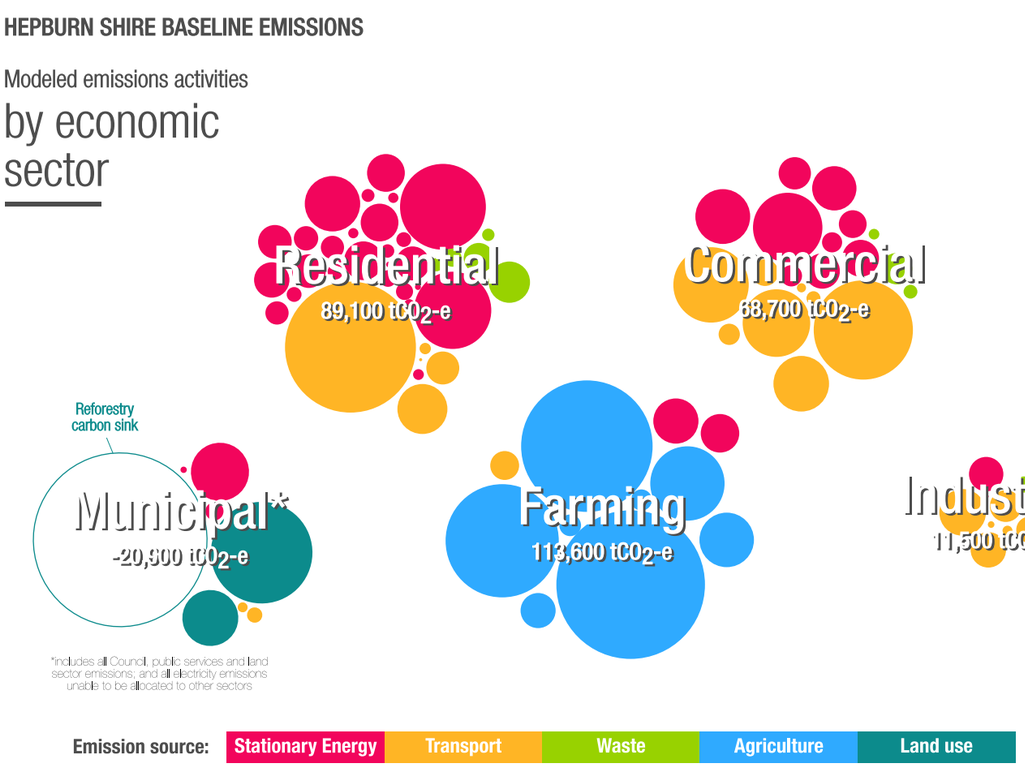
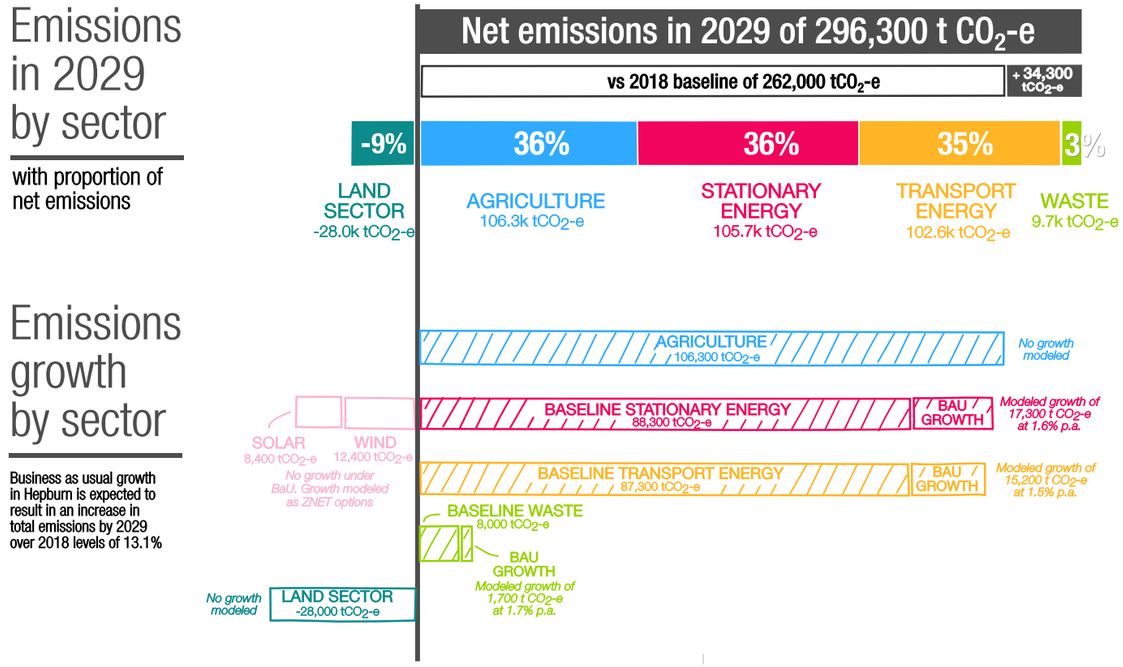


Chart 5: Business as Usual growth



Under the Business as Usual scenario (BaU), the local emissions are forecast to grow by 13.% by 2029 (or 34,300 tCO2-e per annum). Growth paths are modeled for all emission activities based on expected growth in activity in their respective sectors, including factors such as population growth. The 'BaU' represents a 'no action' pathway and does not include modelled adoption of renewable and energy efficiency technologies (which are part of the ZNET profile).

Ward by Ward

The Hepburn Shire has many distinct towns, villages, and hamlets located across the 1,470 square kilometres, inclusive also of native forests and farmland. Within those locations, there is strong local pride and identification. In order to give visibility to the distinct footprints of some of these areas, the following table and accompanying chart, reflects a high-level breakdown across the five local government Wards in the Shire.

Table 3: Baseline by

Shire Wards

Emissions source	Birch	Cameron	Collban	Creswick	Holcombe	Total
Agriculture	7,873	56,903	6,925	17,341	17,283	106,325
Stationary Energy	37,142	9,509	10,328	24,290	7,087	88,357
Transport	29,788	10,955	12,200	23,802	10,585	87,330
Waste	2,748	1,007	1,121	2,193	973	8,043
Land use, land use change and forestry	-5,696	-2,202	-6,581	-4,173	-9,361	-28,014
tCO2-e	**71,855**	**76,172**	**23,993**	**63,453**	**26,568**	**262,041**

Emissions sector	Birch	Cameron	Collban	Creswick	Holcombe	Total
Residential	37,865	10,931	8,881	30,586	6,185	94,448
Commercial	36,966	8,177	6,287	20,950	2,765	75,145
Industrial	6,933	988	1,001	3,796	243	12,961
Farming	10,091	61,387	5,841	23,130	11,182	111,630
Municipal	-20,000	-5,312	1,983	-15,008	6,193	-32,143
tCO2-e	**71,855**	**76,172**	**23,993**	**63,453**	**26,568**	**262,041**

The Ward of Cameron has high emissions and is largely skewed from the agriculture sector due to its relatively high share of grazing area compared to the other Wards. Birch has the highest electricity emissions among the Wards and produces more than twice as many emissions in total as Coliban. This can be explained by higher poulation in comparison to other Wards, but also due to the impact of business and tourism. Hepburn Wind is located in Birch and all electricity generated by the wind farm is allocated to the Ward for the purpose of modeling the local on-site generation impact. Coliban produces the lowest emissions among the Wards in Hepburn Shire and is fairly balanced across the sectors, including a significant carbon sink due to forestry activities that reduced the emissions profile by 27%. Holcombe ward hosts the largest forestry carbon sink, which creates a reduction of 35% to their emissions.

Chart 6: Ward emissions profile

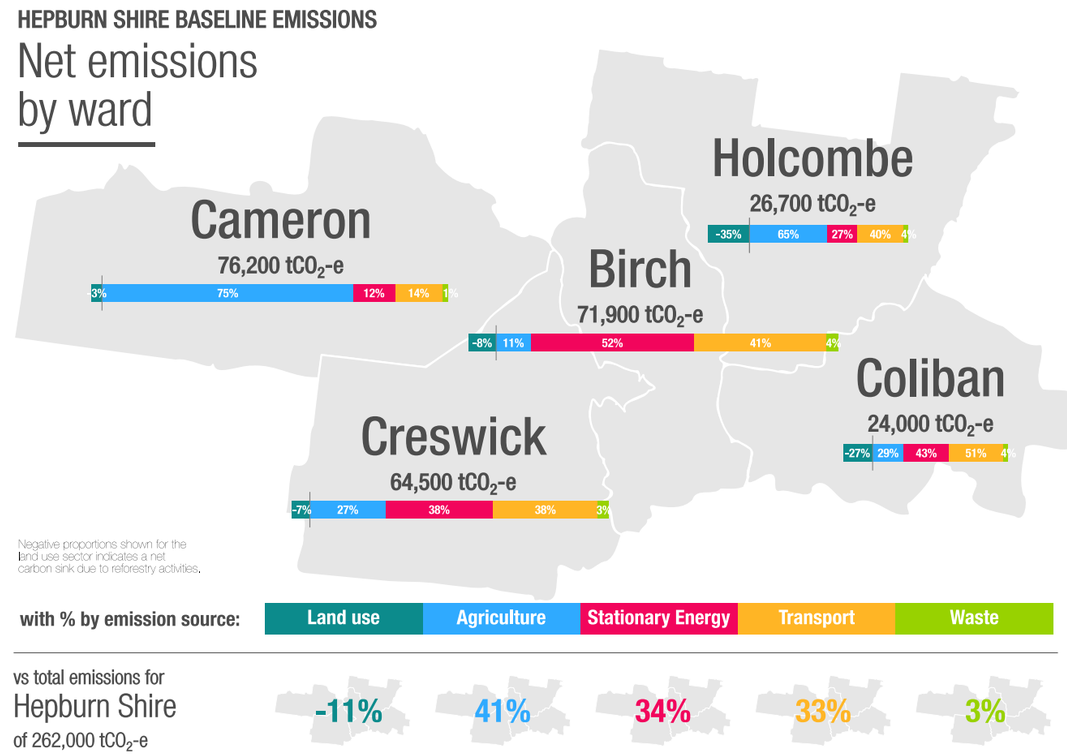


Figure 3: The 2018 electricity baseline postcard

The emissions context

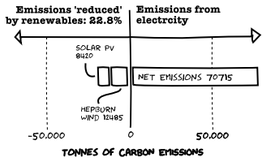
Electricity baseline for Hepburn Shire

znet HEPBURN SHIRE

Shire Summary

Hepburn's emissions from electricity amounts to 70,715 tonnes of carbon emissions annually. Electricity is used for a range of daily business and household needs such as lighting, heating, hot water,equipment and appliances.

We reduce 22.8% of electricity emissions through local generation of renewable energy from rooftop solar and Hepburn Wind.



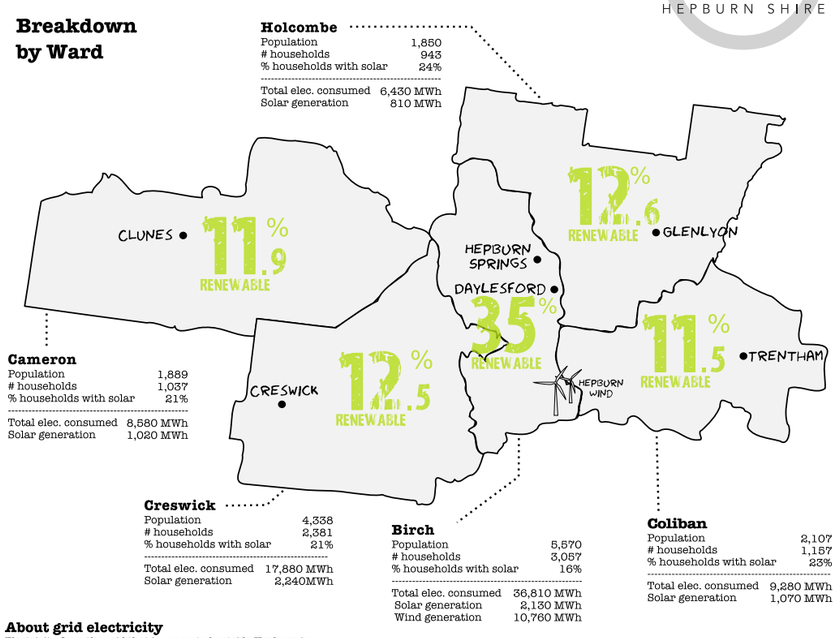
Shire facts

Population	15,753
# households	8,648
Electricity supplied by:	
Solar	7,260 MWh
Wind	10,760 MWh
Supplied by grid	60,960 MWh
Total elec. consumed	78,980 MWh
% Renewable electricity	22.8%
Net emissions	70,715 tCO2-e

Data sources

Australian Bureau of Statistics (ABS), Powercor and Hepburn Shire Council (Rates data), openNEM, Clean Energy Regulator

Breakdown by Ward



Holcombe

Population	1,850
# households	943
% households with solar	24%
Total elec. consumed	6,430 MWh
Solar generation	810 MWh

Cameron

Population	1,889
# households	1,037
% households with solar	21%
Total elec. consumed	8,580 MWh
Solar generation	1,020 MWh

Creswick

Population	4,338
# households	2,381
% households with solar	21%
Total elec. consumed	17,880 MWh
Solar generation	2,240MWh

Birch

Population	5,570
# households	3,057
% households with solar	16%
Total elec. consumed	36,810 MWh
Solar generation	2,130 MWh
Wind generation	10,760 MWh

Goliban

Population	2,107
# households	1,157
% households with solar	23%
Total elec. consumed	9,280 MWh
Solar generation	1,070 MWh

About grid electricity

Electricity from the grid that is generated outside Hepburn is also partially supplied by renewable energy. In April 2018, this totaled around 16% of Victoria's electricity generated

Figure 4: The 2018 energy usage postcard

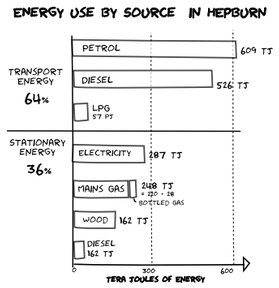
The emissions context

Energy use in Hepburn Shire

znet HEPBURN SHIRE

What energy is used

Hepburn's energy needs are met by natural gas, electricity, firewood, diesel and transport fuels (petrol, diesel and LPG). We use about 1,870 TeraJoules of energy per year.



The energy 'boundary' for ZNET Hepburn incudes all stationary energy used by local residents and visitors, but only transport energy from the local community.

Stationary energy

About 36% of Hepburn's energy needs come from 'stationary' energy sources that power our homes, businesses and infrastructure. A closer look at our stationary energy mix is provided below

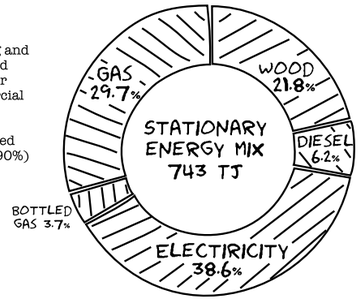
Transport fuels

Transport fuels power the vehicles we use to get around: they account for 64% of energy used by Hepburn's residents and businesses. Petrol is the most used fuel type (51%), followed by diesel (44%) and LPG (5%). All of these fuels produce greenhouse gases and air pollution.

Natural gas: 247 TJ

Natural gas is used by households for cooking and heating both spaces and water. It is also used for industrial and commercial applications.

Most natural gas is piped directly to end users (90%) with the remaining consumed from bottled gas.



Firewood: 162 TJ
from 10kt of wood

Neary 60% of households use firewood for heating sourced, which mostly comes from fallen timber on farming land.

Diesel: 46 TJ
from 1,728 kL of fuel

Diesel is used for farming and agriculture activities (e.g. to power diesel pumps and generators, and for off-road vehicles like tractors).

Electricity: 287 TJ or 80 GWh

Electricity is used for a range of daily business and household needs such as lighting, heating, hot water, equipment and appliances. 23% of electricity comes from local renewable sources: including the households with rooftop solar PV installed (supplying 9.9% of total consumption), and Hepburn Wind (13.5%).

Table 4: Renewable Electricity Mix

Electricity Source		MWh	Energy (TJ)
Grid electricity	(77.2%)	60,961	219.5
Solar	(9.2%)	7,258	26.1
Wind	(13.6%)	10,761	38.7
Total electricity demand	**(per annum)**	**78,980**	**284.3 TJ**

As is represented in Table 4 and in the accompanying postcard, (figure 3) the electricity data is a highly accurate baseline as at 2018, bringing in data sources from Powercor, Clean Energy Regulator, OpenNEM, Hepburn Wind, Australian Bureau of Statistics and Hepburn Shire Council. The current demand is 79,633MWh.

Stationary Energy and Transport

The broader energy context in regards to emissions is described in the above postcard and considers electricity, natural gas, LPG, firewood, diesel and petrol - this relates to energy usage in buildings as well as transport fuels..

Tourism

In high tourism areas such as the Hepburn Shire, exactly who should take responsibility for the footprint of tourism is highly debatable. It is not standard practice for the destination to account for the impact, however, for the purpose of engagement with that sector and best practice, tourism has been accounted for as a breakout piece of analysis, but is not represented in the emissions profile.

As a significant economic base for the shire, a major finding from this work is that the tourism sector produces almost as many emissions as the agriculture sector.

Table 5: Baseline tourism impact

A look outside the Z-NET boundary

Emissions sector	Local	Visitor	
Agriculture	106,325	-	
Stationary Energy	80,466	7,891	(9.2%)
Transport	87,330	76,567	(89.4%)
Waste	6,885	1,158	(1.4%)
Land use, land use change and forestry	-28,014	-	
Total emissions in tonnes CO2-e	**252,992**	**85,616**	
	(74.7%)	(25.3%)	
Total emissions in tonnes CO2-e	**252,992**	**9,049**	
	(96.5%)	(3.5%)	

Visitor transport makes up the bulk of visitors emissions but is excluded from the ZNET boundary as those emissions are captured in the 'home' footprint of visitors.

In regards to the CTP, the impact of weekender or tourist households is also significant when considering future options for engaging with the tourism sector. 30% of households across the Shire are for weekender or tourism purposes as is illustrated in the table below.

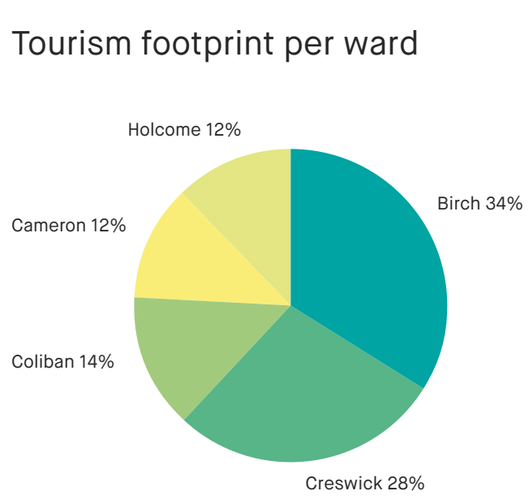
Table 6: Ward tourism profile

Ward level data	Population	# Households Total
Birch	5,570	3,057
Cameron	1,889	1,037
Coliban	2,107	1,157
Creswick	4,338	2,381
Holcombe	1,850	943
Hepburn Shire	**15,754**	**8,575**

Occupied households *	**6,029**
Tourist / Weekender households	**2,546**

*** Occupied households assumed from numbers reported in ABS census**

Chart 7: Tourism by Ward



Once extrapolated out across the wards, the tourism profile tells an interesting story on the carbon footprint of the local areas. In particular the significant weighting of the Brich Ward, which includes tourism hot spots Hepburn Springs and Daylesford. Transport to Hepburn Shire which includes national and international flights and car miles is the significant contributor to the emissions profile.

C

What's Possible and Will it Work?

Zero Net Energy and Zero Net Emissions

Zero net energy for this CTP is defined as a community that reduces and matches its local energy needs with a 100% renewable energy supply. Practically, that means that energy can be imported from the grid or elsewhere, but this needs to be matched with local renewable generation. This calculation is averaged over an annual period of time.

Zero net emissions for this CTP is defined as reaching carbon neutrality, in that the local carbon emissions are reduced, sequestered or offset.

Daylesford was the first example of a zero-net energy town through the development of Hepburn Wind, Australia's first community-owned wind farm. The original Zero Net Energy Town program (Uralla, NSW) defined energy in terms of stationary energy only. Therefore opportunities focused on reducing energy use and developing or importing sufficient renewable energy to balance consumption of stationary energy (electricity, gas and wood).

Given the achievement of the Hepburn Shire to already have a zero-net energy town, the focus has expanded to meet the objective Shire wide, enable the electric vehicle transition and balance remaining gas and transport emissions by exporting the equivalent energy to other communities. This includes a goal of zero-net energy by 2025, with a goal of zero net emissions for the Shire by 2030.

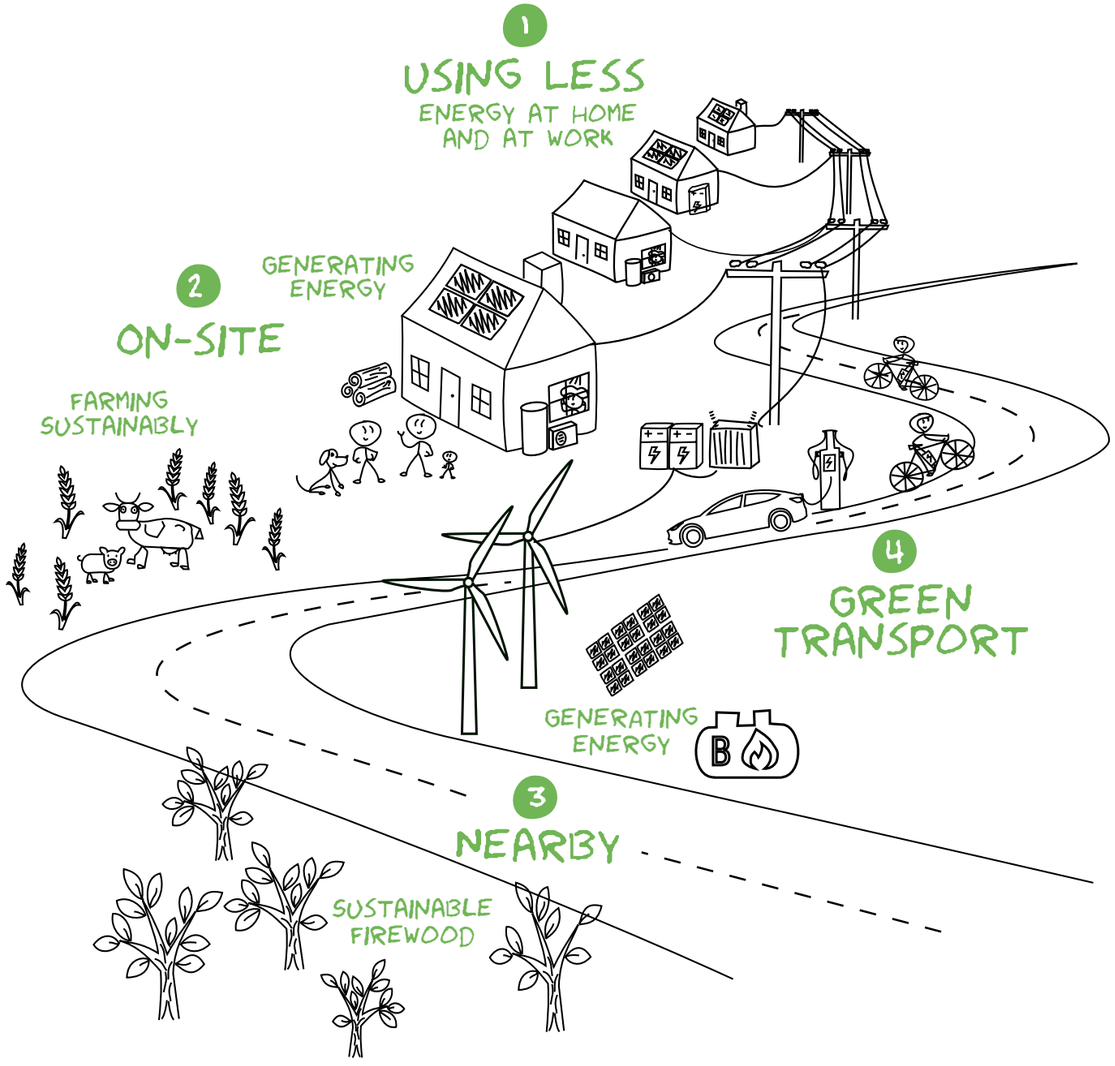
The following opportunities have been identified to progress towards the goal of zero net energy and zero net emissions. These opportunities are grouped as:

- Using less energy
- Generating energy onsite
- Fuel switching
- Generating energy nearby

These opportunities respond directly to emissions associated with the following sectors which are detailed below:

- Stationary Energy
- Transportation
- Agriculture
- Waste and Waste water
- Land use change

Opportunities which focus on energy will be defined first.




ST CEELONG
SCHOOL N°243

From 23% to Meeting 100% Renewable Electricity Supply

The CTP considers that it is vital to focus on how much is needed over time, as it is a far more useful and accurate way to plan for and communicate the magnitude of the task. To inform this, the CTP has undertaken forecasting through the Options Model to consider a number of dynamic factors that will influence the task of reaching zero-net energy, which includes electricity, gas, wood and transport. These dynamic factors include the impact of energy efficiency actions in demand reduction, population increases, the transition off gas based appliances and the transition to electric vehicles. These factors all influence the total emissions profile and therefore the task at hand. The information presented shows how the community can aim for enough installed capacity to achieve the 2025 milestone. Further consideration can also be given to state and federal government targets. For the baseline year of 2018, the Victorian grid is supplied by 16% renewable electricity.

However, despite these interrelated factors, it can also be useful to understand on a high level the task to deal with only electricity as this is a common approach for communities with ambition to reach 100% renewable. The electricity baseline has been completed in a thorough manner, however, it must be noted that it is a moment in time - the 2018 baseline year that is represented and other years will vary. The baseline can be seen on the electricity postcard on page 42 (Figure 2) the current status is 23% renewable electricity supply as at the 2018 baseline year.

Given these considerations, it is possible that an interim target of 100% renewable electricity supply will be met either within Phase 1 or early into Phase 2. This could be monitored and be a cause for community celebration as well as monitoring.

To reach 100% renewable electricity supply an additional 60,961MWh per annum will need to be generated to offset the consumption. Hepburn Wind supplies 10,760MWh and rooftop solar contributes 7,260MWh. This means that the existing wind generation is 4.1MW and the existing rooftop solar PV installations are 5.3MW. Current rooftop solar PV penetration across the Shire is at 19%.

It should be noted that this high level view of moving to 100% renewable electricity supply includes the consumption of Council. Therefore their own activities to reach zero-net emissions by 2021 will influence the strategy deployed.

To reach 100% renewable electricity supply in the most realistic fashion, the electricity component of approximately 60,000MWh is to be offset

This could be supplied by rooftop solar and mid-scale generation.

Rooftop solar PV:
- 50% penetration
- 1254 households
- 6.2MW new solar deployed in the Shire
- 10,000MWh

Mid-scale grid connected generation projects
- 50,000MWh provided through 2-5 local projects dependant on technology and scale deployed
- Examples: 20MW of wind or 30MW of solar (or a combination of technologies)

These strategies are realisable in part through expanding on the current programs such as the Hepburn Solar Bulk Buy and Hepburn Wind actions. They are further enabled by state and local government incentives.

Identifying Projects and Options

This section of the CTP presents findings of the 'Options Model' and recommends a pathway for tackling emissions using a least-cost approach. This requires an assessment of opportunities using detailed financial modelling.

The identification of potentially feasible projects was drawn from a number of sources and methods:
- Around 90 project or program ideas were harvested from the Carbon Free Conversations held across the Shire in 2017. Participants were able to log ideas onto the OurSay platform or provide them at workshops
- A literature review of local historical documents as part of an early context report. Ideas from these were also brought into the project assessment process
- New projects were able to be nominated on OurSay during the Z-NET pilot project
- There were also emergent opportunities that came up through the process that were considered

21 technology postcards[2] were designed specifically for the Z-NET process and were tested around the Shire with 250 community members. The findings from this influenced the opportunities which have been modelled for the CTP. The postcards showed that highest levels of community interest were for battery storage, rooftop PV, hot water and building fabric upgrades (retrofitting). For mid-scale technologies, solar farms were the most popular, followed by wind energy.
It is important to note that many of the achievable projects put forward during the Carbon Free Conversations are already underway, including:

1. Masterplan for Shire
2. Hepburn Solar Bulk Buy program
3. Solar Savers rates program for low income households
4. Business and Farm energy audit matching
5. Training for energy audits
6. Fund to support zero-net emissions

The natural environment projects put forward were still quite conceptual, as were the suggested planning regulation changes. There was a strong focus on community education and awareness raising. The Z-NET CAP were presented with the recommendation that there was the need for foundational work – further investigation, design or feasibility on key issues rather than site specific projects. Community readiness was brought up throughout the consultation process as a necessary consideration of what could be done with existing capacity. The projects suggested by the community are integrated into the implementation table at the end of this document.

[2] *www.littlesketch.es/experiments/ZNET-Hepburn-postcards/*

Opportunities relating to zero-net energy

Hepburn Shire is an established leader in renewable energy, and is learning (like other communities) how to address other emissions sectors. Many of the 'shovel ready' opportunities are in stationary energy, such as the proposed solar farm by Hepburn Wind and the current, and already successful, residential solar PV bulk buy program. There is the opportunity, given this local knowledge and capacity, to move very quickly to achieving 100% renewable electricity supply and then zero net stationary energy using an established mix of on-site opportunities within residences,businesses and community-scale renewable energy projects.

For households, a total of five on-site energy efficiency options were identified with an average simple payback of 5.8 years, including opportunities outlined in Table 7 on page 54. These options are estimated to reduce household energy consumption by 40% by 2029. On site renewable energy (solar PV) is expected to reduce energy demand by a further 18.9%, while another 15.3% of stationary energy (by GJ) currently from gas combustion could be switched to (clean) electricity.

The immediate financial return for some on-site activities is complicated by the high proportion of weekenders. This results in the financial payback being lower, due to periods of time where the property is vacant. However, with the payback from solar power improving all the time it can still represent a worthwhile investment.

For businesses, options for energy efficiency and renewable energy have the potential to reduce stationary energy emissions by 10.4%.

The contribution of household (9.8% of total emissions) and business abatement options (2.3%) need to be supplemented by utility scale renewable and sustainable energy projects that can reduce stationary energy emissions by a further 42.8% by 2029.

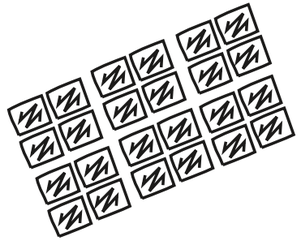
Achieving this relies upon significant uptake in energy efficiency within business and households; significant on-site generation; and significant new solar and wind capacity investments across at least 2-3 sites. The distribution network (22kV) is unable to handle greater than 10MW export at a single location but the 220kV line will be able to support larger capacity.

The successful delivery of all the identified stationary energy opportunities provides a 100% renewable electricity supply by as early as 2024. This would signal a landmark achievement for a rural community.

Balancing the firewood supply with reforestation is capable of delivering a 100% renewable wood supply within the 10 year transition timeframe.

As an example for the Hepburn Shire, with over 45% of their stationary energy profile relating to wood usage, the Uralla Z-NET group are undertaking a three year project titled 'Elephant in the Woodland' looking at sustainable firewood, biodiversity on farms and the impact of wood collection, the education of collectors to collect sustainably and the education of users as to what is sustainable wood.

Gas (both mains and bottled) and to a lesser extent diesel generation are likely to remain as a significant form of energy use at the end of the transition period. However, in energy terms these could be offset by the surplus electricity exported to the grid subject to the renewables target being met.



The opportunity groups are defined below:

Using less energy
Reducing energy consumption through behaviour changes and measures, such as increasing the thermal performance of homes and businesses (e.g. through insulation) and installing energy efficient appliances. These actions reduce the amount of energy required to power the town - making the goal of zero net energy more achievable.

Generating energy on-site
Generating energy on local residential, commercial and community properties, both to offset energy consumption (behind the meter) and to potentially export energy to the grid for use by others. Battery storage could enable energy generated on-site to be stored for later use. This also includes firewood resource replenishment on site.

Fuel switching
Switching fuels from a fossil fuel to a source more easily matched with renewable energy. This includes replacement of gas and wood appliances with electric ones. These activities drive energy use from other sources towards electrical energy, which can then be matched with greater renewable energy generation locally (including electricity generation and nearby forest management and reforestation which can create a sustainable source of wood energy).

Generating energy nearby
Generating renewable energy within the Shire boundary from places such as appropriately located wind turbines and solar farms. For wood energy, this means improved management and reforestation on sites in and around Hepburn, that will help match the firewood usage and supply of the region.

Opportunities analysis method
An assessment approach was applied to 16 possible energy abatement options. The majority of options were communicated through a 'postcard' which evaluated the technology and resource in relation to the local context. Those options that were applicable in the local context were then modelled according to their impact in meeting zero net energy, zero net emissions (within their emission sector) and their financial implications.

The following table outlines the opportunity within the stationary energy sector:

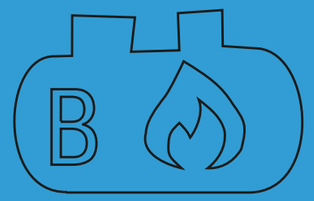
Table 7: Stationary energy opportunities and options

Opportunity group	Opportunity set	Abatement option	Option description
Using less	Home energy efficiency upgrades	Residential Hot Water - Heat pump	More than 50% of households in Hepburn Shire have electric storage hot water systems, and a further 30% run from gas or wood. These are a very inefficient way of heating water and a large contributor to household energy use. Powering the electric hot water systems from solar PV, or replacing any of these with a heat pump or solar hot water unit offers significant savings.
Using less	Home energy efficiency upgrades	Residential lighting	Lighting makes up around 10% of Australia's energy consumption. The relatively recent use of halogen downlights in some households means that the proportion of energy used for lighting in these homes is even higher. 50% of all lamps are incandescent or halogen types which are obvious targets for replacement. Replacing halogen with high quality efficient LED alternatives can save 80% of the energy used in lighting.
Using less	Home energy efficiency upgrades	Residential appliances	Older electrical appliances can account for the largest proportion of household consumption (up to 35%). Older appliances (such as fridges) generally draw higher operating and standby power and are particularly good targets for upgrades. Measures such as Minimum Energy Performance Standards (MEPS) and Energy Labelling, help to guide improvement in energy efficient appliances.
Using less	Home energy efficiency upgrades	Residential heating and cooling	Energy used for residential space heating throughout most of Victoria, and Hepburn specifically, is high. Of total heating/cooling energy used, often somewhere between 80-90% is associated with heating. The availability of timber means a high proportion of space heating in Hepburn uses wood (58% of households) with an average 3.5 tonnes burnt annually per home. Many homes will have reverse cycle air conditioning, however the use of these for heating is often quite low. The best options for space heating are efficient pelletised wood heaters or reverse cycle (heat pump) air-conditioners.
Using less	Home energy efficiency upgrades	Residential thermal fabric	Most houses built before the year 2000 have limited or no insulation. Houses without insulation have poor thermal performance. Draughts and large glazed areas are also factors in poor thermal performance. An average house without insulation can be improved by 2 to 3 stars with insulation and some other basic efficiency measures. This equates to a 50% energy saving for space conditioning.
Using less	Business Actions	Business energy efficiency	Small to medium local businesses often have significant energy use associated with heating/cooling, lighting and appliances (e.g. servers, computers etc). Businesses can also have high standby power loads from leaving equipment running 24/7. Larger commercial and industrial businesses often have very high heating loads - for space and water heating, as inputs to other processes. A number of options exist for more efficient management of large electrical and gas loads.
Fuel switch	Home fuel	Residential Dual Fuel to all-electric	Over 80% of Victorian homes operate as "dual fuel" - meaning the use of both electricity and gas. Gas is used most commonly to supply cooking, space heating and water heating - with the last two typically comprising 50% to 75% of a household's energy use. Electricity offers the potential for far more efficient space and water heating (through heat pump technology) and the ability to supply these loads from renewable energy - saving both emissions and money. Solar powered, all-electric homes typically cost between zero and $1,000 per year to run - as compared with almost $3,000 per year for typical Victorian dual fuel homes.
Generate on-site	Home generation	Residential solar photovoltaic	Hepburn has excellent climatic conditions for solar. The total rooftop solar capacity in Hepburn is estimated to be nearly 6 MegaWatts (the equivalent of 1,250 large household systems of 4kW each), based on an available rooftop area of 82,000 sqm. Using all of this roof space could meet about 40% of Hepburn's total household annual electricity demand.
Generate on-site	Home generation	Residential battery storage with solar	Should some form of community micro-grid or virtual power plant be possible in the future, medium scale storage options may be attractive to store and supply power locally. At a household level, storage enables high utilisation (e.g. 80-90%) of on-site solar generation with the grid being used as a back up during low generation periods (e.g. winter). Substations and power lines around the Hepburn Shire are not currently constrained and should be able to accommodate a reasonable increase in solar PV across Hepburn. The introduction of battery storage on the low voltage side of the substation reduces the impact of high penetrations of solar PV and may avoid the need for punitive solar export limiting or even refusal.
Generate on-site	Business Actions	Business Solar PV	Businesses typically have excellent "load profiles" for integration of solar PV - that is, they tend to use a lot of electricity during the day when solar PV generates electricity. Many businesses can also take advantage of larger solar PV systems, having larger roof spaces, higher electricity use and higher connection capacity to the grid. As such, the economics of solar PV at small, medium and large commercial and industrial sites tends to be even more attractive than for residential.
Nearby	Shire / Grid scale electricity actions	Restoration and reforestation for firewood(energy component	Over half of Hepburn homes (58% according to the ZNET Hepburn Household Survey, 2018) use wood for heating, with around 20% of those households harvesting firewood from their own properties. And while this wood (including fallen timber), may seem 'renewable' or 'grown on-site', the definition of wood as a 'sustainable resource' is more complex. Moreover, sustainable firewood is more accurately defined as coming from a (usually certified) sustainable source where regrowth of any consumed wood is managed. Purchasing sustainably grown firewood ensures that the net emissions from burning firewood are offset by the regrowth of timber (i.e. a net zero emissions outcome). However, sustainable firewood has a cost premium.

Opportunity group	Opportunity set	Abatement option	Option description
Nearby	Shire / Grid scale electricity actions	BioEnergy	Council is developing a pilot project, with views to expand to a 65kW system which delivers 252 MWh of electricity into the grid per annum and a 257MWh heating load. Whilst it is unlikely that the bio-energy will be a significant contributor to the CTP the Hepburn Shire Bioenergy Plant will make a modest contribution. Productive land in the Hepburn Shire is primarily pasture land for grazing. Crop stubble is minimal. Forestry activity and saw milling occur in neighbouring shires, but not within the Hepburn Shire. Fallen hardwood is available as a resource in the area, but this is currently used for space heating (a high percentage of households use wood heating). The Shire's waste is a reasonable source of biogas.
Nearby	Shire / Grid scale electricity actions	Micro Grid / VPP	Community microgrids utilise local resources to meet local demand. They enable high local penetration and sharing of technologies such as solar, wind, hydro, storage, combined heat and power and demand response. Microgrids also reduce losses in the electricity network. A Virtual Power Plant (VPP) is a similar concept that is less constrained by geography. VPPs use internet technologies to aggregate consumption and production from multiple households and businesses: this allows distributed energy resources (DERs) like solar, batteries and 'flexible' loads to participate in markets for energy generation and grid support services.
Nearby	Shire / Grid scale electricity actions	Utility Scale Solar PV (23MW)	Hepburn has a medium solar exposure and plenty of available land for utility scale solar. Engagement with the local electricity distributor has indicated that a single large utility scale project would be feasible in Hepburn Shire on the 220kv line. Further, a number of small to mid-scale projects could be integrated on the 22kv. This option includes the proposed 3MW solar PV farm which will be integrated with the Hepburn Wind project.
Nearby	Shire / Grid scale electricity actions	Utility Scale Wind (20MW)	The total wind resource in the region is high. Accounting for appropriate land uses, elevations, and population data, the wind farm capacity in the Hepburn area has been estimated at 1,500MW, however the lack of access to the grid renders many of these sites inappropriate, as does proximity to households. Hepburn lies on tablelands with a reasonable to good wind resource and predominantly grazing farmland that is suited for wind turbines. The wind is already being harvested by Hepburn Wind's two community-owned turbines at Leonards Hill, generating enough power for 2,000 homes at around 11,000MWh per annum. Current turbines are scaled at 4-5MW, a mid-scale wind farm could meet this quota easily.
Fuel switch	Transport	Electric vehicle (EV) transition	Australia has been slow to embrace EVs - partly due to a lack of model availability, current premium costs and concerns about vehicle range and charging infrastructure. However, EVs are forecast to comprise over 50% of light vehicles sales within 20 years. Recent modelling suggests that the replacement of all internal combustion engines with battery EVs in Australia would increase total electricity demand by around 26%. For Hepburn, the electrification of transport is an opportunity to target around 50% of energy demand and 33% of total emissions.

In communities with limited renewable energy potential, importing or procuring green energy would generally be considered. However, opportunities analysis suggests that Hepburn can reach 100% renewable electricity supply without the need for procurement from other communities.

Sourcing bottled biogas and sustainable wood would also contribute to Hepburn meeting its zero-net energy target.



Grouped stationary energy opportunities are presented on the following page according to their impact in meeting zero net energy, zero net emissions (within their emission sector) and their financial return.

An overall assessment of their value according to a human-centered design framework (financial viability, technological feasibility and social desirability) is also provided. Social desirability was correlated through community forums in which 250 citizens engaged and voted on the 21 technology postcards.

Reference to the methodologies used are available in the Options Model (see Appendix A).

Table 8: Impact of Stationary Energy Actions

Opportunity group	Opportunity set (group)	Modelled uptake	Impact (yearly)		Financial (2018)	Overall assessment (financial viability, technical feasibility and social desirability)			Notes
			Energy (GJ) (% of total stationary energy)	Emissions (t CO2-e) (% of total emissions)	NPV	$	Tech	:)	
Use less	Home energy efficiency upgrades	Based on between 14% and 80% uptake for individual energy efficiency actions.	85,223 GJ -9.80%	10,246 t -3.50%	$11,964K	2	3	3	Established technology, business case slightly reduced by high number of weekenders
Use less	Business actions	Based on 80% uptake rate for small businesses.	9,927 GJ -1.10%	3,199 t -1.10%	$2,743K	3	2	2	Very positive business case, but businesses have historically been challenging to motivate to take action.
Generate on-site	Home & Business	Based on 50% target of solar penetration for households and 80% of businesses.	50,243 GJ -5.80%	18,847 t -6.40%	$15,668K	3	3	3	Declining costs has made onsite PV very attractive and the technology has significant support locally.
Fuel switch	Residential dual fuel to all electric	Based on uptake of 50% of dual fuel households.	32,720 GJ -3.80%	3,752 t -1.30%	-$15,227K	1	2	2	Business case on an individual level improves markedly when only one gas appliance left to replace.
Nearby	Reforestation (for firewood)	Based on uptake of the 58% of homes using wood heaters.	193,321 GJ -22.2%	NIL	-$8,705K	1	3	2	Poor financial viability, but necessary to deliver net zero energy for wood.
Nearby	Solar, Wind & Bioenergy	Based on the deployment of 43MW of new renewable energy capacity.	387,613 GJ -44.5%	126,812 t -42.8%	N/A	1	2	3	Declining costs will see the financial case continue to improve over the next few years.

Opportunities Relating to Zero-Net Emissions

The opportunities that contribute to emissions reduction beyond energy have been developed at a high level to inform the CTP. Further work will be required to refine these options as detailed analysis of options outside energy was not included within the current scope of the work. The pathway for addressing these opportunities including research and pilot trials are outlined in Section E - Implementation Plan. The detailed opportunities analysis for emissions reduction outside energy is not exhaustive, but includes the major opportunities for a pathway towards zero net emissions. The opportunity groups are defined below.

Using less
Reducing emissions through measures such as reduction in the emissions intensity of agricultural production and waste reduction practices.

Generating on-site
Generating or producing offsets on site, through practices such as emissions capture (capturing and destruction of methane from manure) and soil carbon sequestration.

Fuel switching
This includes the emissions benefit of re-directing fossil fuel based emissions to electricity where they can be more easily mitigated through increased renewables and switch out of diesel in favour of sustainably sourced biodiesel.

Generating nearby
Generating or producing offsets at the community scale, such as vegetation management through to carbon capture (reforestation) and Greenpower options or carbon-neutral electricity options (such as Powershop).

Opportunities analysis method
An assessment approach was applied to 14 possible (non-stationary energy) abatement options to contribute to zero net emissions. Options were communicated through a 'postcard' which evaluated the opportunity in relation to the local context. Those options that were applicable in the local context were then modelled according to their impact in meeting zero net emissions (within their emission sector) and their abatement cost.

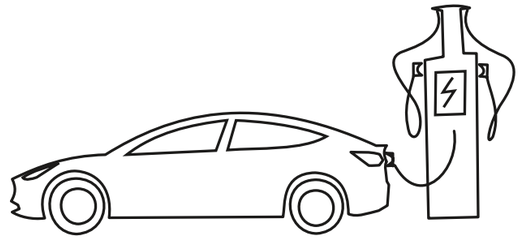
Transport

In pure energy terms, the transport energy profile is approximately two times stationary energy, but is similar in emissions terms. As a rural community with high levels of private transport use, focusing in the short term on promotion of other transport modes or preferably purchasing more fuel-efficient vehicles makes sense technically and financially.

In the medium term, an accelerated shift to electric vehicles will deliver significant benefits, by significantly reducing the energy use associated with private transport and directing emissions towards renewable electricity. This change allows the community to absorb transport emissions through existing and new community-scale renewable energy projects.

The model forecasts a transition of Hepburn's vehicle fleet to electric vehicles over the 10 year Z-NET timeframe. It firstly acknowledges that the predicted uptake in (full plug-in) electric vehicles is highly uncertain and contingent on policy decisions, the willingness of manufacturers, and the development charging infrastructure etc. However for the purpose of illustrating the potential impact of EVs on transport emissions and energy demand (particularly the increase in electricity demand in the Shire for charging), this option targets the 'owners case' for both passenger and LCVs - heavy trucks are not considered as EV-versions are in further in their infancy for these large trucks.
An overview of the contribution of each transport opportunity to reaching Z-NET are listed to the right. The opportunities are further detailed in the table on the next page.

LOW EMISSION PASSENGER VEHICLES	Contribution to reaching -NET	1% of emissions 2.9% of transport 2.9% of transport energy
ELECTRIC VEHICLE TRANSITION	Contribution to reaching Z-NET	10.6% of emissions 30.5% of transport emissions 18.9% of energy 20.9% of transport energy
RESIDENT RIDE SHARE / ACTIVE TRANSPORT	Contribution to reaching Z-NET	0.8% of emissions 2.4% of transport emissions 2.4% of transport energy
LOW EMISSION LCVs AND TRUCKS	Contribution to reaching Z-NET	0.9% of emissions 2.5% of transport emissions 2.5% of transport energy
BIODIESEL FOR TRUCKS	Contribution to reaching Z-NET	1.5% of emissions 4.5% of transport emissions 0.0% of transport energy



The following table outlines the opportunity within the transport sector:

Table 9: Transport opportunities and options

Opportunity group	Opportunity set (group)	Abatement option	Option description
Using less	Local transport	Low emissions passenger vehicles	This option considers the (encouraged) transition of Hepburn's current residential and commercial/industrial passenger vehicles to newer and more efficient models (i.e. smaller internal combustion engine vehicles). Modeling in this option assumes that average vehicle mileage remains consistent over time (i.e. does not include behavior change and modal shift impacts). The option targets four vehicle types for a combination of replacement with smaller (i.e. 6 cylinder to 4 cylinder and 8+ cylinder to 6 cylinder) and/ or more efficient (newer) engines, based on Australian average fuel efficiencies for newer (less than five years old) vehicles.
Using less	Local transport	Low emissions LCVs and trucks	This option considers the (encouraged) transition of Hepburn businesses' light commercial vehicles (LCV) and assorted trucks to newer and more efficient models. Modeling in this option assumes that average vehicle mileage remains consistent over time (i.e. does not include behavior change and modal shift impacts). Opportunity modeling using Australian datasets (ABS, 2016) shows that newer model LCV and non-freight trucks have tended to be more efficient (around 5%) than older models, however the efficiency of heavy trucks (i.e. Rigid and Articulated) has on average not improved. Accordingly, while LCV/non-freight efficiency is modeled as a natural turnover (with zero marginal cost), modeling of the changeover of Rigid and Articulated trucks to more efficient versions is assumed to have a marginal cost (i.e. a 'premium' model assumed to be 'more efficient').
Using less	Local transport	Resident ride share / public transport	Ride sharing (e.g. car pooling) and choosing active transport modes (e.g. walking and cycling) are two simple ways to reduce the number of trips made using transport fuels, and therefore emissions generated. This option looks at how each of these options could reduce emissions from: a) Trips "to and from work" by Hepburn residents able to ride share/carpool, and b) 'Personal' (i.e. non-work related) short trips (under 5 kms) that could be shifted from car travel to active mode of either walking or cycling. Trip "type" data is taken from the ABS Motor Vehicle Survey (2016) for Victoria and from the ZNET Hepburn Survey (2018). Already there are local programs such as the 'Creswick Car Pool' initiative that can be expanded on.
Fuel switch	Local transport	Biodiesel for trucks	Biodiesel is a near zero emission alternative to regular diesel that can be used in (most) existing diesel vehicles. This option models the transition of Hepburn businesses' diesel trucks to using B20 Biodiesel (i.e. Blended 80% diesel and 20% biodiesel). Modeling in this option assumes that average vehicle mileage remains consistent over time (i.e. it does not include behavior change and modal shift impacts).
Fuel switch	Local transport	Electric vehicle transition	Electric vehicles (EVs) use electric motors to drive their wheels. Electricity is either stored in batteries in the vehicle, or generated by a secondary motor powered by petrol or diesel (i.e. a hybrid-electric vehicle). Battery powered EVs and 'plug-in' hybrids can be charged using (high capacity) home charging units or at public charge stations. Similar vehicle electrification trends are happening in commercial and public transport. Importantly, the replacement of vehicles with electric versions increases overall electricity demand, meaning that EVs are a way to 'switch' from fossil fuels to renewable (electricity). Already there are three local public EV charging stations in the shire.

Agriculture

The overall trajectory for reaching zero net emissions in sectors like agriculture is much more reliant on non-local factors. There are industry challenges which cannot be immediately solved. For example, further industry research is required to better understand how more humane measures can be taken to reduce enteric emissions of livestock. There is action that Hepburn can take, but it will need to be respond to the risks to ensure that the local industry is not overly or unfairly burdened by the impact of innovation cost.

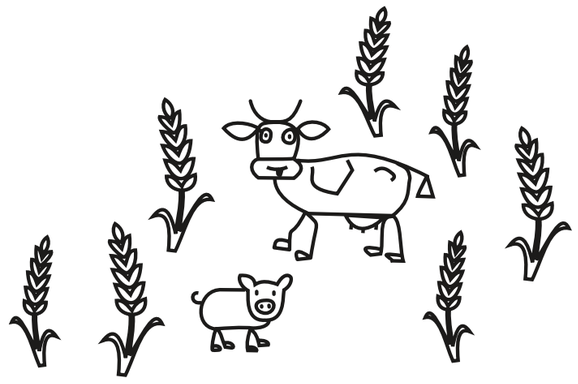
There are two broad patterns on sustainable agriculture and food. The first presents the case for humanity to move to a 'plant rich' diet. This means reducing the increasingly 'meat rich' diet now being adopted by middle-income countries as well. The other aims to maintain the same 'meat rich' diet albeit with high technology, efficiency, holistic management and a focus on biology, soil health and eco-system services.

The case for reducing agricultural emissions is emerging within Australia and internationally. Therefore it is useful to continue to monitor where the sector is at, from a top down approach as well as on the ground pilot projects. In the case of the peak body for livestock - Meat and Livestock Australia (MLA), there is a project with CSIRO to identify pathways to reach the target of carbon neutrality by 2030. Current strategies under investigation include genetic selection, vegetation management, feedlotting, feed supplements, fire management, dung beetles and legumes.

MLA perceives the co-benefits of working to a carbon neutral goal as:

- increased productivity in the red meat industry
- additional farm income from carbon mitigation projects
- contribution to government targets on emissions reduction
- high quality product for consumers

The practices listed in the two case studies on the following page are recognised and approved under the Australian Government's Emissions Reduction Fund (ERF), which "provides incentives for Australian businesses, farmers, land holders and others to adopt new practices and technologies to reduce Australia's greenhouse gas emissions", (CER, 2018). These 'incentives' are in the form of Australian carbon credit units (ACCUs), which are generated from each project and sold to the Australian Government. The context for referring to the ERF methods is that these are the types of actions that should work and are robust. It should also be considered that the same actions (at smaller scale, that may be more suited to Hepburn farmers) can still be done and reduce emissions outside the ERF.



Victorian pilot project case studies are listed below.

Bimbadeen

Bimbadeen is a 300 head cattle farm on Phillip Island that has been producing carbon neutral beef since 2014, sequestering around 200 tonnes per hectare. To reach its goal of carbon neutrality, the farm has deployed an action plan based around:

- Continuous grazing - cycling the cattle and cell grazing
- Animals - genetic selection and changing feedstock to impact methane emissions
- Energy - vehicles, waste products, building and equipment
- Vegetation and soil management - sequestering carbon, soil retention, habitat creation, stock protection, tree planting

Bimbadeen's carbon sequestration comes from mulching deep rooted crops and reforestation on site. The farm has been able to increase the total organic carbon from 160 tonnes/ha to 220 tonnes/ha within three years in selected paddocks. For farmer Bob Davie, the first step was to calculate the carbon footprint per Angus cow with the formula of 19 kilograms of C02-e per kilogram of carcass. For soil carbon, a government-approved test for carbon credit units was deployed. Up to two tonnes of carbon can be sequestered to the soil from a five tonne crop. Bimbadeen now is host to honey production, free-range eggs and agri-tourism.

Meredith Dairy

Meredith Dairy deploys a comprehensive sustainability portfolio of actions including:

- annual tree planting program to promote biodiversity and C02 sequestration
- no till cropping, direct drill sowing of crops, stubble retention
- monitoring & replenishing soil nutrients
- rotating plantings of clovers & lucerne to promote soil fertility
- purchasing green power and using renewable Biofuel (when available)
- solar hot water systems
- solar panels and a solid fuel boiler, which uses waste timber instead of non-renewable LPG
- stock rotation and exclusion from sensitive landscape areas like waterways
- monitoring via surveys of biodiversity, stream quality & carbon consumption.

CLIMATE SMART FARMS	Contribution to reaching ZNET	**14.2% of emissions** 2.9% of stationary energy 1.7% of electricity
SOIL CARBON SEQUESTRATION IN GRAZING SYSTEMS	Contribution to reaching ZNET	**5.9% of emissions** 16.5% of agriculture emissions
HERD MANAGEMENT FOR BEEF CATTLE	Contribution to reaching ZNET	**0.8% of emissions** 2.1% of agriculture emissions
BEEF CATTLE: FEEDING NITRATE SUPPLEMENTS	Contribution to reaching ZNET	**0.8% of emissions** 2.1% of agriculture emissions
DAIRY CATTLE: FEEDING DIETARY ADDITIVES	Contribution to reaching ZNET	**0.3% of emissions** 0.9% of agriculture emissions

New South Wales examples include The Carbon Farm at Bingara, which is a community owned asset. It consists of an area of 100 hectares of formerly degraded grazing land. It is being regenerated to showcase the options for sequestering carbon into soil. The Carbon Farm will provide a site for farmers, researchers, and visitors to participate in, to see and to consider the many and varied options for soil management and carbon capture.

Another community project builds on the Natural Sequence Farming pilot project at Mulloon Creek. The project scales up the outcomes from the Mulloon Community Landscape Rehydration Project (MCLRP) which now involves around 20 landholders. The project aims to rebuild the natural landscape function of the entire Mulloon catchment and boost its resilience to climatic extremes. This will lead to more reliable stream flows, improved ecosystem functioning and enhanced agricultural productivity.

The pathway developed recognizes that whilst farmers are able to impact agricultural emissions, the opportunity to go significantly ahead of an industry wide transition is somewhat constrained. For this reason, the analysis included evaluation of offsets within the sector and within the community boundary. In practice, this means that land use change emissions are offset in Hepburn by reforestation within the Shire boundary as a priority before equivalent offsets are sought beyond Shire borders. The following table outlines the opportunities within the agricultural sectors.

Table 10: Agriculture opportunities and options

Opportunity group	Opportunity set (group)	Abatement option	Option description
On-site	Agriculture	Climate smart farms	This option targets small and medium sized farms for implementing a suite of zero net carbon actions on farm that include: addressing on-farm fuel and energy use, reducing animal (enteric) emissions via feed stock and capturing carbon in soils through various practices and technologies.
On-site	Agriculture	Herd management for beef cattle	Better herd management practices for beef cattle can reduce the emissions intensity of production. These practices are recognised and approved under the Australian Government's Emissions Reduction Fund (ERF), which "provides incentives for Australian businesses, farmers, land holders and others to adopt new practices and technologies to reduce Australia's greenhouse gas emissions", (CER, 2018). These 'incentives' are in the form of "Australian carbon credit units" (ACCUs), which are generated from each project and sold to the Australian Government. Under the "Beef Cattle Herd Management" method, crediting is based on emissions reductions achieved through efficiency gains, where emissions are reduced while beef production is maintained or increased.
On-site	Agriculture	Beef cattle - feeding nitrate supplements	Feeding nitrate containing supplements to beef cattle, by replacing urea lick blocks with nitrate lick blocks for pasture-fed beef cattle, can reduce emissions from enteric fermentation (i.e. in the cow's stomach). This practice is recognised and approved under the Australian Governments Emissions Reduction Fund (ERF). Feeding nitrate supplements may be adopted without participation in the ERF (which is more suited to larger or aggregated herd sizes). Moreover, the benefits of participating in a "Feeding Nitrates to beef cattle" ERF project are expected to cover the costs. The economic case for those participating under the ERF are expected to include costs of new practices, monitoring and auditing (for ERF), and benefits of improved productivity (i.e. as cattle are expected to better utilise the pasture they consume) and the value of ACCUs.
On-site	Agriculture	Dairy cattle - feeding dietary additives	Feeding high fat dietary supplements to dairy cattle reduces methane produced in the cows' rumen and emissions of nitrous oxide and methane in dung and urine. This practice is recognised and approved under the Australian Governments Emissions Reduction Fund (ERF)[3]. Feeding nitrate supplements may be adopted without participation in the ERF (which is more suited to larger or aggregated herd sizes). Moreover, the benefits of participating in a "Reducing greenhouse gas emissions in milking cows through feeding dietary additives" ERF project are expected to cover the costs. The economic case for those participating under the ERF are expected to include costs of supplements, monitoring and auditing (for ERF), and benefits of improved productivity (i.e. as cattle are expected to benefit from improved digestion) and the value of ACCUs.
On-site	Agriculture	Soil carbon - sequestration in grazing systems	The soil in grazing systems can be managed to sequester carbon dioxide. Some of these methods relate to: 1. Shifts within an existing cropping or mixed enterprise system, such as: rotation to eliminate fallow with a cover crop, rotation to increase the proportion of pasture to crops and pasture, rotation pasture cropping. and organic matter and other offsite additions 2. Shifts within an existing pastoral system: Increasing productivity through irrigation or fertilisation, rotational grazing and shifts to perennial species 3. Shift to different system: Conventional to organic farming system, Cropping to pasture system, and Retirement of land and restoration of degraded land Any combination of these practices that sequesters carbon in grazing system soils may form the basis of an eligible ERF project under the "Sequestering carbon in soils in grazing systems". However it should be noted that soil carbon projects under the ERF require highly technical measurement and verification methods.

[3] www.cleanenergyregulator.gov.au/ERF

Waste & Waste Water

Emissions associated with waste and wastewater are in the control of community, Council and the local water authorities (Central Highlands Water and Coliban Water). Both Council and the water authorities have made public commitments to zero net emissions within the timeframe of the Transition Plan, which means that the waste emissions sector will reduce to negligible levels by 2029. The community can assist in the transition through a reduction in waste going to landfill which would otherwise need to be offset under the Council's commitment to reach zero emissions in waste. The following table outlines the opportunity within the waste and waste water emissions sector:

Table 11: Waste and waste water opportunities and options

Opportunity group	Opportunity set (group)	Abatement option (opportunity)	Option description (from postcard)
On-site	Waste	Reduce waste to landfill	Landfill waste - particularly of organic content - emits greenhouses gases as waste decomposes. This option provides a general opportunity assessment for reducing the amount of waste to landfill through a combination of actions to use/waste less, increase recycling rates and to compost organic materials on site. These are just a handful of the household and business-level behavioral change opportunities outlined into the Hepburn Shire's Waste Management and Resource Recovery Strategy (2014). Policy and strategic actions at the Council and Regional level - outlined in the Grampians Central West Waste and Resource Recovery Group's Regional Waste Management Plan - are assumed to be implemented to support the outcome of reduced landfill waste. It should be noted that reducing organic waste for collection will impact the amount of available feedstock for waste to energy projects, however the priority should be on waste minimisation measures as this will deliver greater environmental benefits.
Nearby	Waste	Hepburn Council Zero Emissions Waste commitment	Council is actively working towards diversion of waste from landfill. In addition to the detrimental environmental impacts of sending waste (particularly organic waste) to landfill, the economic burden is significant for a rural local government area. Diversion of waste from landfill is well supported in community, however the particular methods used for this diversion must be assessed on a case by case (material, community, cost) basis.
Nearby	Waste	Central Highlands Water Zero Emissions Waste commitment	Central Highlands Water is committed to minimizing its environmental impact by responding to the challenge of climate change. This will be achieved by: - Preparing an annual inventory of greenhouse gas emissions and energy consumption - Forecasting greenhouse gas emissions over a five year period - Identifying and assess greenhouse gas reduction opportunities - Incorporating cost effective and sustainable greenhouse gas and energy reduction opportunities into strategic and regulatory planning processes

Land Use

The principal opportunity in the land use sector is through reforestation of land as carbon sinks, as outlined below.

Table 12: Land use opportunities and options

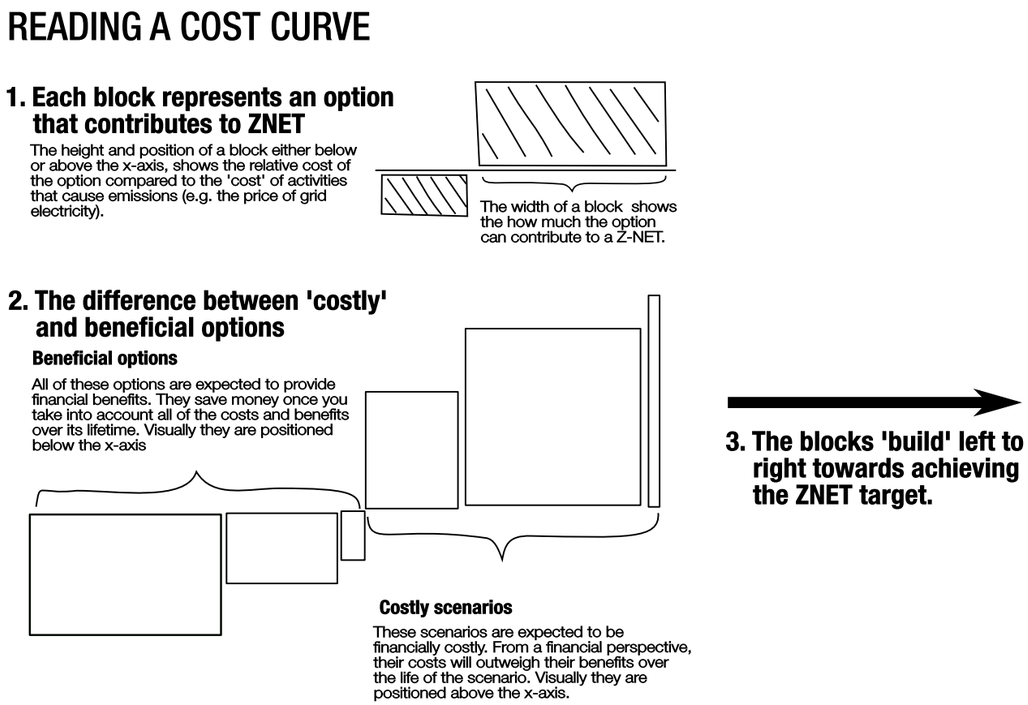
Opportunity group	Opportunity set (group)	Abatement option (opportunity)	Option description
Nearby	Land use change	Restoration and reforestation (carbon sequestration)	Carbon sink forests are for the dedicated purpose of carbon sequestration (absorbing carbon from the atmosphere). Reforestation projects not used for firewood (or other wood products) act as carbon sinks in the Shire. The Wombat State Forest acts as a significant carbon sink in the Hepburn Shire. There are three primary categories of land use changes: 1. Land clearance, and the resulting loss of stored biomass (land clearance may either be new land clearance, or re-clearance) 2. Afforestation 3. Bushfires

Zero Net Emissions Cost-Curve

The CTP is underpinned by the least-cost pathway. That is, it is a strategic prioritisation and planning tool as well as a 'communication' tool. In order to communicate the relative costs of opportunities to reach zero net emissions, a cost-curve has been developed which summarises the impact against the goal of zero net emissions and the relative cost or benefit.

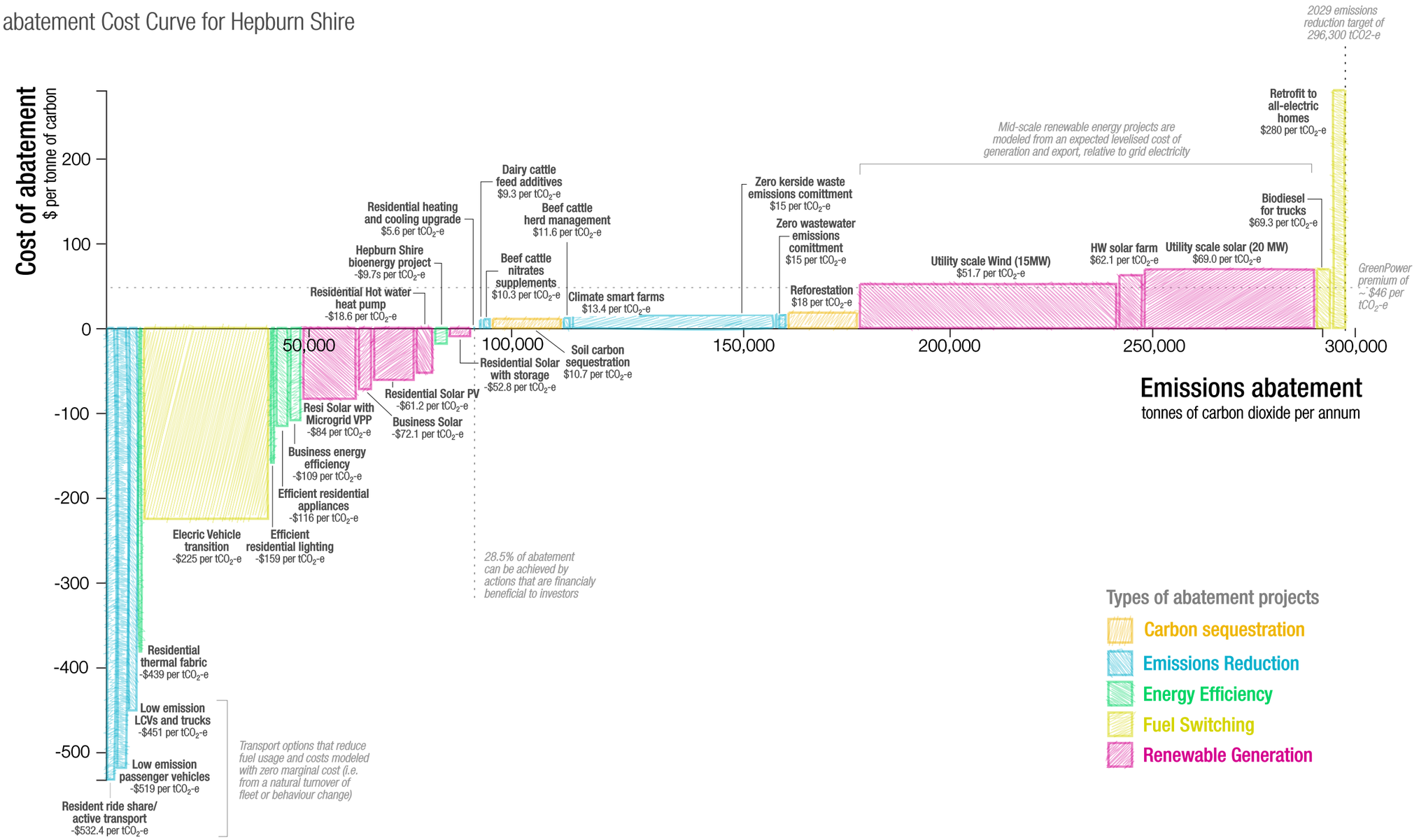
The following figure represents how to read the cost-curve chart (Chart 8) on the following pages 76-77. References to the costs are available in the Options Model (Appendix A) and it is modelled through to the 2030 target.

Figure 5: How to read the cost-curve chart



COMPARING OPTIONS TO TRANSITION TO ZERO NET EMISSIONS

An emissions abatement Cost Curve for Hepburn Shire



The Options Model

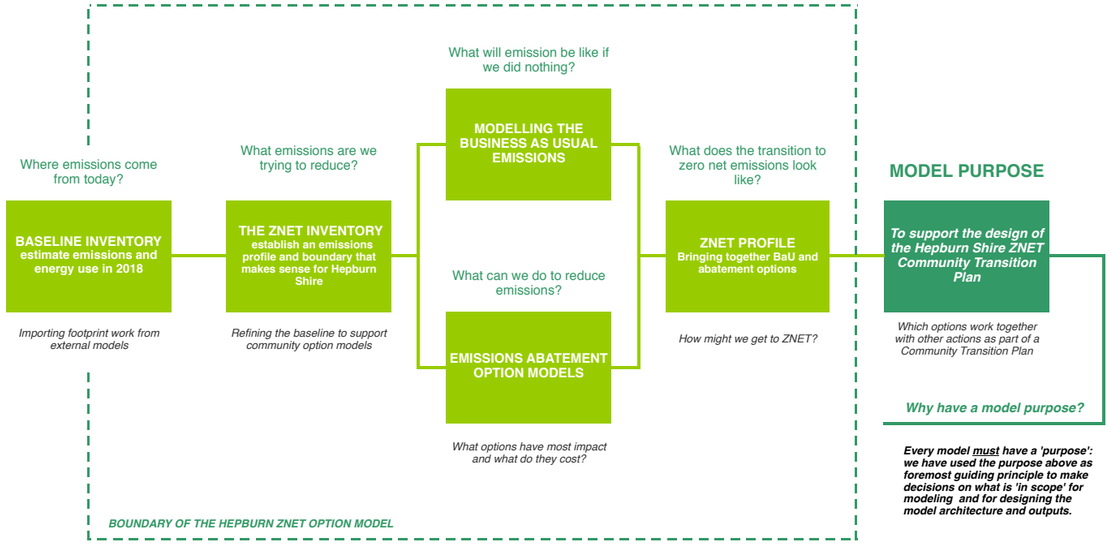
The Z-NET Options Model was used for scenario mapping of 138 emission reduction activities. These activities were selected for their technical feasibility, economic viability and social desirability (incorporating social justice considerations). Options modelling enabled the project team to compare the costs, benefits and impacts of emission reduction activities and prioritise their implementation. These individual abatement options were then grouped and staged logically to develop the CTP. All models are versions of the real world that simplify complexity and help better understand what really matters and where to focus attention and this options model is no exception. It is in no way exhaustive, but helps to understand the costs, benefits and impacts of a suite of energy and other 'emissions abatement actions' that have been selected for their combination of technical feasibility, economic viability, and social desirability (incorporating social justice considerations).

"Essentially, all models are wrong, but some are useful" (George Box, statistician)

How the various sets of data intersect is depicted in the graphic opposite:

The immediate focus of this CTP is energy, and abatement options have been developed with the intermediate goal of delivering zero net energy for the community.

Figure 6: The Options Model diagram



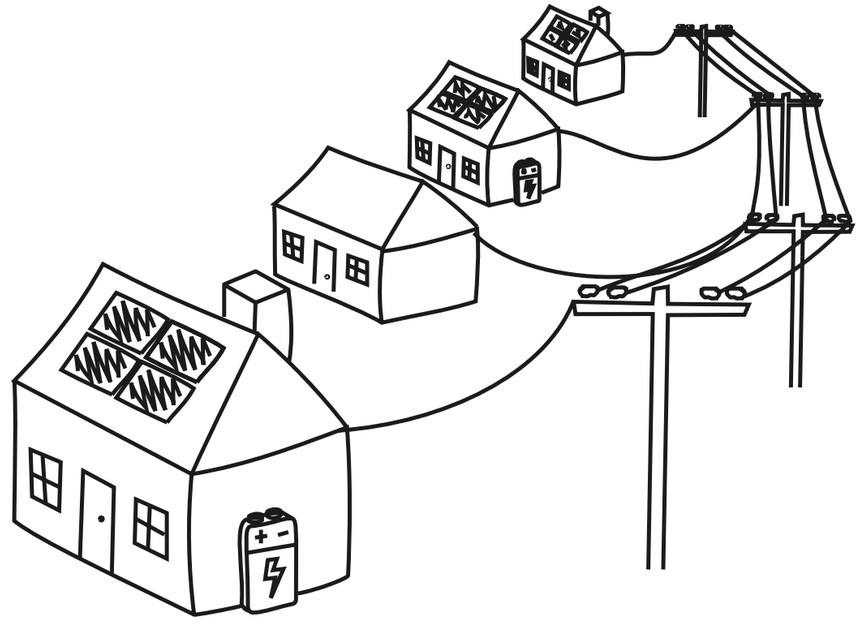
The following section details the three phase pathway to zero net emissions.

Table 13: Summary of modeled Z-NET options

Option place	Responsibility	Option Name	ZNET Phase	Cost of carbon		Abatement potential		Contribution to ZNET Emissions by 2029
				$ per t CO2-e		t CO2-e p.a.		% of total emissions
On-site	Households	Residential Hot Water: Heat Pump	I	-18.6	(13)	3,599	(15)	1.2%
		Residential Lighting	I	-158.9	(6)	1,393	(24)	0.5%
		Residential Appliances	I	-115.5	(7)	3,394	(16)	1.1%
		Residential Heating And Cooling	I	5.6	(17)	703	(28)	0.2%
		Residential Thermal Fabric	I	-381.5	(4)	1,157	(25)	0.4%
		Residential Solar Photovoltaic	I > II	-61.2	(11)	10,543	(8)	3.6%
		Residential Battery Storage With Solar	I > II	-52.8	(12)	4,563	(11)	1.5%
		Residential Dual-Fuel To All Electric	I > II	280.3	(30)	3,752	(13)	1.3%
	Business	Business Energy Efficiency	I	-108.8	(8)	3,199	(17)	1.1%
		Business Solar Pv	I > II	-72.1	(10)	3,741	(14)	1.3%
	On farms	Climate Smart Farms	I > III	13.4	(22)	42,056	(3)	14.2%
		Herd Management For Beef Cattle	I > III	11.6	(21)	2,229	(22)	0.8%
		Beef Cattle: Feeding Nitrate Supplements	I > III	10.3	(19)	2,229	(22)	0.8%
		Dairy Cattle: Feeding Dietary Additives	I > III	9.3	(18)	926	(27)	0.3%
		Soil Carbon: Sequestration In Grazing Systems	I > III	10.7	(20)	17,539	(6)	5.9%
	All premises	Reduce Waste To Landfill	I > III	0.0	(16)	971	(26)	0.3%
Nearby (Shire-level projects)	Land owners	Reforestation (for firewood)	I > IIII	na	-	0	(31)	0.0%
		Reforestation (for carbon sequestration)	I > III	18.0	(25)	17,600	(5)	5.9%
	Renewable energy project owners	Microgrid / VPP	II > III	-83.5	(9)	13,690	(7)	4.6%
		Hepburn Wind Solar Farm (3MW)	I	62.1	(27)	6,264	(9)	2.1%
		Hepburn Shire Bioenergy Plant (65kW) - energy component	I	-9.7	(14)	292	(30)	0.1%
		Utility-scale Solar PV (20 MW)	II > III	69.0	(28)	42,533	(2)	14.4%
		Utility-scale Wind (20 MW)	II > III	51.7	(26)	64,032	(1)	21.6%
	Organisations (service providers)	Hepburn Shire Bioenergy Plant (65kW) - waste component	I > III	-9.7	(14)	5,482	(10)	1.9%
		Hepburn Council Zero Emission Waste Commitment	I	15.0	(23)	632	(29)	0.2%
		Central Highlands Water: Zero Emissions Commitment	I	15.0	(24)	2,324	(21)	0.8%
Mobility		Low-Emission Passenger Vehicles	I > III	-518.6	(2)	2,928	(18)	1.0%
		Low-Emission Lcvs And Trucks	I > III	-450.9	(3)	2,600	(19)	0.9%
		Biodiesel For Trucks	I > III	69.3	(29)	3,965	(12)	1.3%
		Electric Vehicle Transition	I > III	-225.0	(5)	31,303	(4)	10.6%
		Resident Ride Share and Active Transport	I > III	-532.4	(1)	2,448	(20)	0.8%

What Does the Options Analysis Tell Us?

The options analysis over the 10 year targetted timeline, indicates that a three stage pathway to zero net emissions is an ambitious but realisable approach for the Hepburn community. The modelled options are summarised in the table opposite and the key phases are then explored. The three phases are: Phase 1: 2019 - 2021, Phase 2: 2022 - 2024 and Phase 3: 2025 - 2029.



Key Elements of Phase 1 2019-2021

The first stage celebrates Hepburn's leadership in sustainable energy, with a concentration on energy efficiency opportunities and energy generation on-site. This is consistent with adopting the least-cost approach, which will reduce the amount of 'nearby' renewable energy projects required to achieve a 100% renewable energy supply. These options are based on proven technologies which have a high level of social support.

This phase includes the delivery and celebration of a second stage solar farm at the Hepburn Wind site to complement the existing 4.1MW capacity of Gale and Gusto (wind turbines). It also includes the delivery of a local bioenergy demonstration project of 65kW capacity.

The first phase helps lay the development work for mid-scale renewable energy projects via Hepburn Wind's leadership and local sustainability group engagement, as well as a micro-grid / virtual power plant project (VPP), which would then be delivered in Phase 2. This project is essential to allow continued growth in on-site generation.

Similarly, this first phase is also proposed to develop capacity and commence delivery of reforestation, capable of balancing a renewable, sustainable supply of firewood and ultimately creating the land use change required to offset agricultural emissions. Further, improvement in detailed knowledge around opportunities to reduce transport, agricultural and land use emissions will ready the community for a shift in focus away from energy towards other emissions sectors in the later two phases.

The first phase includes improving upon knowledge and delivery of early transport actions, with an early focus on improving fuel efficiency at vehicle replacement, rideshare and active transport. A waste to energy project would be delivered by Council, capturing a portion of emissions associated with organic waste; the Council commitment to meet zero net emissions from waste would be met during the latter part of this phase through a number of supporting actions.

The Central Highlands Water plan to reduce emissions from wastewater commences in earnest.

These listed actions are considered 'quick wins' that are largely underway through various initiatives with different stakeholder groups.

Key Elements of Phase 2 2022-2024

Phase 2 includes delivery of significant investment in mid-scale renewable energy projects (40MW of new capacity) to create a 100% renewable electricity supply and achievement of zero-net energy. The potential of battery storage should be considered for some of the mid-scale project as this will allow higher levels of generation to be achieved, without contravening network capacity constraints. Delaying delivery of these projects to approximately 2022 - 2024 will also allow for costs of solar and wind generation to further decline (somewhat absorbing the cost of battery storage required). Should the level of required mid-scale community wind and/or solar projects not be pursued (due to financial viability or network constraint reasons), the option of procurement from larger solar or wind farms outside the Shire will need to be considered.

The output from these mid-scale 'nearby' projects would involve some export of electricity to other communities when solar or wind production is high and usage in Hepburn Shire is low. The delivery of a local micro-grid / VPP project is required during this phase to maintain growth in on-site electricity generation.

Waste reduction measures would continue to further reduce reliance on waste offsets. The emissions reduction actions by Central Highlands Water are proposed to continue.

Knowledge and capacity would be further built around key agricultural production changes required to reduce emissions; including 'climate smart' farms, with pilots occuring for a number of strategies designed to reduce emissions associated with meat and dairy livestock and soil sequestration. These are piloted to 2024, informed by industry research that improves the animal welfare associated with responses to reduce enteric emissions. Programs will be designed in this phase which can forge a new kind of leadership in Hepburn around reduction of agricultural emissions.

Significant sector partnerships (see Section D) will need to be established to usher in this phase, as well as financing to actualise it.

Key Elements of Phase 3 2025-2029

During Phase 3, the electric vehicle transition will commence in earnest. It is proposed that this is matched with increasing deployment of renewable electricity generation to meet the charging requirements. Programs involving on-site energy actions come to fruition with the transformation of building stock through energy efficiency and on-site solar investments.

Through a combination of further efficiencies and reduction in travel demand, but predominantly as a result of electric vehicle transition, transport related emissions decline to approximately two-thirds of the 2018 benchmark. The Hepburn Shire is forecast to continue to be a net exporter of renewable electricity, which offsets the remaining balance of transport emissions.

Agricultural emissions are forecast to be significantly reduced, to a level approximately half of the 2018 benchmark, through soil carbon actions and livestock initiatives. The remaining agricultural emissions are offset through land use change (reforestation) within the Shire, resulting in zero net emissions by 2029. Reforestation also supplies (above and beyond land use change) a local 'renewable' firewood supply.

The commitment from Central Highlands Water will be met in 2029. Council and community actions continue to reduce waste emissions. The combination of these activities can reduce total waste emissions to a negligible level by the 2030 target.

The diagram below sets out the proposed pathway to zero net emissions by 2029. A comparison with the business as usual emissions highlights the projected abatement of 296,300tCO2-e by 2029.

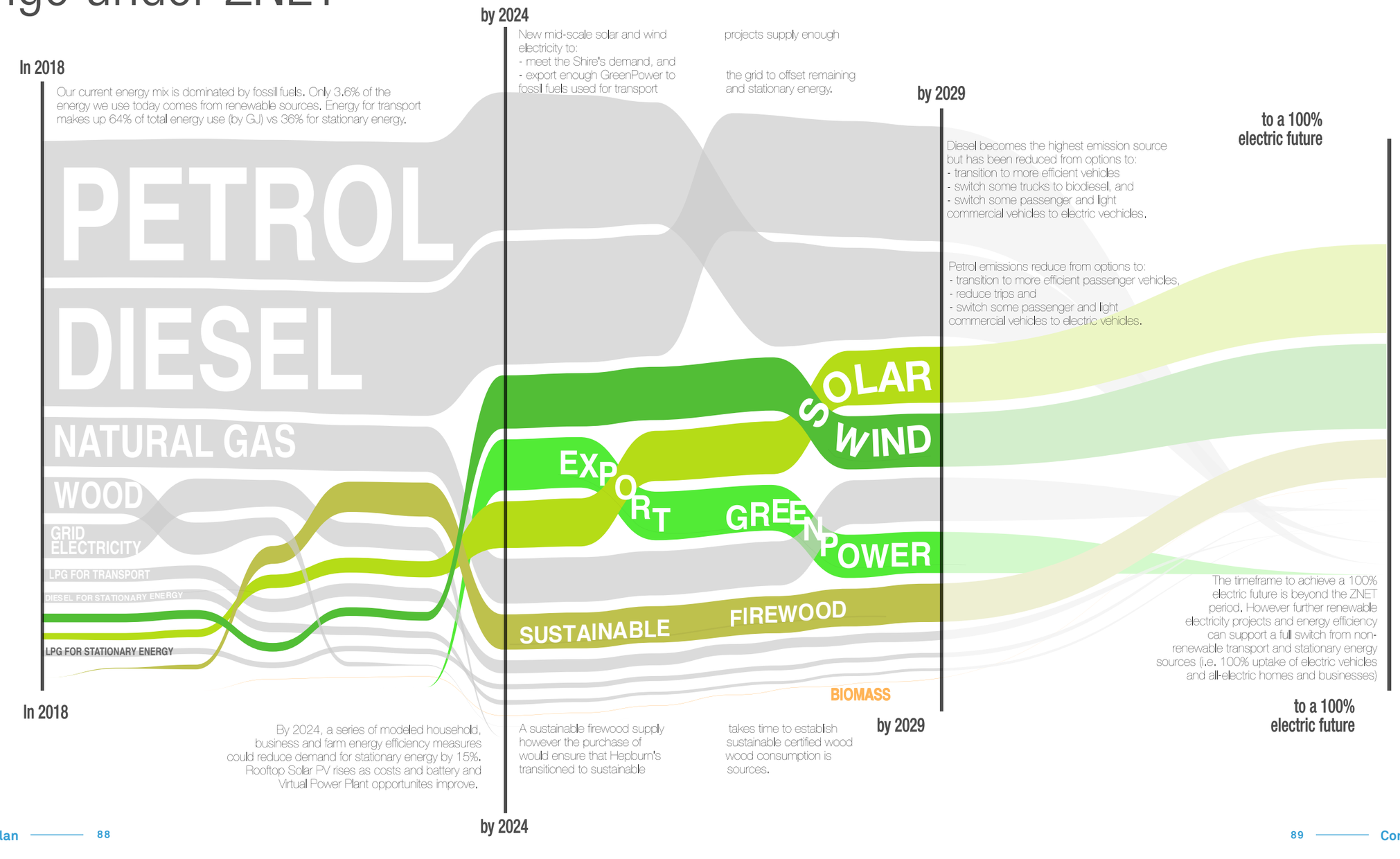
The forthcoming pages host Figure 8: Reaching zero-net energy including *transport* and visualise the significance of transport, which is often unaccounted for in planning for zero net energy.

Chart 9: Equalising emissions with abatement

THE ZNET ENERGY TRANSITION

How Hepburn's energy sources change under ZNET

The width of each of ribbon represents each energy source's contribution (by GJ) to Hepburn's energy mix under ZNET



A sector based breakdown tells a more nuanced story, noting the balancing of transport emissions with export of renewable electricity to other communities and the offsetting of remaining agricultural emissions with land use change. The following table describes the impact of options to the 2030 target.

Table 14: Z-NET options impact

Emissions reduction by emissions sector and economic sector

Emissions sector	BaU 2029 'target' Emissions	Abatement option impact	Emissions after impact	% reduction
Agriculture	106,325	60,624	45,700	57%
Stationary Energy	105,705	167,209	-61,504	158%
Transport	102,567	43,244	59,322	42%
Waste	9,724	9,409	314	97%
Land use, land use change and forestry	-28,014	17,600	-45,613	63%
Total emissions with ZNET actions (t CO2-e)	**296,307**	**298,087**	**-1,780**	**101%**

Economic sector	BaU 2029 'target' Emissions	Abatement option impact	Emissions after impact	% reduction
Residential	105,858	132,606	-26,748	125%
Commercial	82,571	61,470	21,101	74%
Industrial	13,722	7,103	6,619	52%
Farming	113,870	68,956	44,914	61%
Municipal	-19,715	27,951	-47,666	142%
Total emissions with ZNET actions (t CO2-e)	**296,307**	**298,087**	**-1,780**	**101%**

Beyond the life of the plan

Noting the risk of making long term projections, the emissions profile of Hepburn will continue to evolve beyond the life of the CTP. The electric vehicle transition will continue beyond the life of the plan. New mid-to-large scale renewables will be required to 'keep pace' with this transition. Capacity in the order of 55MW of additional solar or 37MW of additional wind will be required by 2040 to meet these new electric vehicle charging requirements. Agricultural emissions will continue to decline as practices improve, but will continue to need to be balanced by some land use change.

Meeting the zero net emissions target before 2030 will set the Hepburn community up to be a carbon positive community.

Network considerations

The Hepburn Shire hosts three 22kV distribution network feeders and other lower voltage lines operated by Powercor. It does not have any higher voltage 66kV distribution lines within the geographic boundary. The western part of the Shire is also traversed by a 220kV transmission line, operated by Ausnet Services. Further details on network considerations can be found in Appendix B.

The Distribution Network

According to Powercor, the capacity of the distribution network (i.e. the total power rating of feeders and transformers) in and around Hepburn Shire is relatively low. This reflects the historical nature of development in the area, particularly without any significant number of large industrial or commercial electricity users.

Distribution Network Service Providers (DNSPs) such as Powercor are regulated to carry out several different functions associated with providing the physical grid infrastructure (i.e. the poles and wires that carry our electricity from power stations and other smaller generators to homes and businesses).

Amongst other things, DNSPs must maintain minimum reliability levels (the current standard requires that 99.998% of annual demand for electricity is met); manage voltage levels in local parts of the network; and, plan and maintain grid infrastructure.

In contrast, DNSPs are not regulated to ensure a transition to a high penetration of renewable energy in any given part of their network area. As such, they typically do not lead such transitions. In this context, any community that wishes to move to a high penetration of locally generated renewable energy (potentially with or without storage), must work within the technical constraints faced by DNSPs in their management of the network.

With regard to the distribution network, only 'medium' scale (mid-scale) renewable energy projects can be connected to this local network. The 22kV lines can carry around 8-12MW of exported electricity each, fully loaded. This results in around 36MW of total export capacity within the Shire. However this is only on the basis that the 22kV lines are not already constrained.

Any new generation must consider the existing rooftop solar and/or other mid-scale embedded generation on the same line. Lower voltage lines are assessed at that level, not as a total inclusive of the 22kV lines. The low voltage lines can connect around 1-2MW, however under 1MW is cheaper. 1-2MW typically requires the installation of a dedicated transformer, at the project developer's cost.

The best locations for new generation facilities are sites that are close to the zone substation, namely Creswick and Clunes. At either location, in the order of 4-10MW should be possible. By way of contrast, given their further distance from the Castlemaine substation, a project near Glenlyon or Trentham would likely need to be installed with some level of storage.

In line with their latest Distribution Annual Planning Report (December 2017), Powercor has no plan to augment or increase the capacity of transformers, lines or substations within the Shire area over the next decade. This means that the costs of any infrastructure upgrades associated with installing new renewable energy projects will likely need to be met (either fully or partially) by project proponents.

The Transmission Network
The 220kV Ausnet transmission line runs from Ballarat to Bendigo, directly through the centre of Hepburn Shire.

Ausnet has currently determined this line as having the potential for 'some' to 'high' network access, with the potential for up to a 50MW connection.

Were 30MW to 50MW possible to be connected into the 220kV line, this would constitute the majority of the new renewable generation required in Hepburn Shire to support the Z-NET plan. A small number of distribution-connected, mid-scale projects could be built first, the larger project could then supplement the transmission-connected generator to meet the remainder of the Z-NET requirement. A 40MW wind farm was abandoned in this area due to low wind conditions, therefore it is likely that either high wind turbines (such as a 4MW turbine with over 100m hub height) or solar would be most suitable.

Opportunities for Z-NET
Discussions between the Z-NET team and Powercor led to the suggestion that the feeder BAN11 should be the focus for mid-scale (1 to 10 MW) renewable energy and storage projects, as well as virtual power plant-type programs where a portion of the embedded storage could be reserved for strategic network use. The particular area of need and opportunity within BAN11 can be seen on Map 2 opposite page.

Demand response (e.g. reducing load such as turning air conditioners off or down during peak demand events) can assist with power outage issues in this regard, however it should be noted that demand response is typically implemented over short durations and as such, does not deliver significant energy, and therefore carbon, savings.

Implementing the CTP requires a significant level of new, larger scale renewable energy projects. To achieve zero net energy by 2025, approximately 40 MW of new renewable energy generation capacity will be needed. To achieve zero net emissions by 2030, this increases to 70 MW.

It should be noted that a combination of projects is most likely rather than a one size fits all approach.

A potential way to increase the level of new renewable generation on sites where significant grid connection limits apply is to oversize the solar (and potentially storage), as relevant to the site's grid connection export limit. As an example, previous analysis has found that oversizing a solar farm by a factor of almost double (as compared with its grid connection limit) can still lead to only a small (i.e. <10%) of the annual solar generation being lost through export curtailment.

Storage can assist with further increasing the utilisation of renewable generation behind the site's grid connection limit, albeit at an increased cost to the project. Previous high level analysis has found that for a small, 2MW grid connection limit on a 22kV line, up to 8MW of solar PV and 30 MWh of storage can be installed, ensuring that over 10 GWh is exported to the grid annually (within the 2MW limit) and with only 2% of the generated energy being lost to 'clipping' (or grid curtailment). Whether this type of project is economically viable would need to assessed on a case by case basis. The solar clipping ratio is represented in Chart 11.

Map 2: BAN 11 focus area for projects

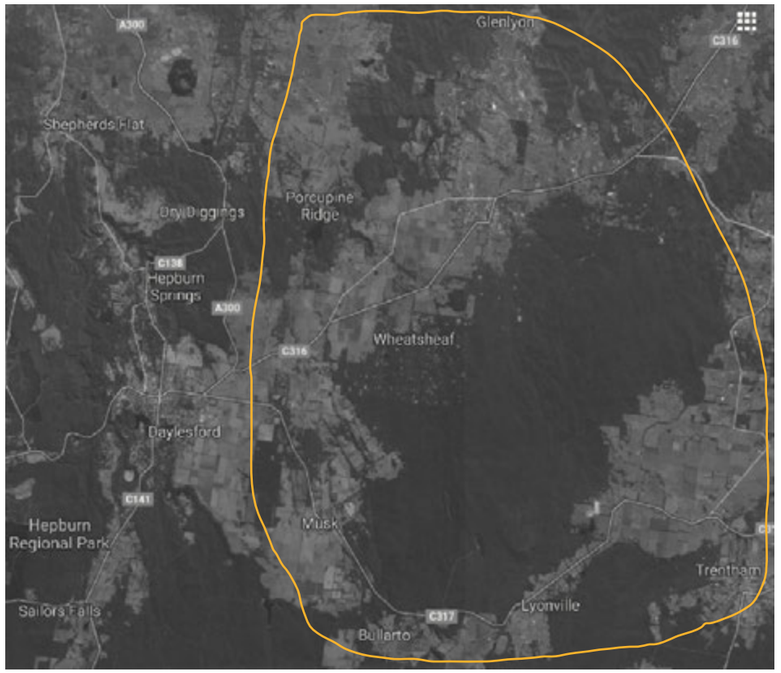
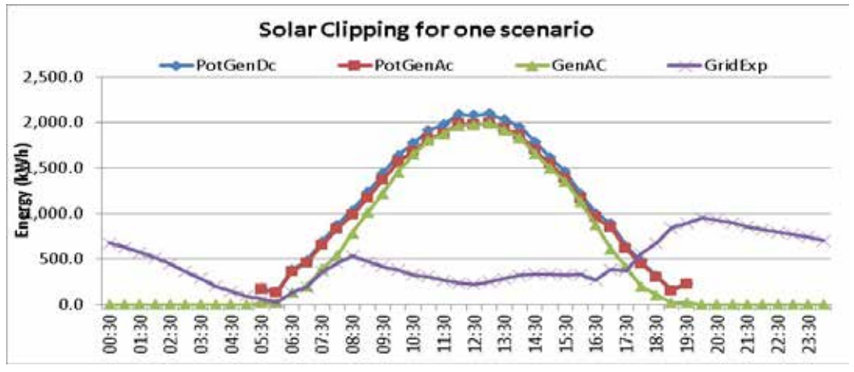


Chart 11: Solar clipping



Given the network capacity constraints in the project area, a breakdown of potential project scales to achieve the 2025 and 2030 goals are as follows:

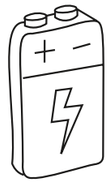


Table 15: Solar farm scales

No. Projects Required	Timeframe	Capacity Required for Zero Net Energy/ Emissions (MW)	Grid Connection Limit (MW)	Oversizing Factor	No. of Projects	220kV Transmission Line
At Grid Connection Limit	by 2025	40	2		20	
	by 2025	40	5		8	
	by 2025	40	10		4	
	by 2030	70	2		35	1-3
	by 2030	70	5		14	1-3
	by 2030	70	10		7	1-3
Oversize Solar	by 2025	40	2	2	10	
	by 2025	40	5	2	4	
	by 2025	40	10	2	2	
	by 2030	70	2	2	18	1-3
	by 2030	70	5	2	7	1-3
	by 2030	70	10	2	4	1-3
Oversize Solar & Storage	by 2025	40	2	4	5	
	by 2025	40	5	4	2	
	by 2025	40	10	4	1	
	by 2030	70	2	4	9	1-3
	by 2030	70	5	4	4	1-3
	by 2030	70	10	4	2	1-3

The cost of the transition

The Options Model for the project identifies 22 different project types or areas of activity that can be implemented to achieve the 10 year vision. Each of these have been costed, taking into account current and likely future prices of technology, likely uptake and other relevant factors. These are represented in Table 13 on page 80. Further details on the methodology for these costings and assumptions are located in the Options Model (Appendix A).

Most of these activities have an associated initial capital investment. Over time, many of these activities actually save more money than they cost (e.g. residential lighting or solar PV). Others have a cost that will never be fully recouped over the lifetime of the activity.

Costs and benefits are also relevant to different parties. For example with residential solar PV, households fund the up-front capital outlay and benefit from the energy bill savings delivered by the project over the life of the system.

'Levelised Cost' is the cost of the activity measured over its project lifetime, taking into account all upfront and ongoing costs, along with all savings compared with a Business as Usual approach. The activities that result in a net positive financial return with benefits exceeding their up-front investment and any ongoing costs (e.g. maintenance) are:

- Residential hot water, lighting, appliances, thermal fabric, solar PV and battery storage;
- Business energy efficiency and solar PV;
- Efficient passenger vehicles and efficient commercial vehicles;
- Electric vehicle transition;
- Modal shifts (including rideshare);
- Hepburn Shire Council Bioenergy Plant; and
- Micro-grids: shared solar and storage.

D

How Might it Work? The Role of Enablers

Sector partnerships

There is a broad spectrum of sectors that contribute to local emissions and stand to gain from reduction strategies. To engage with these sectors and enhance the effectiveness of the various Z-NET phases, the project team will be looking to develop new partnerships and collaboration approaches throughout the Z-NET program. These approaches for collaboration will need to be structured early, considering the particularities of the Z-NET phase and sector involved. This could be as Roundtable groups coming together for discussion, expert presentations, or as more formal working groups as the sector becomes more engaged.

Deepening the engagement with the agriculture, transport, waste, land use, tourism and local business sectors will be especially key. Collaborative approaches will be sought for local solutions, firstly as trials and then broader implementation. This approach would follow the same trajectory as the options modelled here for the stationary energy component.

Role of Households & Businesses

Individual householders, farmers, landowners and business owners have a very important role to play. The realisation of the CTP is in part based on all of those stakeholders undertaking actions in key areas - particularly demand reduction, energy efficiency upgrades, shifting to sustainable transport and expanding micro- and small-scale renewable energy generation.

Supporting local households, farmers and businesses to understand what they can achieve is an engagement and educational goal of the Plan. Pivotal to this is increasing awareness of the economic benefits for households and businesses. This requires timely and readily understandable information for builders, renters and homeowners about the potential for energy savings. Practical workshops about these measures are recommended. A free energy audit program is also recommended to inform these actions and ensure they are more readily taken up locally. Transport is an individual or business decision that people can make.

Households in Hepburn are diverse and can be complex to retrofit, with different appliance mixes leading to different choices regarding the transition. For all Hepburn homes, space heating and water heating are the two biggest uses of energy. However different homes use different appliances to meet these requirements. For example, hot water is met variously with electricity storage tanks, bottled gas storage tanks, or mains gas instantaneous systems (as well as solar and heat-pump technologies). Space heating is similarly diverse and is being met with a mix of electric resistive heating, gas ducted or wall furnace heaters (mains or LPG), wood, hydronic and reverse cycle air conditioning technologies.

For businesses, space heating/ cooling, lighting and computing are often the largest energy loads.

There is an opportunity for Hepburn homes to become more efficient as well as increase their use of renewable energy as a power source. This means reducing space heating and hot water loads through insulation (ceilings, walls and floors), draught sealing, efficient windows and upgrades to heat pump or solar hot water technologies. Following this, on-site solar PV generation and storage can substantially meet most of the remaining load (up to 80-90%).

Businesses typically have predominantly daytime electricity loads that match well with solar PV generation. The use of high efficiency heat pump air conditioning systems can significantly reduce their heating and cooling loads. Aside from farmhouse opportunities, farmers can apply energy efficiency and renewable energy opportunities to their farming practices such as solar powered water pumps. Landowners can consider carbon farming opportunities on site to enhance local carbon sinks.

The Role of Local Government

Leadership
The collaboration of local government with industries and communities is vital for success of the CTP. As industries and communities seek lower carbon alternatives to current practices, there are a number of changes which need to occur to facilitate these transitions. Hepburn Shire Council is already active in these areas and has potential to amplify their work proactively to further facilitate these changes.

Key to supporting these specialised sectors will be engagement with peak bodies and complementary programs that may aid them to progress from business as usual trajectories.

Hepburn Shire Council joined the Cities Power Partnership, an initiative of the Climate Council, in October 2018. Local councils who join the partnership make five action pledges on tackling climate change, renewable energy, efficiency, and transport. Networks such as this can stimulate peer leadership and sharing of learnings. Council has also pledged to the Victorian Government's TAKE2 program delivered by Sustainability Victoria, which is another initiative supporting community, industry and government collaboration on climate change action. The Victorian Government's Climate Change Framework has a focus on working with 'sectors' to set emissions reduction targets and pathways to achieve the 2050 net zero net target legislated, inclusive of mandatory targets for certain sectors.

To date, Council has shown strong support for actions which help to reduce emissions. Their future role in the implementation of Z-NET may include:

- Staff resourcing to assist the coordination of the governance and programs
- Monitoring, refining, expanding and promoting the Z-NET CTP and Blueprint
- Continuation of targeted projects which support an increase in energy efficiency or renewable generation in the broader community
- Continuation of current programs which assist vulnerable groups and individuals within the community to access energy efficiency and renewable generation technologies, including financial support
- Facilitating and advocating for improved planning and building outcomes to ensure a more sustainable shire into the future
- Continuation of current goals to achieve emission neutrality for Council operations
- Proactively seeking other innovative methods to improve the environmental and economic sustainability of the region

Planning support
There is significant opportunity in the Hepburn Shire for renewable energy development given the existing council and community aspirations to be a 'lighthouse community' for community-owned energy facilities, demonstrating the economic and environmental benefits of local ownership and energy generation. Council could consider additional supportive policies or resolutions to ensure that new developments and the transition occurs in a highly effective and beneficial way.
For example, countries such as Germany and Denmark commonly utilise voluntary local government or regional resolutions as planning recommendations that are neither legally binding nor enforceable. However, what has occurred in general since these have been implemented, is a significant positive impact on the characteristics of the new projects developed.

The Steinfurt County in Germany have implemented Community Wind Guidelines. These emphasise the importance of local neighbourhood participation and benefits, including minimum community equity stakes of 25% with a $1,000 investment minimum and the use of regional banks for financing.

Given the background of Hepburn as an initiator of community energy in Australia, a similar approach would be suitable for the Shire to ensure the new developments deliver local benefits that improve social and environmental wellbeing - in line with the CTP's commitment to securing social justice outcomes.

In Cornwall UK this is also occurring with municipality renewable energy planning advice for proponents. Different expectations are detailed for different technologies. For solar developments they recommend agricultural solar with grazing, ecological enhancement of the landscape through biodiversity activities, and the inclusion of visitor attraction and education facilities. These types of recommendations would also be appropriate in the context of the Hepburn Shire.

The Role of Networks

Planning for Utility Scale Renewables
A partnership approach is needed for the network to respond to the intentions of the community to transition. As detailed earlier, Powercor has advised that the capacity of the Hepburn Shire distribution network (i.e. the total power rating of feeders and transformers) in and around Hepburn Shire is relatively low. This is particularly the case given the historical development of the area, without significant amounts of large industrial or commercial electricity users.

At the same time, there is no major expansion (or "augmentation") of the distribution network in Hepburn Shire planned for the next decade.

The 220kV Ausnet transmission line however, appears to offer significant opportunity for a utility scale renewable generation project.

A key challenge for implementation of the Z-NET plan is to understand how constrained the three 22kV feeders in the project area are, what ability they have to be able to connect mid-scale renewable generation projects, and at what cost. This will guide the location of new utility-scale renewable energy projects so as to maximise their capacity, which is key to utility scale renewable energy projects – in order to deliver on the overall level of new generation capacity required by 2029.

DNSPs do not have this type of data readily available. Typically, an individual assessment is made each time a specific project applies for grid connection to ascertain its impact on the network and its likely connection capacity.

In order to strategically plan for project implementation, feasibility work will need to be undertaken, in partnership with Powercor, to assess (in particular) the 22kV feeders for their level of capacity and ability to accommodate larger (i.e. 5MW to 10MW) renewable energy projects, with and without storage.

Working together
DNSPs and TNSPs can and should work with communities to assist in the transition to high penetration of renewables - through network planning, joint projects, partnerships and being clear and transparent about what is required from a technical standpoint.

For the purposes of the Z-NET Hepburn project, ideally Powercor and Ausnet Services will assist with: identifying parts of the network in which significant penetrations of renewables can be accommodated; advising on the best locations within the project area to locate small and utility scale battery storage – to deal with reliability and network constraint issues; investment in strategic renewable energy and storage projects where they will actually benefit their network planning and management as well as the goals of Hepburn Z-NET.

A joint project between Powercor and Hepburn Z-NET, and potentially Ausnet Services as well, is recommended so as to understand how and where to deploy renewable energy and storage assets that can support the 10-year strategic vision. Such a project could occur as part of the Australian Energy Regulator's (AER's) Demand Management Incentive Scheme (DMIS) – whereby funding is available to undertake network investigations as well as provide project investment for local generation, storage and demand management.

Knowledge Generation, Education and Engagement

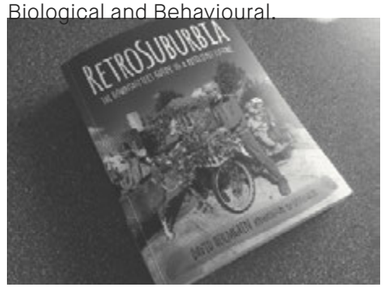
As a community energy leader, there is a high level of energy literacy in the Hepburn Shire regarding renewable energy generation and the perception of what is possible to achieve locally. However, like all other communities in Australia, local data on emissions from other sectors has previously been somewhat invisible so there hasn't been an opportunity for detailed engagement and awareness raising on the task ahead to reach carbon neutrality. There is a need for continuing to build this awareness locally.

Community engagement
Community engagement must be seen as the cornerstone of local actions. The Community Transition Plan can be seen as a 'next-step' and be used for localised place-based planning and engagement across the Shire to stimulate local action. A dedicated website to host elements of the Plan as a practical destination would be useful. As would ensuring there is an engagement component to all programs and projects deployed as part of the Plan.

Local education curriculum
Schools based engagement around the Z-NET Plan is a significant opportunity, both to utilise the resources developed through this project such as the 21 technology postcards and to deepen engagement with the significant local actions that are occuring. The potential exists for Z-NET curriculum to be developed for local usage as well as for non-local schools that are touring sites such as Hepburn Wind. Embedding climate change education into local schools will ensure the next generation are more informed, engaged and capable of sustaining Z-NET in our community. There are also opportunity for citizen science projects to be initiated with the broader community.

Tailored Z-NET Hepburn materials could be created with WithOnePlanet.org.au, which is a climate change education portal. It is designed to support teaching about environmental viability, culture awareness, and active citizenship. It's an inquiry- and challenge-based teaching and learning method that focuses on environmental education through three themes: carbon (our environment), culture (our community) and citizenship (our responsibilities). It forms the premise that understanding climate change from these three perspectives, will support students in making decisions about how best to live successfully in a low/zero emissions world.

A significant local resource for how to move to more productive and resilient households has been developed by Hepburn Springs local and co-founder of the permaculture movement David Holmgren. Currently in its second print RetroSuburbia is a manifesto for household action, especially in regards to the approach of using less as an action of climate adaptation and mitigation. The book outlines options available to retrofitters in three 'fields' – the Built, Biological and Behavioural.



University partnerships
The Z-NET project already has university partners including the University of New South Wales (working on social justice) and Melbourne University (technical support). Going forward, in order to generate further knowledge on the transition and to aid projects, activities and programs, these partnerships should continue to be maintained and explored. University partnership can bring in-depth investigation into certain aspects of the transition process as well as assist in the scalability and replicability of the Blueprint.

Governance

Harnessing existing local capacity

Establishing and developing a framework to formalise an engaged local group with agency over the Z-NET Community Transition Plan was a mandate of the project. In the case of the Hepburn Shire, there is an abundance of existing community organisations: community energy co-operative Hepburn Wind, sustainability groups and others of relevance such as community banks. Although these organisations may have narrow mandates and be in different levels of activity, it is important to ensure that the Z-NET plan can harness this existing local capacity rather than reinvent the wheel. A further consideration is how the Z-NET governance structure could seek to serve the mandates of these groups rather than create more onerous activities for volunteers.

The original Community Advisory Panel (CAP) was comprised of 17 community representatives who came together on three occasions to learn about the Z-NET Hepburn Shire program, what current strategies and opportunities exist; and to develop and recommend a set of goals and priorities for the Community Transition Plan. The approach aimed to provide a way for 'everyday citizens' to collaborate as a mix of selected and self-nominated participants; all with a common interest and connection to the Hepburn Shire.

Matching governance with Phases

The CAP was established for the purpose of the Z-NET development phase and to assist the project team to refine the Plan. The activities of the CAP were structured as:

- Phase 1: Community engagement
- Phase 2: Feedback on the opportunities
- Phase 3: Formalising the governance structure
- Phase 4: Taking the Community Transition Plan forward

Taking the Plan forward

Given the pre-existence of many formal organisations, it is more efficient for the governance going forward be a collaborative/collective impact group – with a set of guiding principles and mandate in the form of Roundtables, rather than forming a new incorporated association. The Council is proposed to convene the primary Roundtable, with future sector based Roundtables to be convened by sector partnership experts.

The CAP is proposed to transform into the Z-NET Roundtable, with participation from the five sustainability groups, Hepburn Wind, Hepburn Shire Council and interested individuals for the first phase which is highly focused on energy.

As the Plan reaches the implementation and action phase it is considered that over time the Z-NET Roundtable may be replicated for new sector engagement such as Z-NET Tourism Roundtable or the Z-NET Farm Roundtable – dependent on programs and resourcing.

The Z-NET Roundtable would look to: create and/or recommend local projects that could be funded by the Z-NET Climate Resilience Fund; be local advocates for Z-NET; and, ensure local community members and businesses are aware of Z-NET.

An overview of the Z-NET Roundtable mandate is proposed to be:

- Z-NET Targets: having a common agenda for change including a shared understanding of the problem and a joint approach to solving it through agreed upon actions.
- Tracking implementation and emissions reduction: overseeing and measuring results consistently to ensure shared measurement for alignment and accountability.
- Championing the CTP: a plan of action that outlines and coordinates mutually reinforcing activities.
- Collaborating around Z-NET programs: enhance the impact of individual sustainability groups through collective actions, open and continuous communication across the many players to build trust, assure mutual objectives, create common motivation.
- Council role: provide backbone support to help participating organisations coordinate.

It is proposed that there should be funding for implementation of the CTP and that a coordination role should be established – the Z-NET Leadership Group which would further support the Roundtable and be made up of a Hepburn Shire Council representative and members of the Z-NET project team. The Z-NET project team is currently made up of members of Renew and Little Sketches , with support from local organisations such as Hepburn Wind, but may evolve over time to include other partners. The auspice of this role could be hosted through a number of pathways dependant on the focus of the activities and the available funding. In lieu of funding, the Roundtable will progress activities without a paid backbone support role.

Funding

A significant amount of personal and institutional funding and finance will need to be leveraged for implementation, as detailed in the 'Cost' section on page 95 and within the Options Model (Appendix A). Some of this will be through government and philanthropic initiatives, some will be bank or impact investment financed, others will be through community donations and investment. In particular, key to the deployment of multiple mid-scale projects, will be the need for a stable long term support scheme for mid-scale community energy projects to unlock finance for such projects.

Z-NET Climate Resilience Fund

As government and philanthropic funding can wane, within the Hepburn Shire there are several grant making entities dispersing micro-grants to various community projects, inclusive of Council, three community banks and Hepburn Wind. There is an appetite across these organisations to create more targeted, better quality projects and programs that create 'legacy' or 'intergenerational' impact. To create this, and to enable some of the objectives of Z-NET, it is proposed that a local Z-NET Climate Resilience Fund is established.

Already there are community energy grants occurring locally. Hepburn Wind Energy Fund and Hepburn Shire Council Towards Zero Grants are doing donation funded solar power systems on community facilities – nine systems were funded in the 2018 financial year - and energy efficiency upgrades. Hepburn Wind has also delivered the first electric vehicle charging station through their energy fund. Bendigo Bank was the first mover in the community energy space through the provision of $3.1M project finance for Hepburn Wind in 2010. The three community banks in the Shire are well positioned to provide project finance for any significant projects.

Given the existence of these current funds, the funding gap is for projects that are mostly focussed on behaviour change, engaged with climate resilience opportunities and education oriented. Primarily projects include those that are difficult to otherwise secure funding for, given that there are few climate funds currently available.

The fund concept has been recommended to potentially be between:

- Hepburn Shire Council
- Daylesford, Creswick and Trentham Community Bank
- Hepburn Wind
- other local partners

The concept is that partners could allocate a portion of their funds annually to the Z-NET Climate Resilience Fund and that the host could be Bendigo Bank Community Enterprise Foundation, so that communities and not-for-profit organisations can raise and distribute tax-deductible donations.

The Roundtable would assist the creation of this Funders group and make recommendations regarding future projects. These are currently forecast to be small scale behaviour change grants, however could escalate to project finance over the timeline of Z-NET. The aim of the fund is complement the community, government and instutional funding that will also be available.

The fund is proposed to have three initial streams:

1. A granting scheme for project ideas, enable behaviour change programs with no return on investment, project feasibility and business case studies to occur – a high risk stage for projects
2. Zero or low interest project finance fund, once the feasibility had been proven, this could fund small – mid-scale projects
3. Leverage funding – having a small cash amount available to leverage other grants as a cash co-contribution

Tracking progress

Effectively monitoring progress towards achieving the 10 year goals of the Z-NET Hepburn project is crucial to the ongoing success of the model. It is imperative to consistently understand where emissions are coming from and how successful the CTP's interventions are in meeting emission reduction targets. This understanding will enable future programs to be more targeted and effective.

Whilst the current emissions profile shows where Hepburn Shire emissions are coming from, it does not illustrate what is causing emissions to change over time. These dynamic factors range from local, state and federal policy to technology uptake and shifting social norms. Tracking progress is enabled by the setting of clear, tangible and measurable actions (see Phase 1, 2 and 3) that can be monitored effectively over the time period and will have to consider these dynamic influences.

The following methods are recommended to monitor and evaluate program effectiveness, track progress and create accountability within future project delivery to ensure actions are undertaken. The monitoring framework should create accountability of different stakeholders through an information sharing and feedback mechanism to improve program implementation.

1. Evaluating projects and programs - tracking implementation

As the CTP has an implementation focus, the current Shire-wide projects and programs should be the primary focus in order to map their impact. This would give insights into the initial changes to the emissions profile due to the programs. For example, the impact of the Hepburn Solar Bulk Buy will be easy to assess and measure. Programs and projects could be measured annually and provide interim statistics on progress.

2. Evaluating methodology - improving the profile

- Identify sectors with highest mitigation potential and gather more detailed and sophisticated data for further analysis.
- Evaluating the usefulness of each dataset and level of granulation reached as part of this baseline and setting priorities for future development of the profile.
- Engage community stakeholders at critical points of the program – generate new data, consultation etc.

3. Updating the emissions inventory

- Adapting baseline emissions as necessary and updating inventory.
- Track emissions against BaU scenario. Progress can be tracked by updating the emissions tool on a regular basis.
- Develop sensitivity analysis for different sectors.

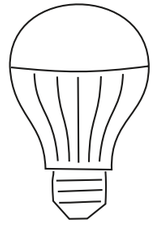
4. Enhancing sector engagement

- Monitoring how key partnerships are progressing such as with Powercor and Ausnet, and other ecomomic sectors.

5. Tracking behaviour change

- Building upon the household energy and behaviour survey, the survey will be refreshed and implemented in accordance with the three phases.

As with other projects of this type, the ability to evaluate and develop the profile will be dependent on the level of funding available in future. In order to strive towards the first goal of zero-net energy by the end of 2024 to meet the Shire-wide target of 2025 (and potentially the aspirational goal of zero-net electricity by 2021), the first three years should ensure at a minimum the focus on tracking the impact of renewable energy, demand management and energy efficiency projects. It is recommended that Council takes ownership and is accountable for monitoring and evaluating the emissions inventory.



ZNET abatement in 2029

the impact of modeled options

298,087

Tonnes of C02-e reduced by abatement actions by 2029

100.6%

or a reduction in emissions by 2029

E

The Pathway to Hepburn Z-NET

This final chart showcases the multifaceted range of factors at play in considering the driving factors, the locations, as well as the opportunities to meet the emissions challenge.

The activities are translated into actions in the following Implementation Plan.

Chart 11: Connectivity of who and how

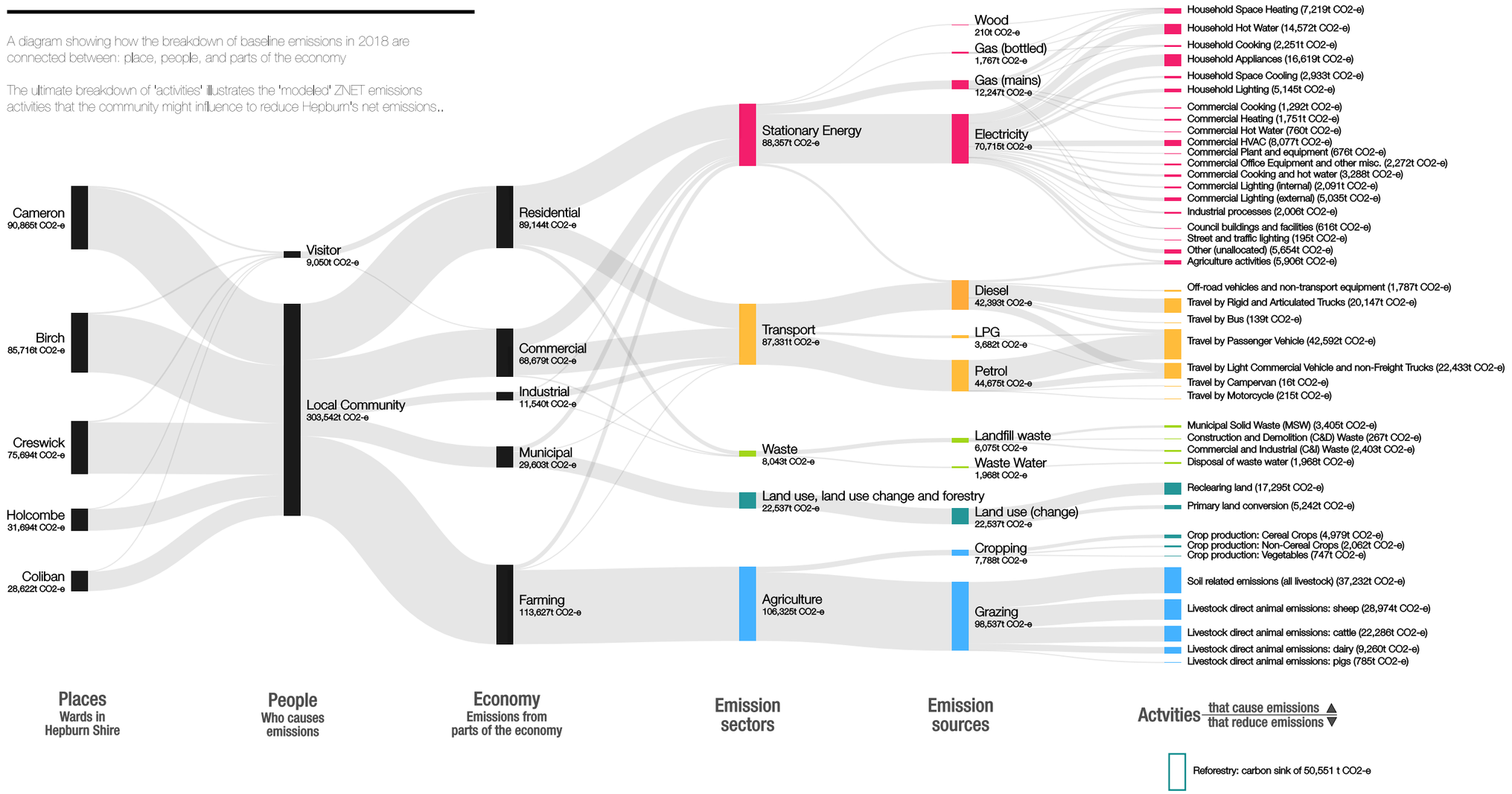
HEPBURN SHIRE BASELINE EMISSIONS

How emissions connect from sectors to activities

A diagram showing how the breakdown of baseline emissions in 2018 are connected between: place, people, and parts of the economy

The ultimate breakdown of 'activities' illustrates the 'modeled' ZNET emissions activities that the community might influence to reduce Hepburn's net emissions..

The activities the community can influence to reduce emissions



Who is responsible for emissions

How emissions are connected to everyday activities

Implementation Plan

Actions listed in the following table are community based actions that have emerged through community engagement. The Council action plan for zero-net emissions due to Council operations by 2021 details their mandate and is available online[3].

Who will take responsibility for specific actions within the Implementation Plan will need to be explored with the local community, Council and CAP in the next phases of Z-NET.

Modelled costings for individual actions are available in the Options Model (Appendix A).

[3] *https://www.hepburn.vic.gov.au/hepburn/wp-content/uploads/2017/08/ATTACHMENT-2-Toward-Zero-Emissions-Road-Map-Hepburn-Shire-2017-21-002.pdf*

MAIN INITIATIVES TO 2029	INITIATIVES	Engagement / sector partnerships	Analysis & Strategy	Tests & Demonstration	Implementation	Scaling up
Community Engagement	Education Curriculum				Phase I 2019 - 2020	Phase II 2022 - 2025
	Community Transition Plan engagement	Phase I 2019				
	Website - Z-NET practical actions				Phase I 2019- 2020	
	Tourism: Z-NET energy trail		Phase I 2021	Phase II 2022	Phase II 2023 - 2024	
	Sustainable streets program	Phase I 2019	Phase I 2019	Phase I 2020	Phase I 2021	Phase II 2022 - 2025
Sector Engagement	Tourism: carbon neutral tourism campaign for visitors	Phase I 2019	Phase I 2019	Phase I 2020	Phase I 2021	Phase II 2022 - 2025
	Agriculture	Phase I 2019				
	Business: network of ambassadors	Phase I 2019	Phase I 2019	Phase I 2019		
	Schools:					
	Network distributor: strategic feasibility for local generation, storage and demand management projects	Phase I 2019	Phase I 2019	Phase I 2020	Phase I 2021	Phase II & III 2022 - 2029
	Transport: options development for sustainable transport	Phase I 2019	Phase I 2019	Phase I 2020	Phase I 2021	Phase II & III 2022 - 2029
Energy	Home energy efficiency audits	Phase I 2019	Phase I 2019	Phase I 2019	Phase I 2019	Phase I & II 2020 - 2024
	Home energy efficiency retrofits and upgrades (including heat pump, solar hot water bulk buy etc)		Phase I 2019	Phase I 2020	Phase 1 & II 2020 - 2024	
	Farm energy efficiency audits and upgrades	Phase I 2019	Phase I 2019	Phase I 2019	Phase I 2020	Phase I & II 2020 - 2024
	Business energy efficiency audits and upgrades	Phase I 2019	Phase I 2019	Phase I 2019	Phase I 2020	Phase I & II 2020 - 2024
	Hepburn Solar Bulk Buy: households (including Solar Savers)				2018	Phase I & II 2019 - 2024
	Residential dual fuel to all electric: community campaign and appliance switch	Phase I 2020	Phase I 2020	Phase I 2020		
	Reforestation (for firewood)					
	Hepburn Shire council bioenergy project			Phase I 2019	Phase I 2019	Phase I 2020

MAIN INITIATIVES TO 2029	INITIATIVES	Engagement / sector partnerships	Analysis & Strategy	Tests & Demonstration	Implementation	Scaling up
	Hepburn Wind solar farm		Phase I 2019		Phase I 2020 - 2021	
	Additional mid-scale generation projects / community battery storage	Phase I 2019	Phase I 2020		Phase I 2021	Phase I & II 2021 - 2024
	Virtual Power Plant	Phase I 2019	Phase I 2020	Phase I 2020	Phase I 2021	Phase I & II 2021 - 2024
	Large-scale solar farm for 220kv transmission line	Phase I 2020	Phase I & II 2020 - 2022		Phase II 2023	
	Micro-hydro electric at Daylesford Lake		Phase I 2019		Phase I 2020	
Transport	Resident rideshare	Phase I 2019	Phase I 2019	Phase I 2019	Phase I 2020	Phase I & II 2020 - 2024
	E-bike share program	Phase I 2019	Phase I 2020	Phase I 2020	Phase I 2021	Phase II 2022 - 2024
	Safe walking and bicycle paths	Phase I 2019	Phase I 2019	Phase I 2019	Phase I 2020	Phase I & II 2020 - 2024
	Biofuel programs	Phase I 2019	Phase I 2020	Phase I 2020	Phase I 2021	Phase II 2022 - 2024
	Electric vehicle transition: EV public car charger stations	Phase I 2019	Phase I 2020	Phase I 2020	Phase I 2021	Phase II 2022 - 2024
	Electric vehicle transition: EV car share program	Phase I 2019	Phase I 2020	Phase I 2021	Phase II 2022	Phase II & III 2023 - 2029
	Community bus project: electric or biofuel	Phase I 2019	Phase I 2020	Phase I 2021	Phase II 2022	Phase II & III 2023 - 2029
Agriculture	Climate smart farms local pilot	Phase I 2019	Phase I 2019	Phase I 2020	Phase I 2021	Phase II & III 2022 - 2029
	Herd management for beef cattle awareness raising and pilot	Phase I 2019	Phase I 2020	Phase I 2021	Phase I 2022	Phase II & III 2023 - 2029
	Beef cattle - feeding nitrate supplements awareness raising and pilot	Phase I 2019	Phase I 2020	Phase I 2021	Phase I 2022	Phase II & III 2023 - 2029
	Dairy cattle - feeding dietary additives awareness raising and pilot	Phase I 2019	Phase I 2020	Phase I 2021	Phase I 2022	Phase II & III 2023 - 2029
	Soil carbon - sequestration in grazing systems awareness raising and pilot	Phase I 2019	Phase I 2020	Phase I 2021	Phase I 2022	Phase II & III 2023 - 2029
Waste	Reduce waste to landfill	Phase I 2019	Phase I 2020	Phase I 2020	Phase I 2021	Phase II 2022 - 2024
	Hepburn Council Zero Emissions Waste commitment				Phase I 2019 - 2021	
	Central Highlands Water Zero Emissions commitment				Phase I - III 2019 - 2029	
	Village scale composting	Phase I 2019	Phase I 2020	Phase I 2020	Phase I 2021	Phase II 2022 - 2024
	Plastic Free Town initiative, Plastic Wise Policy	Phase I 2019	Phase I 2019	Phase I 2019	Phase I 2020	Phase I & II 2020 - 2024
Land use change	Restoration and reforestation (carbon sequestration)	Phase I 2019	Phase I 2020	Phase I 2020	Phase I 2021	Phase II 2022 - 2029
	Land use: options for enhancing local carbon sinks	Phase I 2019	Phase I 2019	Phase I 2020	Phase I 2021	Phase II & III 2022 - 2029
Planning & housing	Sustainable building code	Phase I 2019	Phase I 2019 - 2020		Phase I 2021	
	Prefab / tiny house demonstration for affordable housing	Phase I 2019	Phase I 2019 - 2020	Phase I 2021	Phase I 2021	

F

Appendices

Appendix A

In order to model the impact of options over both the period, and over each option's lifetime (which is often longer than 12 years), all global assumptions require the capacity to be 'forecast' into the future. Accordingly, the model has a forecast length out to 2050 to enable the economic evaluation of options with long asset lives (using a Discounted Cash Flow approach). These 'growth forecasts', or escalation paths, allow modelling of changes over time in variables such a energy tariff prices, grid emissions factors, and by granular end use' item in the emissions inventory using a set of proxy growth factors (e.g. population growth to influence the emissions from household waste).

The model contains economic and energy/emissions modelling for the Hepburn Z-NET plan, covering the period from 2018 (the 'baseline' year) to the ZNET 'target' year of 2029. The model produces estimates of emissions and energy consumption for each year for two scenarios:

1. the 'Business as Usual' (BaU, or 'Reference case") Profile which models how the baseline inventory of emissions and energy use is expected to change over the Z-NET period due to external drivers such as population and economic growth;
2. the 'Z-NET Profile' which models how the aggregated impact of emission abatement options could reduce the BaU Profile to reach Z-NET in 2029.

To support these scenarios:

- a baseline inventory is an externally modeled dataset that estimates Hepburn's emission and energy use by emissions source, emissions sectors of Stationary Energy, Transport, Agriculture, Waste (including waste water) and Land Use (Land Use Change and Forestry), end user sector (e.g. Residential, Commercial, Industrial, Farming and Municipal) and end user type (i.e. Hepburn Community or Visitors);
- a 'Z-NET inventory' is modeled which refines the baseline into more granular components of 'end use activity' which can be targeted at an option level (e.g. by technology or program). The Z-NET inventory is also used to set a 'boundary' or scope of which emissions are included in the Z-NET target;
- individual emissions abatement options are modeled to design and choose actions and programs to support the Z-NET CTP.

The Z-NET Technology Postcards

The Z-NET Technology Postcards are an educational and engagement tool available here:

The Postcards have been developed distinctly for the Hepburn context and can be adjusted and added to as more options are developed to support the Z-NET Plan implementation.

The Z-NET Options Model
The Z-NET Options Model is available at www.z-net.org.au/hepburn

The Z-NET Technology Postcards
http://littlesketch.es/experiments/ZNET-Hepburn-postcards

Interactive Tools
http://littlesketch.es/experiments/ZNET-Hepburn-particles
http://littlesketch.es/experiments/ZNET-Hepburn/
http://littlesketch.es/experiments/ZNET-Hepburn/bubbles/

Appendix B

Network Considerations

The Hepburn Shire hosts three 22kV distribution network feeders and other lower voltage lines operated by Powercor. It does not have any higher voltage 66kV distribution lines within the geographic boundary.

The western part of the project area is also traversed by a 220kV transmission line, operated by Ausnet Services.

The Distribution Network

Distribution Network Service Providers (DNSPs) such as Powercor are regulated by the Australian Energy Regulator (AER) to carry out several different functions associated with providing the physical grid infrastructure (i.e. the poles and wires that carry our electricity from power stations and other smaller generators to homes and businesses).

Amongst other things, the AER ensures that DNSPs:

- maintain minimum reliability levels
- the current standard requires that 99.998% of annual demand for electricity is met;
- manage voltage levels in local parts of the distribution network (e.g. at a street level) within a range (e.g. 216 volts to 253 volts); and
- plan and maintain grid infrastructure to ensure these reliability levels are met.

DNSPs face severe penalties for not delivering on these requirements.

By contrast, DNSPs are not regulated by external parties (such as the AER or any part of Government) to ensure a transition to a high penetration of renewable energy in any given part of their network area. As such, they typically do not lead such transitions. In this context, any community that wishes to move to a high penetration of locally generated renewable energy (potentially with or without storage), must work within the technical constraints faced by DNSPs in their management of the network.

Technical issues

High penetrations of renewables can cause technical issues in distribution networks. These can include:

- Voltage rise – where significant amounts of renewable generation in one part of a distribution network push voltage above acceptable limits. This is a near term issue that is starting to be experienced now in Hepburn Shire as well as other parts of Victoria; and
- Exceedance of grid capacity – where the level of energy being exported from renewable energy in one part of a distribution network exceeds the capacity of local power lines and transformers. This is a medium-term issue (e.g. 5-10 years) that may only be experienced where significant amounts of new renewable energy investment occurs in the Hepburn Shire;

Powercor will likely have specific requirements and constraints on new renewable energy and storage investment. In Hepburn Shire, these may include:

- limits on the capacity of solar or wind that can be connected to the grid at any specific site;
- limits on the amount of energy that can be exported to the grid, from either small (e.g. household) systems or larger (e.g. solar farm) scale projects.

Export limiting

Limiting export to the grid from rooftop solar is an increasing issue within Hepburn Shire and throughout Victoria. Distribution businesses place maximum limits on solar export where they believe that adding to the level of embedded solar in that part of the network will lead to voltage problems during periods of high solar exports (e.g. sunny, cloudless afternoons).

In practice this means either a maximum inverter size is allowed at a site (e.g. 2 kilowatts) or a maximum export limit is required of an inverter at a site (e.g. a 5 kilowatt inverter with an export limit of 2 kilowatts). As a worst-case scenario, exports may be limited to zero (i.e. no export allowed).

From the perspective of a household or business with solar, there is a significant difference between: a system that can export some energy (e.g. with a 2 to 5 kilowatt limit); versus one that is not allowed to export (i.e. zero export). The former will still allow a significant amount of export to the grid – perhaps 80-90% of its total potential exports. This obviously attracts feed-in tariff revenue and continues to make the solar project economically viable for the household/business.

Zero export is a significant economic disadvantage – as potentially most of the solar electricity generated becomes unusable and therefore attracts no feed-in revenue.

As an example, a typical Hepburn "dual fuel" home consuming 10 to 15 kilowatt hours per day with a 5 kilowatt solar PV system could export approximately 75% of its solar electricity to the grid (time of use depending). If this system was unable to export at all, at current feed-in tariff prices, this would reduce the annual bill savings by around $500 – between half and three quarters of the potential annual benefit.

Export limiting policy needs to be applied by DNSPs in a nuanced way. Ultimately the risk of voltage rise in local parts of the network is only on a small number of days per year (and only for parts of those days). Export limiting policy should be dynamic and should only restrict solar exports during these critical times (and ideally using more sophisticated inverter technology).

Network Capacity/Planning

With regard to the distribution network, only 'medium' scale (mid-scale) renewable energy projects can be connected to this local network. 22kV lines can carry around 8-12MW of exported electricity each, fully loaded. This results in around 36MW total export as an estimate within the Shire - however this is on the basis that those 22kV lines are not already constrained.

Any new generation must consider the existing rooftop solar and/or other mid-scale embedded generation on the same line. Lower voltage lines are assessed at that level, not as a total inclusive of the 22kV lines. The low voltage lines can connect around 1-2MW, however under 1MW is cheaper. 1-2MW typically requires the installation of a dedicated transformer, at the project developer's cost.

The best locations for new generation facilities are sites that are close to the zone substation, namely Creswick and Clunes. At either location, in the order of 4-10MW should be possible. By way of contrast, given their further distance from the Castlemaine substation, a project near Glenlyon or Trentham would likely need to be installed with some level of storage.

In line with their latest Distribution Annual Planning Report (DAPR, December 2017), Powercor has no plan to augment or increase the capacity of transformers, lines or substations within the project area.

Powercor's DAPR sets out the 'load at risk' from network constraints at substations and feeders that are forecast to approach capacity over the next five years (until 2022). The three closest substations of relevance are:

- BAN (Ballarat North);
- BMH (Bacchus Marsh); and
- CMN (Castlemaine)

These are all substations that take 66kV and transform it to 22kV, taking power from the sub-transmission network.

Chapter 7 of the DAPR outlines near-term zone substation constraints and potential mitigation measures by substation. BAN and CMN are not mentioned at all in Chapter 7. BMH (Bacchus Marsh) is anticipated, in the case of a failed transformer during high load periods, to not be able to supply all customer loads. To address this anticipated constraint, Powercor considers that the following network solutions could be implemented to manage the load at risk:

- contingency plan to transfer load away via 22kV links to adjacent zone substations of Melton (MLN) and Ballarat North (BAN) up to a maximum transfer capacity of 3.2 MVA;
- install a new 25/33 MVA third transformer at BMH zone substation for an estimated cost of $6.5 million;
- augment the network at MLN to establish new 22kV feeder ties to permanently transfer 6 MVA of load from BMH zone substation to MLN zone substation for an estimated cost of $1.8 million.

Powercor's preferred and committed option is to establish new 22kV network ties and permanently transfer load to the MLN zone substation. Whilst not their preferred option, it would seem that BAN (Ballarat North) has capacity.

Separately, the Maryborough (MRO) substation is mentioned with 4.9 MVA of load at risk for 75 hours in 2022. This is forecast as a low priority (Powercor aren't forecasting an upgrade prior to 2022) and the DAPR discusses transferring some load to Castlemaine (CMN). CMN is likely unconstrained over the forecast period given it isn't mentioned in Chapter 7.

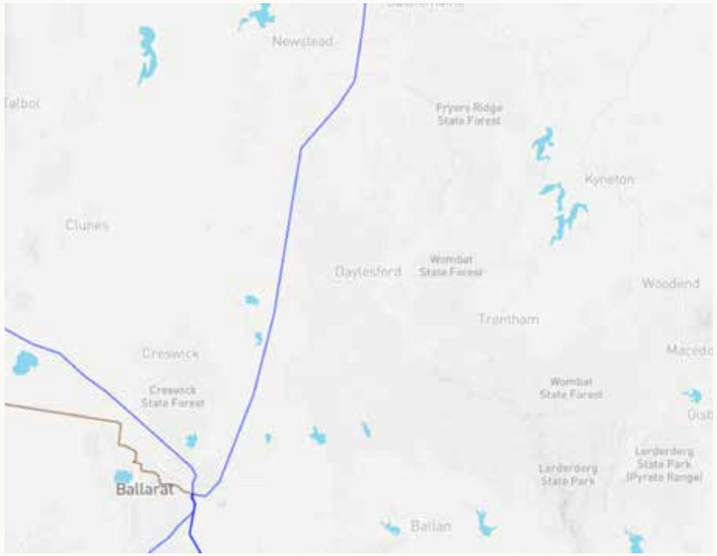
The Transmission Network

The 220kV Ausnet transmission line runs from Ballarat to Bendigo, directly through the centre of Hepburn Shire.

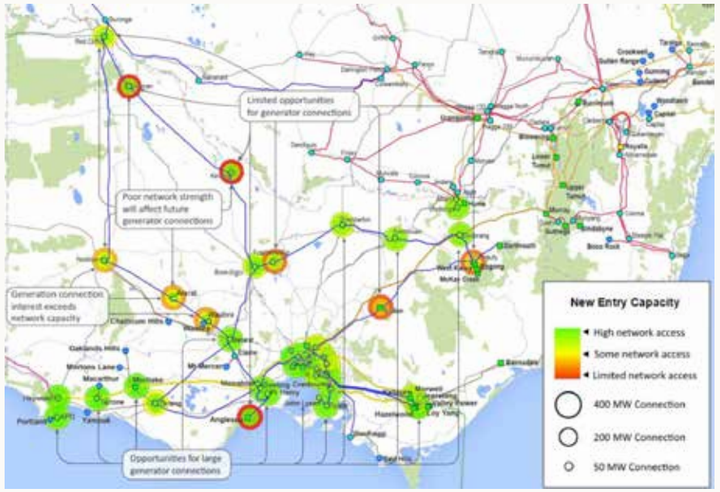
Ausnet has currently determined this line as having the potential for 'Some' to 'High' network access, with the potential for up to a 50MW connection, as per the Ausnet opportunities and challenges network map below.

Were 30MW to 50MW possible to be connected into the 220kV line, this would constitute the majority of the new renewable generation required in Hepburn Shire to support the Z-NET plan. A small number of distribution-connected, mid-scale projects could be built first, the larger project could then supplement the transmission-connected generator to meet the remainder of the Z-NET requirement. A 40MW wind farm was abandoned in this area due to low wind conditions, therefore it is likely that solar would be most suitable.

Map 3: 220kV Ausnet transmission line in Hepburn Shire



Map 4: Ausnet opportunities and challenges network map



The 'Newstead' model

The Newstead model essentially involves the negotiation of a unique distribution network tariff between grid-connected Newstead residents/businesses and Powercor – the local distributor of electricity (which happens to be the same distributor in all of Hepburn Shire).

Distribution businesses are responsible for managing the poles and wires that deliver electricity to our homes and businesses. They charge electricity retailers for this service, and electricity retailers on-charge this to electricity consumers as part of our electricity bills. Our electricity bills are also made up of transmission charges and wholesale energy market charges, along with the retailer's own margin.

Traditionally distribution network tariffs charge consumers on the basis of energy (i.e. kilowatt hours kWh) consumed plus an additional fixed daily component (i.e. cents per day). This network tariff sits within the overall retail tariff that we see on our electricity bill. The problem with such a tariff structure is that it doesn't reflect the way that costs are incurred by the distribution business to provide the network services we require.

We have a highly underutilised network for most parts of the year – with only a few hours on a few days per year where electricity demand peaks. The problem is that electricity networks are being built to cope with that small number of hours per year.

The Newstead tariff seeks to do three main things:

- To guarantee Powercor's required revenue from electricity consumers each year, irrespective of their energy usage. Hence, part of the tariff involves a $1 per day network charge. (For a residential customer, this amounts to an annual fee of $365 – which represents the majority of the annual distribution cost to a residential customer in Victoria.)

- To recognise that some users will have higher peak demand than others and charge them accordingly. Hence, the other component of the network tariff involves a $2 per kilowatt (demand) charge (reset each month). A kilowatt tariff charges on the basis of the maximum instantaneous power draw that a customer may have (as opposed to the amount of energy [in kilowatt hours] they consume over time). A typical Victorian home may have a maximum power demand in the order of four to ten kilowatts.

- To ensure that households and businesses with rooftop solar pay their fair share of network charges – as those consumers with their own solar PV system typically still have high peak demand outside of solar generation hours (e.g. after 5.00pm each day).

A key step with any distribution network tariff is that it must be packaged up by a retailer and passed on to electricity consumers in the form of an overall retail tariff offer (i.e. the tariff that they see on their bill). The Renewable Newstead group are still negotiating with electricity retailers to finalise a retail tariff offer to Newstead residents and businesses.

Renewable Newstead hope that a retailer can package up a retail tariff that looks something like:

- $1.20 per day fixed charge
- $2 per kilowatt
- $0.16 - $0.20 per kilowatt hour – with half of this going to the retailer, and the other half reserved for investment into a local, mid-scale renewable energy project (e.g. a 1 to 10MW solar farm).

With enough local, mid-scale solar or wind capacity (and potentially storage), Newstead will be able to provide its own power needs through 100% renewable energy.
The details of a final retail tariff offered by a preferred electricity retailer to the Newstead community remain to be seen. In addition, Powercor have explicitly stated that from their perspective, the Newstead project is a 'trial' – to last for an initial period of two years. Powercor wish to see the level of local renewable investment and/or changed energy usage behaviour, before committing to scaling up and rolling out this type of distribution tariff arrangement to other communities in their network.

znet
HEPBURN SHIRE