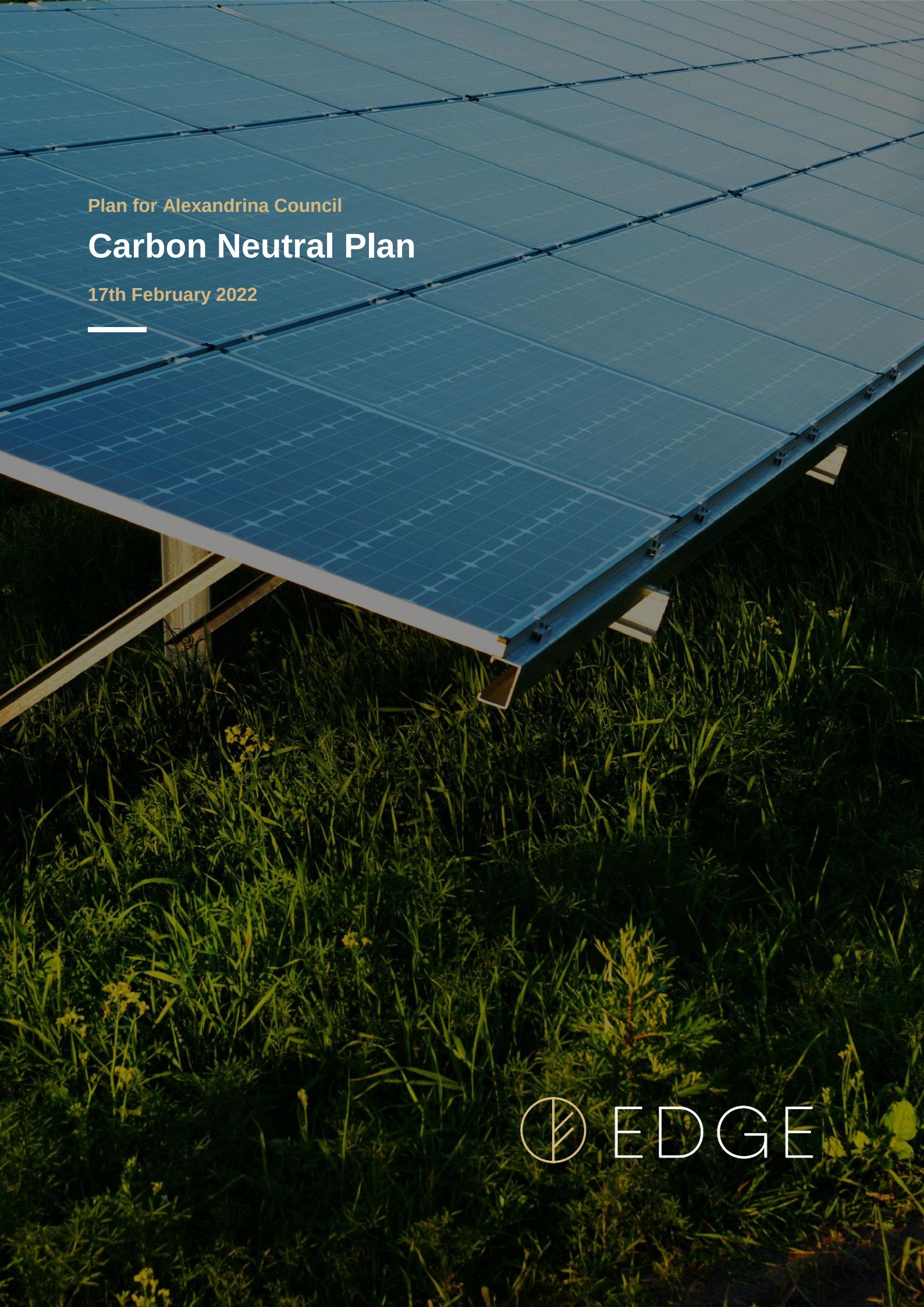

Plan for Alexandrina Council

Carbon Neutral Plan

17th February 2022

EDGE

Project Delivered for:

Alexandrina Council

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Revision	Revision Details	Author	Approved by	Date Approved
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Executive Summary

Since the Industrial Revolution global greenhouse gas (GHG) emissions have been increasing causing significant changes to the earth's climate. Australia's climate has on average increased by 1.44°C since national records began in 1910 (CSIRO; Bureau of Meteorology, 2020). Climate change is caused by an increase is GHG emissions in the earth's atmosphere (CSIRO; Bureau of Meteorology, 2020).

In order to limit global warming to the critical threshold of 1.5°C to 2°C, the Intergovernmental Panel on Climate Change has stated that a 45% reduction of 2010 global GHG emissions is required by 2030 and that immediate action is required to limit the effects of climate change (Masson-Delmotte, et al., 2018). Future climate related risks would be reduced by the upscaling and acceleration of far-reaching, multi-level and cross-sectoral climate mitigation actions (Masson-Delmotte, et al., 2018).

In response to the increasing and urgent global need to reduce GHG emissions and community concern related to climate change, in December 2019, Alexandrina Council supported a climate emergency declaration (CED) (Alexandrina Council, 2020). This provided the organisation with a clear mandate to place climate change at the forefront of local action. A CED is a decision that recognises the science and the serious risks of climate change to Alexandrina's community, economy and ecosystems; and ensures a commitment to act. The CED included a commitment for Alexandrina Council to develop and implement a Climate Emergency Plan as part of Council's strategic planning framework (The Alexandrina Council 2040 Community Strategic plan – A2040).

A2040 establishes a plan for Alexandrina to thrive over the 2020 to 2040 period (Alexandrina Council, 2020). According to A2040 climate change is listed as the issue of greatest concern to the people of Alexandrina (Alexandrina Council, 2020). In response to this, there are four key targets (of 15) that relate directly to climate change outlined within A2040. (Alexandrina Council, 2020).

This Carbon Neutral– Action and Implementation Plan (the plan hereafter) establishes a strategic framework for Alexandrina Council and Alexandrina's community to develop a Carbon Neutral Plan target and to create a pathway to achieving carbon neutrality by the year 2040.

The purpose of the plan is to develop goals and targets to manage corporate and community carbon emissions and provide a roadmap to guide Council and the community towards carbon neutrality. It includes the identification of a suite of key modelled projects and supporting actions, together with a proposed implementation plan for Council and the community.

In order to capture Council's current Scope 1, Scope 2 and limited Scope 3 emissions profile, data from Council operations was used to create a baseline for the 2019/2020 financial year. The Alexandrina community emissions profile has been extracted from Snapshot, an online community climate tool developed to assist local governments to better understand their emissions profile (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019).

The results of the baseline study of Council and community carbon emissions were presented through a workshop to key stakeholders, with the aim of gaining organisational buy-in for the Carbon Neutral Plan. Participants included the project team, representatives from Council's key divisions, and the Climate Emergency Advisory Committee and Elected Members.

12 emission reduction projects were modelled and offsetting projects relating to both Council and community emissions were explored. Council's calculated emissions profile represents approximately 1% of the total of Alexandrina Council's emissions profile. As such, Council's role in reducing the 99% of emissions produced by the community will be focused on education and leading by example, with a focus on sustainability education workshops.

The resulting modelling of emissions reduction and offsetting projects outlined a clear pathway towards carbon neutrality for Council. The implementation of a combination of the modelled projects and supporting actions will see Council achieve carbon neutrality by 2040. These modelled projects are as follows:

- The purchase of electricity from 100% renewable energy sources.
- The replacement of higher energy demand public lighting with LED lighting.

- The transition of council passenger and works vehicles (excluding heavy vehicles, machinery and plant equipment) to initially hybrid vehicles and later a staged transition to electric vehicles. Modelling has assumed that all electric vehicles will be powered by 100% renewable energy.
- The transition of heavy plant and equipment and heavy vehicles from diesel fuel to green hydrogen, resulting in a 100% reduction in emissions.
- The installation of two additional 100 Kw solar photovoltaic (PV) panels erected within the car parks at both the Goolwa Council Office and Strathalbyn Council depot and the installation of battery storage systems to allow for the storage of energy produced through the additional solar networks.

In addition to the modelled projects, grid carbonisation and localised offsetting were modelled. Details of this are as follows:

- The continual decarbonisation of the South Australian electricity grid, i.e., as more renewable energy sources (solar and wind) are constructed and connected to the electricity grid, South Australian homes and organisations will increasingly be powered by renewable energy sources. It is projected that by the year 2030, South Australia will reach the South Australian Government goal of 100% net renewable energy.
- Offsetting the remainder of emissions through local offsetting projects (urban greening) and the purchase of carbon offsets.

One of the key aims of this plan is to model and create a carbon neutral pathway for select Council emissions by 2040. Council emissions are projected to increase by over 1000 tonnes of carbon dioxide equivalent (CO_2-e) from 2020 to 2040. This is due to an increase of Alexandrina's population resulting in an expansion of services; and the addition of the Fleurieu Regional Aquatic Centre. Modelling suggests that by 2040, the total emissions of Council will increase from 3,444 t CO_2-e to 4,437 t CO_2-e (see Figure 1). Implementation of the modelled emissions reduction projects can reduce emissions by 1,449 t CO2-e, a reduction of 32%. The projected decarbonisation of the South Australian mains supply grid will reduce emissions by a further 2,005 t CO_2-e, a reduction of 45%. A remaining 983 t CO_2-e or 22% of emissions will be required to be offset through either local offsetting measures or through the purchase of carbon credits.

Purchasing offsets is considered a last resort in terms of best practice emissions management as offsetting does not assist organisations to reduce or alter emitting practices and carbon stored through offsets in natural environments are vulnerable to loss and change (as a result of fire, disease, drought etc). In seeking Carbon Neutral certification, offsetting represents a considerable cost to Council as for every t CO_2-e emitted, Council will need to purchase a carbon credit through one of the carbon markets. Projected costs for this at 2040 are approximately $50/tonne (UCL; Trove Research; Liebrich Associates, 2021).

Modelling of urban greening suggests that the ability of Council to abate carbon through an urban greening program is considerable and by the year 2040 could offset up to 140 t CO_2-e per year. This is based on a moderate planting regime of 365 trees per year and has the potential to further reduce emissions from 983 t CO_2-e to 843 t CO_2-e by 2040. The remaining 843 t CO_2-e will need to be offset in order for Council to achieve Carbon Neutral status (Figure 1).

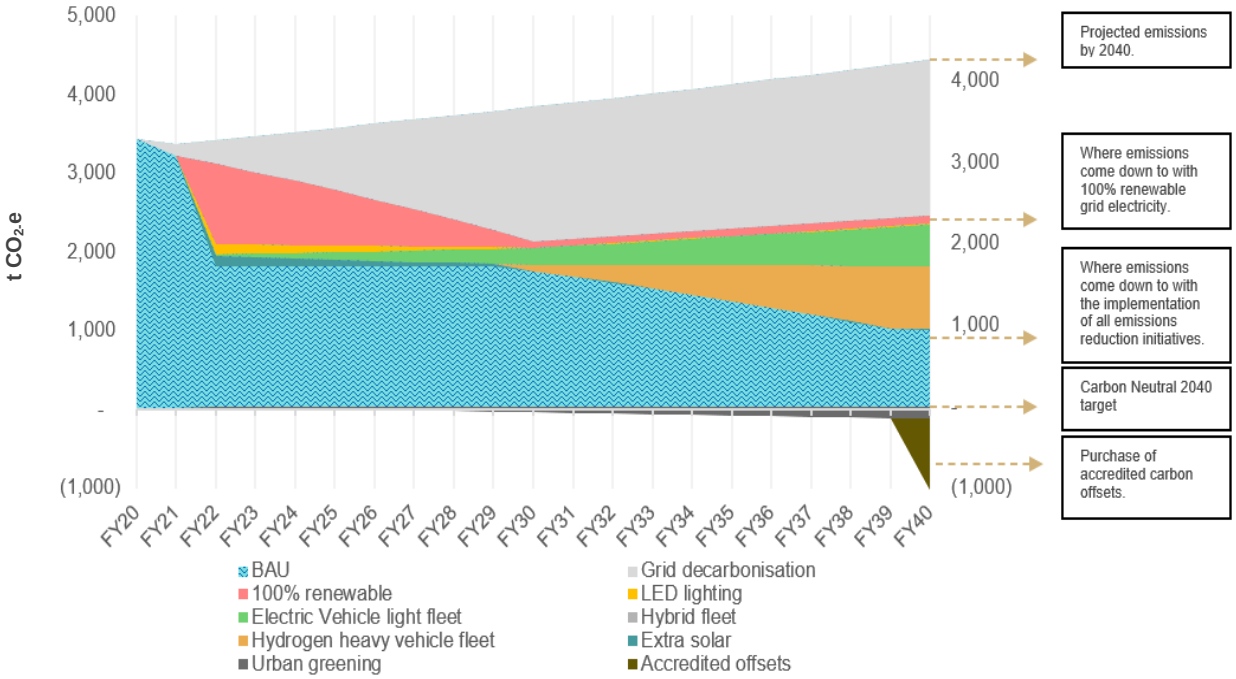

Figure 1. Council's carbon reduction pathway for the modelled emissions reduction projects

Council recognises that their role extends beyond reducing emissions produced by their own operations and management of assets, to collaborating with and assisting the community (residents, businesses, organisations) to lower emissions produced by the community's actions. Modelling of four community emissions reduction projects, the decarbonisation of the South Australian electricity grid and offsetting indicates that it is feasible for the community to achieve carbon neutrality by 2040. The following community projects were modelled as a part of this process:

- A 50% uptake of solar hot water on all new build housing stock.
- A 100% uptake of electric vehicles by all in the community by 2040. All vehicles will be powered by 100% renewable electricity.
- A 100% uptake of hydrogen fuel cell vehicles for all heavy vehicle transport, resulting in 100% reduction in emissions from hydrogen fuel cell heavy vehicles.
- The uptake of rooftop solar PV systems by 5% per annum across the housing stock in Alexandrina Council, with the understanding that 40% of houses within Alexandrina already have rooftop solar PV systems installed.
- The purchase of carbon offsets.

The implementation of all emissions reduction modelled projects has the potential to reduce the projected 2040 emissions from 483,181 t CO_2-e to 214,915 t CO_2-e. The decarbonisation of the South Australian electricity grid, i.e., the production and use of 100% renewable energy within South Australia, projected to occur by the year 2030, has the potential to further reduce total community emissions to 129,467 t CO_2-e. In order to achieve carbon neutrality, the community would need to further reduce the remaining 129,467 t CO_2-e or offset this through verified carbon offset projects.

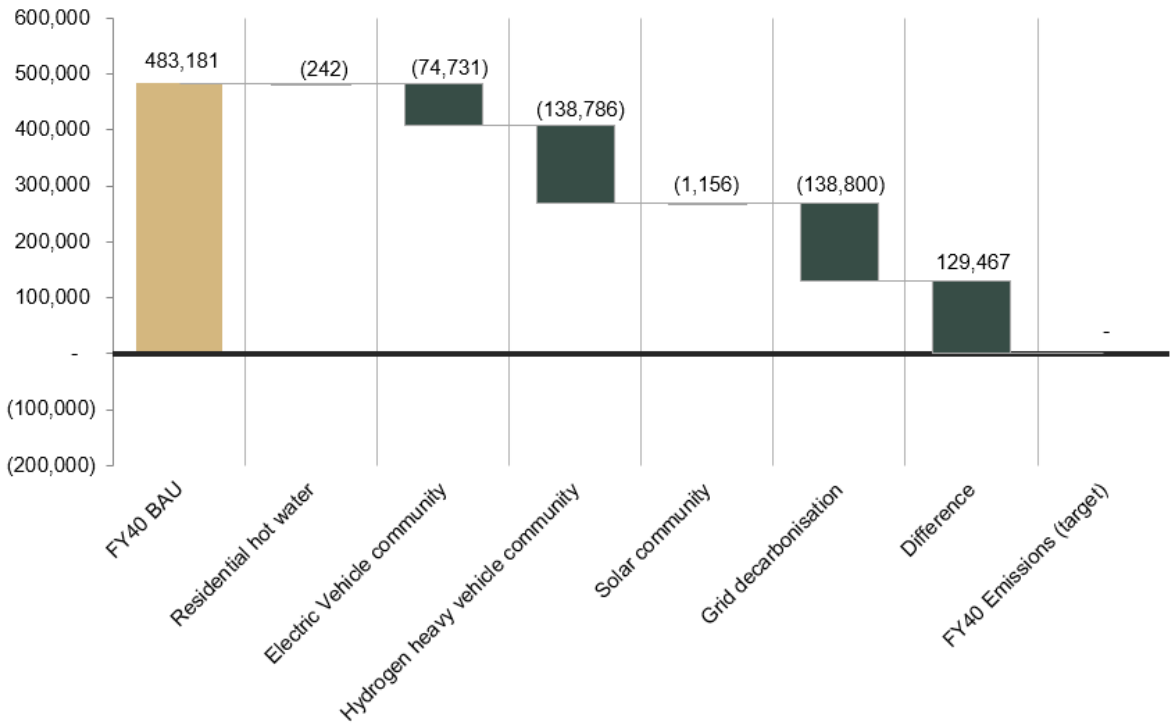

Figure 2. The projected emissions produced by the Alexandrina community by 2040 and the modelled emissions reduction potential of select community modelled projects and electricity grid decarbonisation.

This plan also outlines a range of supporting actions, based on the results of the carbon emission baseline and emission reduction modelling.

This includes:

- A suggested communications plan.
- Recommended supporting actions.
- A summary of the opportunities and risks of offsetting.
- A proposed implementation plan.

Contents

1 Introduction

Since the Industrial Revolution global GHG emissions have been increasing causing significant changes to the earth's climate. Australia's climate has on average increased by 1.44°C since national records began in 1910 (CSIRO; Bureau of Meteorology, 2020). Climate change is caused by an increase is GHG emissions in the earth's atmosphere (CSIRO; Bureau of Meteorology, 2020).

Climate change represents a global threat to people, the environment and the economy. Local Government has a key role to play in meeting the goals of the Paris Climate Agreement (limiting global warming to 1.5°C above pre-industrial levels) in order to reduce the worst impacts of climate change (Cities Power Partership, 2020). Reducing emissions generated in towns and cities can help to significantly reduce GHG emissions (Cities Power Partership, 2020) As a leader and responsible member of the community, Alexandrina Council is seeking a pathway to reduce emissions generated through operations, service delivery and management of assets. Council further recognises that there is a need to support the community (residents, businesses, organisations) to lower emissions. As such, this report sets out a recommended pathway, such Council's goals and targets in managing corporate and community GHG emissions and provides a roadmap to guide Council and community towards carbon neutrality.

1.1 Objectives of the Carbon Neutral Plan – Action and Implementation Plan

The objectives of the Carbon Neutral Plan are as follows:

1. To research and review existing information, trends, data and plans.
2. To develop a GHG inventory, both for Alexandrina's corporate and community driven emissions, based on existing data and freely available information.
3. To develop a clear pathway of suitable actions towards carbon neutrality for Council and community (i.e., identification of a suite of goals, targets and objectives, key projects and supporting actions, together with an implementation plan to achieve the stated goals).
4. To develop suitable actions towards carbon neutrality based on Alexandrina's strategic plan (A2040) and the Environmental Action Plan (2014-18), and other core documents.
5. To assess the feasibility of carbon offset criteria, such as the role of open space and biodiversity as an offset.
6. To consult with the Project Team, Elected Members, Council Officers and the Section 41 Climate Emergency Advisory Panel with meetings and workshops.
7. Determine high level costs and resource implications for budget consideration.
8. Development of strategies, measures and priorities.

1.2 Context

In order to limit global warming to the critical threshold of 1.5°C to 2°C, the Intergovernmental Panel on Climate Change has stated that a 45% reduction of 2010 global GHG emissions is required by 2030 (Masson-Delmotte, et al., 2018). Increasingly organisations, including local Councils are creating plans and actioning projects to reduce organisation emissions. In October of 2021, in the lead up to COP26, the Australian Government presented a Net Zero Plan, with the intention of positioning Australia as a Net Zero economy by the year 2050. This aligns with many state government net zero timelines, including that of the South Australian Government.

In response to this and climate change being expressed as the greatest concern of the people of Alexandrina, in 2019 Council declared a CED (Alexandrina Council, 2020). Following the declaration of a CED, Council established strategic goals to reduce Council GHG emissions and advocate for the uptake of renewable energy (Alexandrina Council, 2020). Council also recognised the importance of supporting the community to reduce emissions and sought to encourage community participation and partnerships with key stakeholders for greater involvement in sustainability issues and promote the adoption of a sustainable lifestyle (Alexandrina Council, 2020).

Alexandrina is one of ten South Australian local government signatories to the Cities Power Partnership, a national program to support Australian towns and cities to alter the way energy is used and generated in cities (Cities Power Partership, 2020). As part of this partnership, Alexandrina has committed to and is progressing as resources permit to (Cities Power Partnership, 2020):

- Energy efficiency programs.
- Sustainable transport programs.
- Installation of renewable energy infrastructure.
- Investigation of a revolving green fund for energy efficiency and renewable energy projects.
- The implementation of a staff and community behaviour change campaign.

Council has also undertaken a range of climate adaptation initiatives including a climate governance assessment and coastal hazard mapping assessment.

1.3 Scope

In establishing this plan, an emissions inventory has been calculated for Council operations utilising available data and the community emissions profile has been sourced from Snapshot. Emissions reduction and offsetting projects have been modelled, with all modelling assumptions listed in Appendix A. Council operational emissions include all Scope 1 and 2 emissions and limited Scope 3 emissions associated with the delivery of services, operations and asset management of Council as an organisation.

Community emissions are considered emissions generated by all organisations and residents living, working and playing within the Alexandrina Council area. The Alexandrina Snapshot profiles have been developed in accordance with the Greenhouse Gas Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019). The GPC Protocol is designed to promote best practice GHG accounting and reporting (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2020).

As demonstrated by Figure 3, Council operational emissions represent approximately 1% of all emissions generated within the Alexandrina Council area. In reducing emissions across the Alexandrina Council area, it is recommended that Council provide leadership through the implementation of actions to reduce the emissions that it controls, principally Scope 1 and Scope 2 emissions.

Emissions are divided into three distinct categories, called scopes. Scope 1 emissions are direct emissions from owned or controlled sources, such as transport fuels (IPCC, 2018). Scope 2 emissions are indirect emissions from the generation of purchased energy (e.g., streetlights, Council buildings) (IPCC, 2018). Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organisation (e.g., waste disposal, purchased goods and services, water usage) (US Environmental Protection Authority, 2021).

It is recommended Council develop a suite of resources and programs that aim to mobilise and stimulate the community to act both independently as well as in partnership with Council, private business and state and federal government departments.

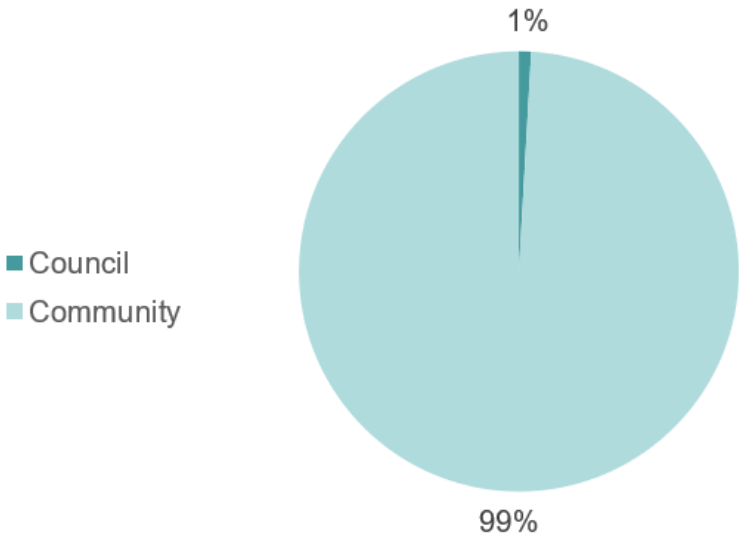

Figure 3. Alexandrina Council emissions generated in 2019/2020 compared to Alexandrina community emissions generated in 2019/20.

Council's operational emissions calculated as part of this plan are limited by the availability of data related to emissions profiling. For example, operational emissions do not include the majority of Council's purchased goods and services or business travel. As such, Council's operational emissions profile is limited to the categories outlined below and in Section 2.2 of this plan.

For the purpose of this plan, only Scope 1, 2 and limited Scope 3 categories are included in the carbon inventory, due to the availability of data. Emissions calculations for Scope 1 emissions (fuels and refrigerants) and Scope 2 emissions (purchased electricity) have been included in the inventory; however, the calculation of Scope 3 emissions is limited to the following categories:

- Approved business travel in private vehicles.
- Solid waste produced by Council (not community waste).
- Mains supply water use.
- Water extraction from water licences.
- Water recycling – recycled stormwater and wastewater.
- Fleurieu Regional Aquatic Centre (FRAC) (shared 50/50 with Victor Harbor): mains supply water.
- Scope 3 emissions associated with fuel purchase (fuel extraction, refinement, transport etc).

1.4 Background

Council operations

In the 2019/20 financial year period, Alexandrina Council produced 3,444 t CO_2-e. It is projected that based on a population growth rate of 1.4% and the assumption that Council services will expand at a corresponding rate, emissions from 2020 to 2040 will increase to 4,437 t CO_2-e (Figure 4). Carbon dioxide equivalent is a measure used to compare the emissions from various greenhouse gases based upon their global warming potential. For example, the global warming potential for methane over 100 years is 21. This means that emissions of one million metric tons of methane is equivalent to emissions of 21 million metric tons of carbon dioxide (OECD, 2013). This projection excludes the decarbonisation of the South Australian electricity grid.

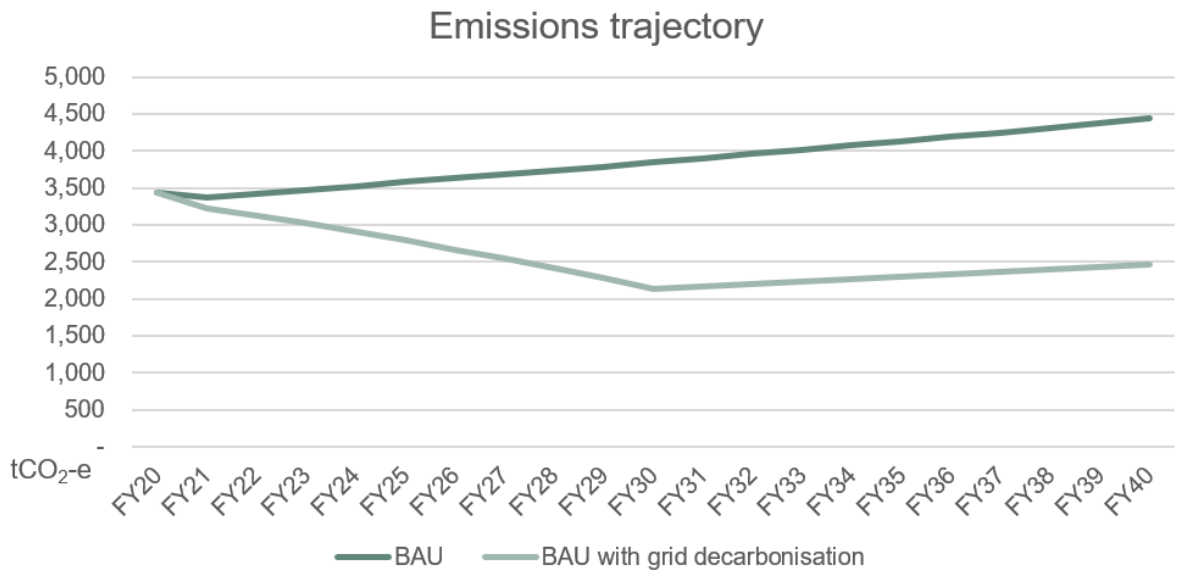

Figure 4. The projected increase in carbon emissions from 2020 to 2040, based on business as usual, compared to a grid decarbonisation model.

Modelling suggests that 77.8% of Alexandrina's emissions can be avoided or reduced through the adoption of modelled projects and that the remaining 22.2% (983 t CO_2-e) will require offsetting.

The Alexandrina target betters the South Australian Government Target of Net Zero by 2050 and aligns Council with a growing group of Council's developing carbon neutral plans and targets (Cities Power Partnerhship, 2021). The modelled emissions reduction projects align with best practice emissions management through prioritising avoidance, reduction and replacement of emissions prior to considering the purchase of offsets (see Figure 5).

Council has already sought to manage its operational emissions through the installation of solar panels on key Council facilities (listed below) and the construction of public electric vehicle charging stations across the local government area.

The following Council buildings have solar photovoltaic panel installation:

- Goolwa Cadell Street Administration and Library Building: 99.88 kW
- Goolwa Works Depot: 50 kW
- Strathalbyn Administration and Library Building: 52.8kW
- Strathalbyn Works Depot: 17.16 kW

Emissions reduction of council operations can be further achieved through adopting renewable energy technology, improving energy efficiency, reducing consumption of energy and sourcing materials and services from responsible (low emitting) suppliers.

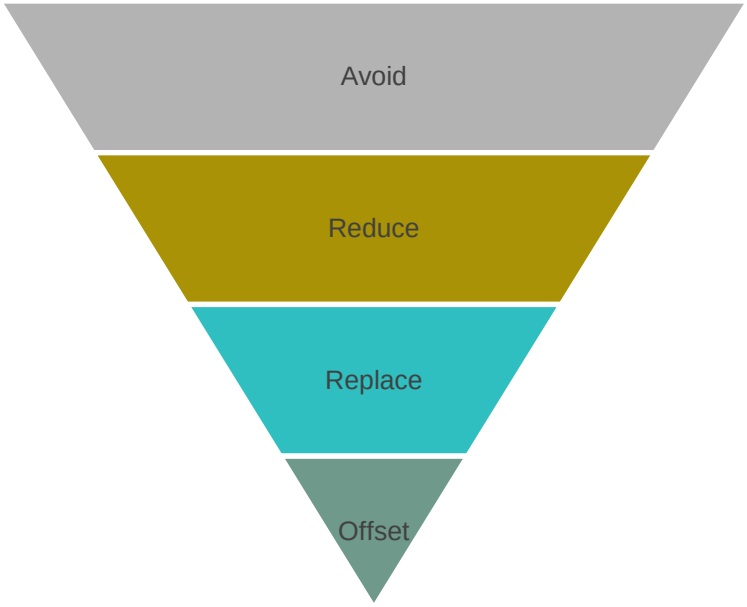

Figure 5. A best practice emissions management hierarchy

Community emissions

Community emissions represent 99% of all emissions produced in the Alexandrina Council area. As such, the greatest opportunity to reduce emissions lies with the residents, businesses and organisations of Alexandrina. To support the community to reduce emissions, it is recommended that Council commit to the following modelled projects:

- A 50% uptake of solar hot water on all new build housing stock.
- A 100% uptake of electric vehicles by all in the community by 2040. All vehicles will be powered by 100% renewable electricity.
- A 100% uptake of hydrogen fuel cell vehicles for all heavy vehicle transport, resulting in 100% reduction in emissions from hydrogen fuel cell heavy vehicles.
- The uptake of rooftop solar PV systems by 5% per annum across the housing stock in Alexandrina Council, with the understanding that 40% of houses within Alexandrina already have rooftop solar PV systems installed.
- The purchase of carbon offsets.

1.5 Targets

It is recommended Council commit to carbon neutrality by 2040. Carbon Neutral is defined by the Australian Government Climate Active Standard as reducing emissions where possible and compensating for the remainder by investing in carbon offset projects to achieve net zero overall emissions (The Australian Government, 2020). In the context of Alexandrina Council, the target is to achieve carbon neutral status for council services and operations related to the scope of emissions captured through this plan, by 2040. This involves avoiding and reducing emissions where feasible before offsetting remaining emissions that are not reduced through emissions avoidance and the modelled reduction projects.

It must be recognised that Council do not control the actions of the Alexandrina community and that establishing a target for the community is the responsibility of the community. The community modelling conducted for this plan demonstrates that it is feasible for the community to achieve carbon neutrality by 2040.

2 Methodology

The methodology undertaken to create the Carbon Neutral Plan is described within this section. The key stages of the methodology are described in Figure 6.

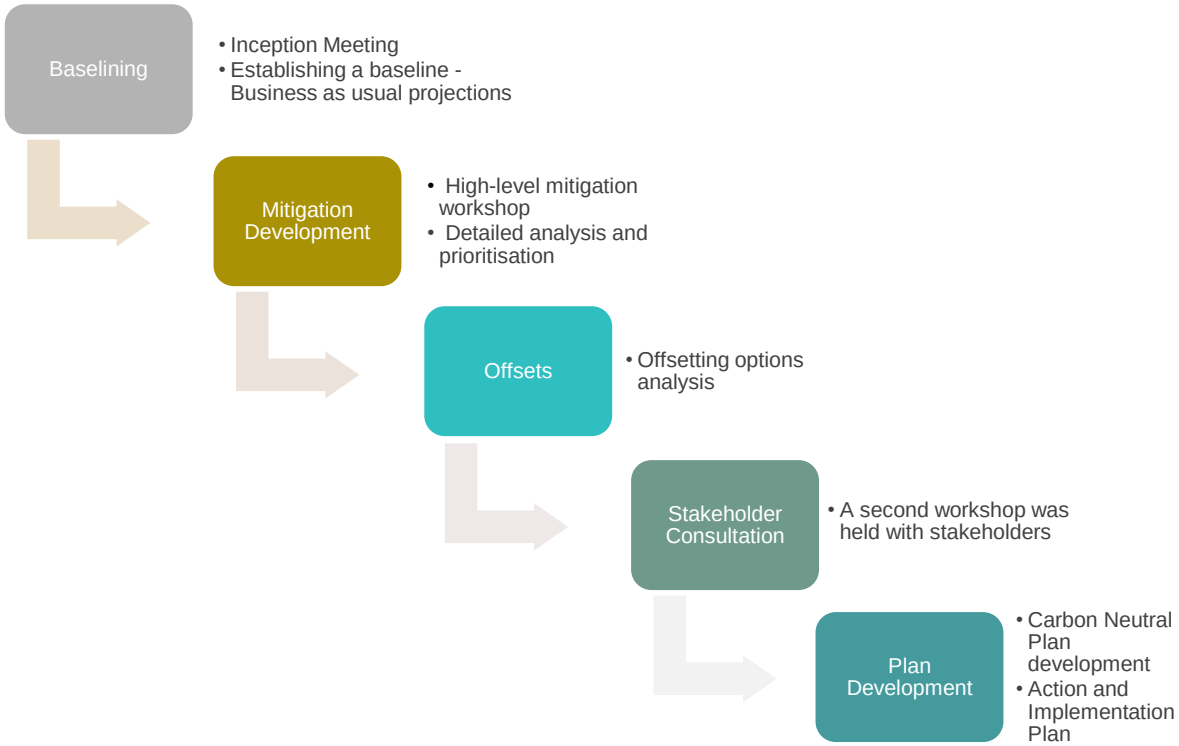

Figure 6. The key phases and stages of the preparation of the plan

2.1 Inception meeting

The project commenced with an inception meeting on the 31st of March 2021 between the Project Team and Edge Environment. The meeting was used to discuss the following:

- Intent, objectives, scope and boundary for the project, including any secondary aims which can be achieved within the scope of the project.
- Confirm relevant plans and data sources.
- Confirm and refine the scope of the GHG inventory and carbon neutral pathway.
- Discuss the format and presentation of deliverables.
- Discuss and clarify roles and responsibilities.
- Finalise the delivery schedule.

2.2 Establishing a baseline – business as usual (BAU) projections

Council operational emissions

Utilising Council generated data and data related to council operations, a baseline for current operations and delivery of services was established for the 2019/2020 financial year.

Emissions calculations for both Council operational and community emissions were conducted utilising National Greenhouse Account factors, Life Cycle Analyses factors, population projection data sourced from profile.id and the Alexandrina community emissions profile sourced from Snapshot (see Figure 17). Business as usual (BAU) projections and emissions calculations have been conducted in accordance with best practice Global Protocols for Greenhouse Gas Emissions Profiles.

Figure 7**Error! Reference source not found.** briefly describes the emissions inventory and calculation process used to determine Council's operational emissions profile.

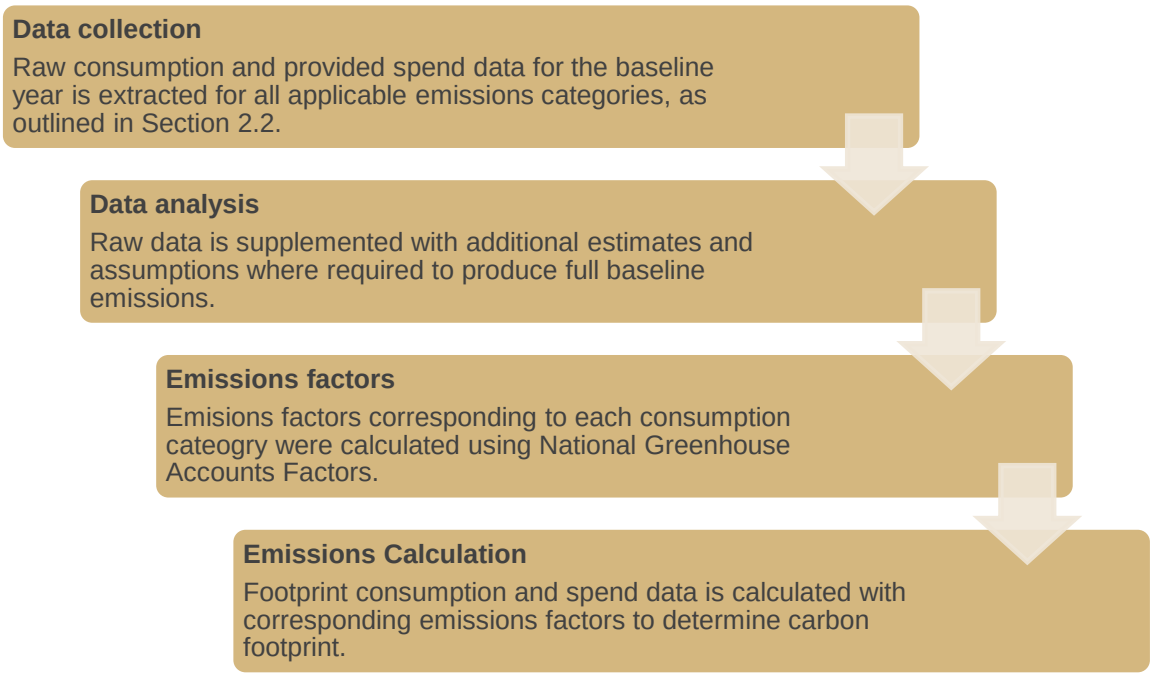

Figure 7. The emissions inventory and calculation process

To convert primary data (i.e., purchased electricity data, waste data, purchased goods and services data) into GHG emissions, we have used LCA databases and the National Greenhouse Account Factors which contain GHG inventories for energy, activities and materials, and global warming potential calculation methods. The databases used converts physical and economic flows into corresponding GHG emissions equivalent (t CO2-e). A schematic representation of this methodology is depicted below in Figure 8.

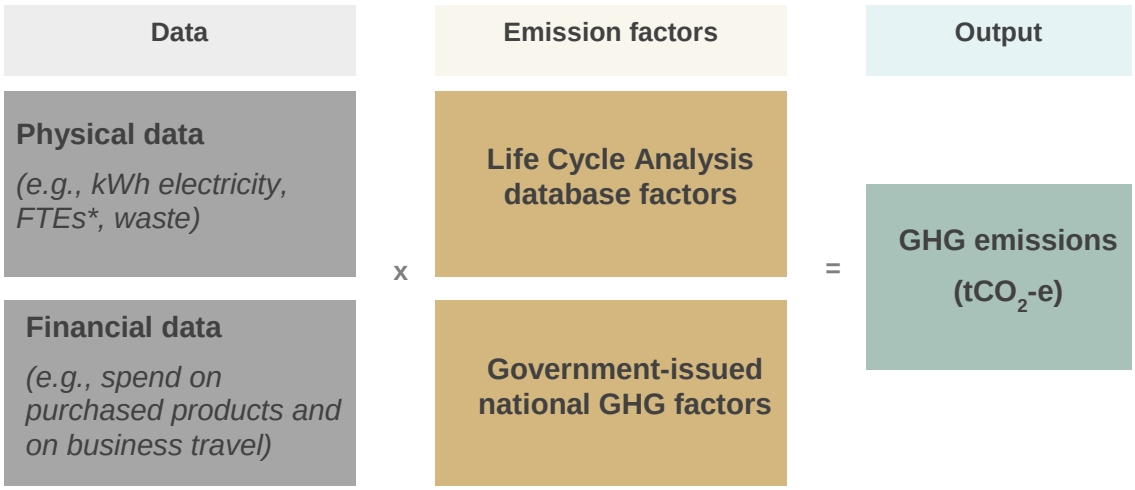

Figure 8. A brief description of how Council's GHG emissions have been calculated

Data related to emissions for the 2019/2020 financial year was supplied by Alexandrina Council, including:

- Corporate fuel use.
- Electricity usage and generation of electricity from solar installations.
- Approved business travel in private vehicles.
- Solid waste produced by Council (not community waste).
- Mains supply water use.
- Water extraction from water licences.
- Water recycling – recycled stormwater and wastewater.
- Gas usage (LPG, BOC).
- Fleurieu Regional Waste Authority (FRWA) (shared with 3 other councils, hence only proportional data has been used): transport fuel for kerbside and fleet, stationary fuel.
- FRWA Office Electricity.
- Fleurieu Regional Aquatic Centre (FRAC) (shared 50/50 with Victor Harbor): Electricity, LPG gas, BOC gas, mains supply water.

Council related emissions were categorised across the following facility groups:

- Fleet.
- FRAC
- Street lighting.
- Administration and libraries.
- Water treatment and pumping.
- Other.

Baseline data for both Council and Community emissions is presented on Council's website under https://www.alexandrina.sa.gov.au/connect/environment/climate-change.

Community emissions profile

The community emissions profile for Alexandrina has been extracted from the Snapshot website. Snapshot is an open access data source of the emissions profile of every local government area within Australia (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019). The Snapshot profiles have been developed in accordance with the Greenhouse Gas Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019). The GPC Protocol is designed to promote best practice GHG accounting and reporting (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019).

2.3 High level mitigation workshop

Edge staff facilitated a workshop on the 26th of May 2021 with the project team to explain the Council operational and community emissions inventory and to explore emissions reduction projects. The project team were lead through a PowerPoint slide deck outlining the breakdown of Council emissions by:

1. Sector; and
2. Scope

The community emissions profile (sourced from Snapshot) was shown to the project team and used to demonstrate the sources of community emissions.

The project team developed a list of preferred emissions reduction projects and prioritised projects through a voting system (see Table 1).

The emissions reduction projects outlined in Table 1 were considered for modelling based on the technical feasibility of modelling and consideration of projects that would likely have the greatest impact on total Council and community emissions reductions, given the respective community and Council emissions profile. The modelling assumptions and limitations are listed in Appendix B.

Table 1. Preferred emissions reduction projects as voted for by workshop attendees.

Emissions reduction project	Total number of votes
Consider emissions in construction guidelines/green developers	12 votes
LED lighting installation	10 votes
Fleet/hybrid/EV/charging stations	10 votes
Urban greening	6 votes
Renewable power	5 votes
Council to consider emissions through a decision-making framework	3 votes
Recycled products in road bases	2 votes

The projects described in Table 1 and Edge's experience and knowledge of emissions reduction projects were used to inform the projects outlined in the modelling phase of the Carbon Neutral Plan for both Council operational emissions and community emissions.

2.4 Detailed analysis and prioritisation

Based on the technical feasibility of the emissions reduction projects and the preferences for particular emissions reduction projects, modelling of select emissions reduction projects were conducted. Additional desktop research was conducted by Edge to explore the mitigation opportunities to model the high-level carbon abatement potential to assist with developing the pathway to carbon neutrality. The findings are discussed in Section 0.

Emissions were projected until the year 2040 to align the emissions reduction target to the Alexandrina 2040 strategic plan. To project the future emissions profile, a range of assumptions were made. These are as follows:

- A 1.4% population growth rate from 2021 to 2040 (based on forecasted population growth) (.idcommunity demographic resources, 2021)
- Decarbonisation of the South Australian grid, aligned with the South Australian Government 2030 goal of net 100% renewable energy by 2030 (Government of South Australia, 2021)
- All electricity provided through the grid will be sourced from renewable energy sources by 2030 (Government of South Australia, 2021).
- Offsetting options analysis Desktop research was conducted to supplement Edge's existing knowledge of offsetting within Australia.
- Offsetting options were categorised across the following categories:
- Carbon Farming.
- Blue Carbon
- Biodiversity Credit Exchange Program.

2.5 Feedback from the second council stakeholder workshop and plan development

A secondary workshop held on the 4th of August 2021 with key stakeholders provided an opportunity to provide information determined through the emissions reduction modelling phase and offsetting options analysis phase. Invitees of the high-level mitigation workshop hosted in May 2021 were invited to attend this workshop.

2.6 Plan development

Feedback was sought and provided from the workshop attendees post-delivery of the second workshop. Feedback was considered and where relevant and feasible incorporated into this document.

Post-delivery of an initial draft report, a secondary report was provided to Council for consideration. Feedback from the initial draft was provided and led to changes and edits of the Carbon Neutral Plan.

3 Findings – Council operational emissions

Alexandrina's combined Scope 1, Scope 2 and limited Scope 3 emissions profile for Council operations across the 2019/20 financial year is 3,444 t CO_2-e.

3.1 Existing Council's emission profile

The Alexandrina Council 2019-2020 financial year emissions profile break down by scope is presented in Figure 9. Council operational emissions are predominantly from purchased energy sources (Scope 2), whilst Scope 1 emissions are related to purchased fuels and refrigerants (38% of emissions). As previously described, Scope 3 emissions calculated as part of this assessment are outlined in Section 2.2 and include purchased goods and services (limited to the data provided by Council), business travel, water treatment, disposal and use and business travel.

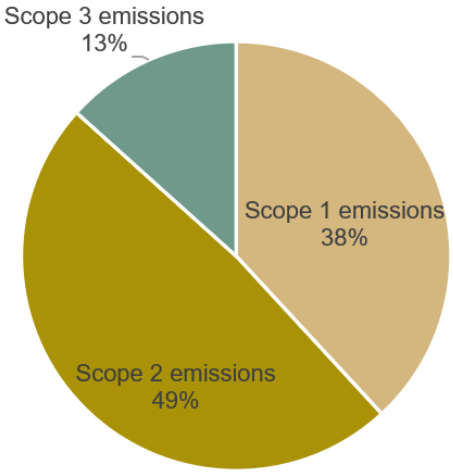

Figure 9. Council operational emissions categorised by Scope

Further analysis and breakdown of the emissions profile by sector reveals that diesel fuel use contributes to a quarter of all modelled council emissions, with over 320,000 litres purchased in the 2019/2020 financial year (Figure 10). Diesel alone contributed approximately 25% of carbon dioxide equivalent (t CO_2-e) to council's operational emissions profile (see Figure 10 and Appendix A).

Purchased electricity, utilising 3,911,774 Kilowatt hours (kWh), contributed 1,682 t CO_2-e (Figure 10).

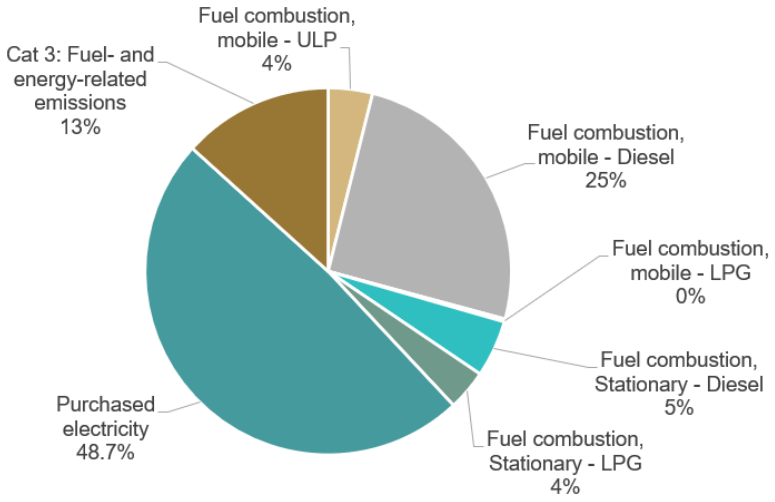

Figure 10. Council operational emissions by source

A breakdown of data and equivalent t CO_2-e is provided in Appendix A.

3.2 Council's emissions reduction pathway through grid decarbonisation

One of the key aims of the South Australian Government is to ensure the South Australian electricity grid is net 100% renewable electricity by 2030. Figure 4**Error! Reference source not found.** represents the projected BAU scenario compared to a grid decarbonisation pathway aligned with the SA Government 100% renewable energy target for council emissions from 2020 to 2040.

Council operational emissions under a BAU scenario are projected to reach 4,437 t CO_2-e by 2040. Under a grid decarbonisation model, whereby all Scope 2 emissions and some associated Scope 3 emissions would be eliminated due to SA grid electricity being sourced from renewable sources, 2,461 t CO_2-e are projected to be emitted by 2040.

The modelling process assumed an annual population growth rate of 1.4%, based on population forecasting provided by id.com.au (.idcommunity demographic resources, 2021). It is assumed that the services provided by council will increase at a rate equivalent to population growth in order to maintain current community service levels. It can be seen that under a grid decarbonisation model, emissions will reduce year on year up to and including the 2030 financial year, when the grid is expected to be almost completely decarbonised. After this time, emissions will slowly increase due to required extra services and associated population growth. However, the BAU projection assumes the emissions from the grid will remain as they have been throughout the 2019-2020 financial year and, as a result of this, emissions will steadily rise from 2021 to 2040. The slight reduction in BAU emissions from 2020 to 2021 is a result of projected additional solar PV capacity reducing council's energy demand for newly implemented solar PV projects installed on council owned buildings.

Figure 11 and Figure 12 are to be viewed in comparison and demonstrate the potential emissions reduction potential across particular council facility group. Figure 11 shows the emissions correlated with a BAU scenario where 2019/2020 financial year data has been utilised to project future 2040 emissions based on a scenario under the assumption that the modelling of emissions reduction projects are not implemented.

Figure 12 outlines potential reductions in emissions under a 2020 and 2040 scenario based on the South Australian grid decarbonising by 2030. It can be seen that under this scenario significant reductions in emissions would be realised across sporting facilities, street lighting, administration and library buildings, water treatment and pumping and other assets.

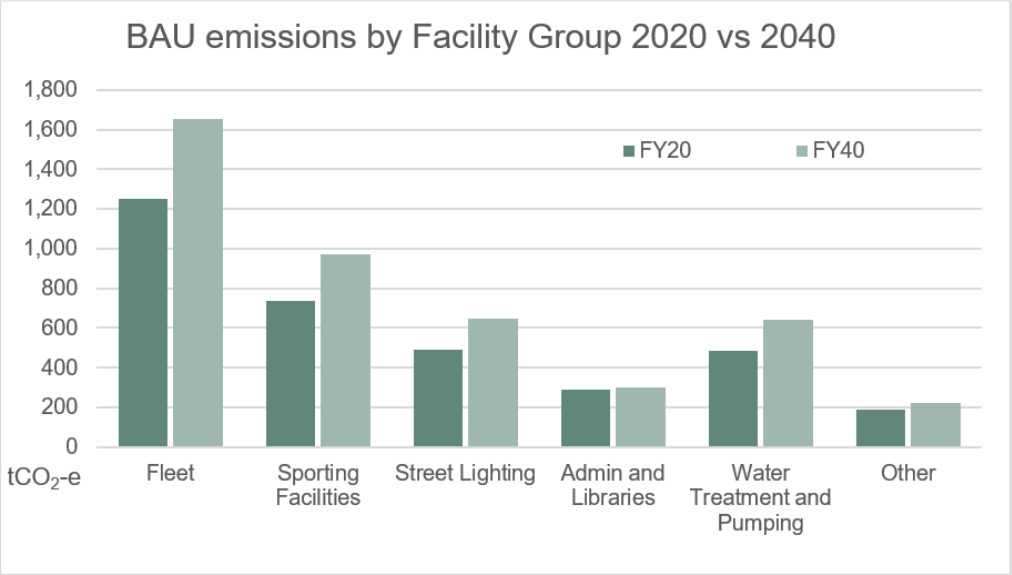

Figure 11. BAU emissions comparing financial year 2020 and financial year 2040 categorised by facility group. Carbon dioxide equivalent is a measure used to compare the emissions from various greenhouse gases based upon their global warming potential. For example, the global warming potential for methane over 100 years is 21. This means that emissions of one million metric tons of methane is equivalent to emissions of 21 million metric tons of carbon dioxide (OECD, 2013).

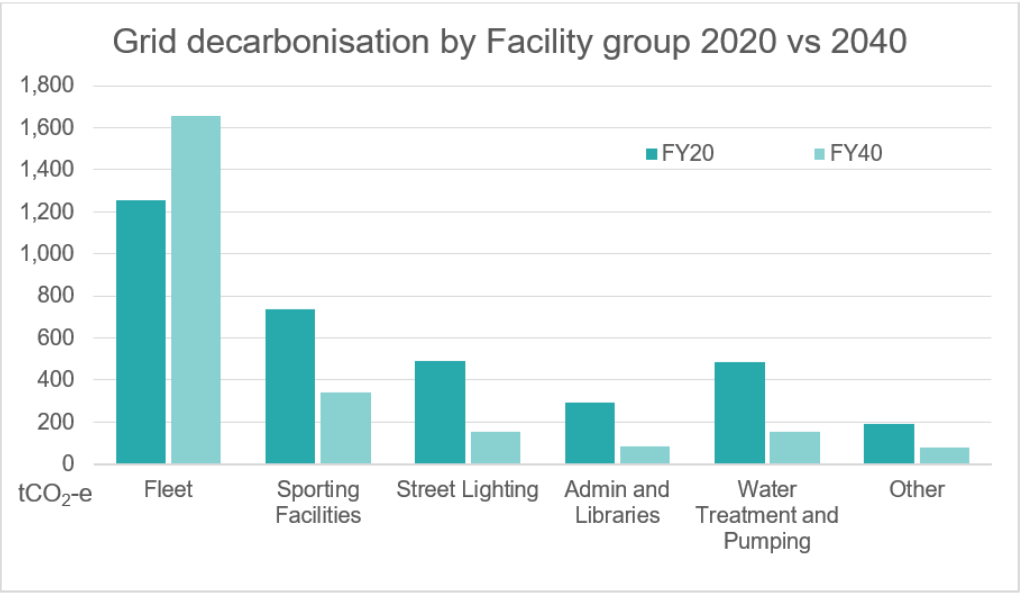

Figure 12. Modelling of a grid decarbonisation scenario in 2020 and 2040 whereby the South Australian grid is powered 100% by renewable energy by 2030.

3.3 Emission reduction projects

This section outlines seven emissions reduction projects modelled for Council and the pathway to carbon neutrality by 2040 (Figure 13). Carbon neutrality is feasible for Council but will, according to modelling, require the purchase of offsets.

Modelling suggests that by 2040, the total emissions of Council will increase from 3,444 t CO_2-e to 4,437 t CO_2-e (see Figure 1). Implementation of the modelled emissions reduction projects can reduce emissions by 1,449 t CO_2-e, a reduction of 32%. The projected decarbonisation of the South Australian

mains supply grid will reduce emissions by a further 2,005 t CO_2-e, a reduction of 45%. A remaining 983 t CO_2-e will be required to be offset through either local offsetting measures or through the purchase of carbon credits.

Modelling of urban greening suggests that the ability of Council to abate carbon through an urban greening program is considerable and by the year 2040 could offset up to 140 t CO_2-e per year. This is based on a moderate planting regime of 365 trees per year and has the potential to further reduce emissions from 983 t CO_2-e to 843 t CO_2-e by 2040. The remaining 843 t CO_2-e will need to be offset in order for Council to achieve Carbon Neutral status.

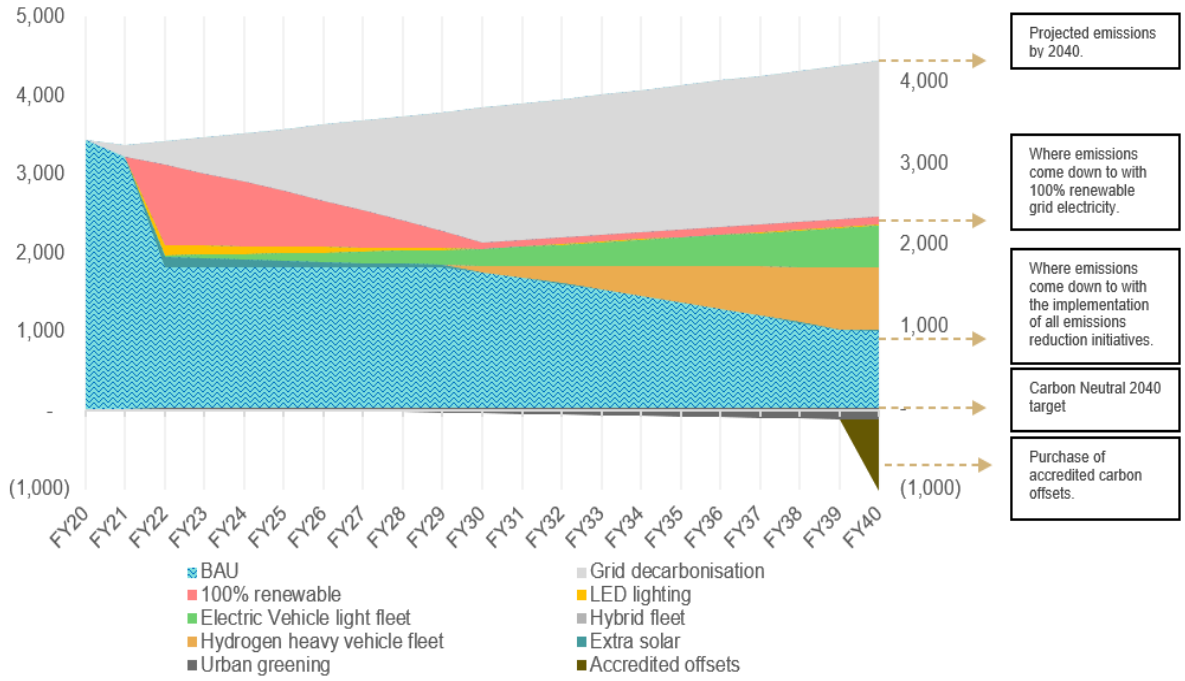

Figure 13. Council's pathway to carbon neutrality by 2040.

Figure 13 includes the business-as-usual scenario, modelled emissions reduction projects, urban greening (a form of localised offsetting), accredited offsets and the electricity grid decarbonisation. Table 2 lists the abatement potential and the net present value (PV) per tonne of CO_2-e abated of emissions reduction projects only.

Table 2 shows seven emissions reduction projects that are colour coded and ranked according to the value of the emissions reduction (Net Present Value) per tonne of CO_2-e abated. The net present value represents the future dollar value per tonne of CO_2-e from implementing the mitigation scenario by 2040. For example, installing solar is projected to provide a saving of $11,452 per tonne of CO_2-e by 2040. The green colour coded projects, such as LED lighting changes, additional solar (car park solar at Goolwa and Strathalbyn) and additional solar + battery storage represent cost savings for Council over time, i.e., the capital costs will be recouped by operational savings by the 2040 period. The column titled t CO_2-e represents the total tonnes of CO_2-e abated by the mitigation scenario. It can be seen that although 100% renewable energy represents a minor cost (net present value dollar savings per tonne CO_2-e), adopting this action will provide the greatest impact in terms of emissions abated (13,732 t CO_2-e).

Table 2. Ranking of the modelled Council operational emissions reduction projects according to financial savings and costs to Council.

Rank	Mitigation Scenario	t CO2-e of emissions abated	Net Present Value dollar savings per tonne of CO2-e (PV$/t CO2-e)
1	Extra solar (no battery)	246	-$ 11,452
2	Extra solar + battery	246	-$ 11,201
3	LED lighting	615	-$ 929
4	100% renewable energy	13,732	$ 90
5	EV fleet	4,194	$ 96
6	Switch heavy fleet to hydrogen vehicles	4,986	$ 297
7	Hybrid fleet	452	$ 363

Transitioning Council's light vehicle fleet to electric vehicles and purchasing 100% renewable energy represents moderate costs to Council, however, the emissions abatement potential of both projects to the 2040 period are significant (4,194 t CO_2-e and 15,13,732 t CO_2-e respectively).

Changes to emissions reductions are illustrated in a Marginal Abatement Cost Curve (MACC) (Figure 14). The MACC is used to model the costs/savings of a particular emissions abatement project and quantifies the comparative potential abatement of t CO_2-e from different emissions reduction projects.

The costs outlined below in Figure 14 represent an increased capital cost to Council, however, these costs need to be considered in comparison to the costs required to offset these same emissions, if the emissions reduction project is not implemented. Given the current and projected increase in the price of carbon by 2040, the costs of implementing such projects is less than the projected cost of offsets (assuming a carbon cost of more than $70/tonne by 2040 (MacDonald-Smith & Greber, 2021).

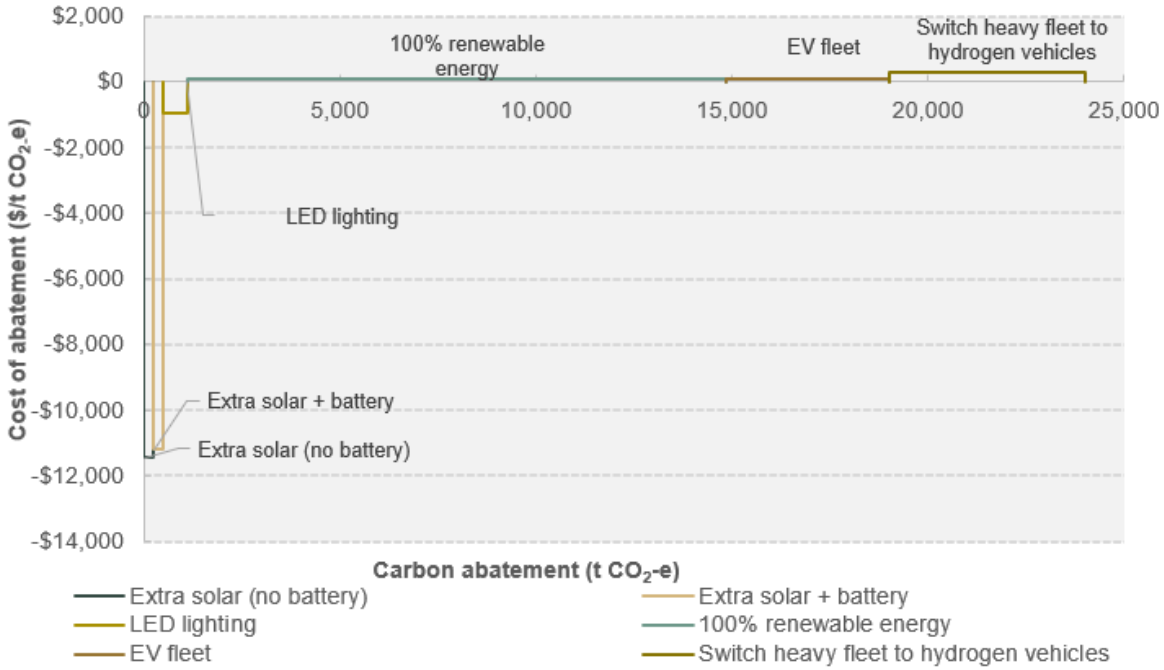

Figure 14. The modelling of six emissions reduction actions that may be taken by council to reduce emissions.

Projects modelled in the MACC were informed through research and analysis and priorities listed during workshop 1 and represent the key areas of emissions abatement modelling focus.

LED lighting

Public lighting, including street lighting and public space lighting is a high ongoing cost for Council (Rhodes, 2021). Replacing existing higher energy use lighting with LED lighting can reduce the costs of electricity, as LED lighting draws a reduced amount of electricity compared to the existing public lighting infrastructure, which consists of fluorescent and high pressure sodium lamps. The upgrading of lighting from existing high energy demand public lighting to low energy demand LED lighting represents a cost saving for Council of $929/t CO_2-e abated and a total abatement potential of 615 t CO_2-e (Table 2) from 2022 to 2040. These figures are based off of the assumption that the transition from higher energy use lighting to LED lighting will commence in 2022. Although the capital costs of LED lighting are often higher than other forms of lighting, LED lighting replacement costs are reduced due to the extended durability and lifetime of LED lighting compared to that of higher energy demand lighting. LED luminaries (lights) have a lifetime of between 50,000 and 100,000 hours, compared to the working hours of fluorescent lighting of 15,000 – 30,000 hours (Dibia, 2018).

Additional solar and battery storage

Alexandrina Council has already adopted and installed several arrays of solar rooftop systems to help reduce the ongoing costs and emissions associated with the purchase of grid supplied electricity (see section 1.4). The modelling of two additional solar arrays, one located at the Strathalbyn Works Depot and one at the Goolwa Cadell Street Office consists of two 100Kw systems. Due to the limited availability of suitable roof space, modelling has been conducted based on the erection of cark park solar. Car park solar involves the construction of a steel frame and the placement of solar panels onto the steel frame. In this manner, cars can park in the shade under the solar panels and the solar panels can be connected to the relevant buildings.

Installing additional solar at the Goolwa Council Office and the Strathalbyn depots will result in an emissions reduction of 246 tonnes of CO_2-e for a cost savings of $11,452/t CO_2-e. The incorporation of on-site batteries did not increase the emissions reduction potential of the solar PV installation,

however, the costs per tonne of emissions abatement of $11,201/t CO_2-e represents a slight reduction, compared to the solar without battery storage comparison. The capacities and costs of the solar systems were based on commercial quotes obtained for a car park solar installation at Goolwa (Specialised Solutions, 2021). However, due to the supplied quote, providing information outside of the scope of this project, costs have been applied only for the installation of two 100kW systems, one located at Goolwa and the other at Strathalbyn.

The expected decarbonisation of the mains supply electricity grid limits the emissions abatement potential of additional solar and solar including battery storage as mains supply electricity is expected to be sourced from 100% renewable energy by 2030.

Battery systems continue to drop in price, increasing the financial viability of on-site battery storage technology. This not only reduces electricity demand and costs but also allows for greater flexibility in utilising stored electricity when commercial grid prices are high and storing electricity when commercial grid prices are low. Some benefits are as follows (Shell Energy, 2021):

A reduction of peak demand by deploying battery during high demand periods.

Charging the battery during low costs periods and using the stored electricity during high-cost periods.

There are a range of available market access schemes:

- Frequency Control Ancillary Services (FCAS): A process used by the energy market operator to maintain the frequency of the system within the normal operating band around 50 cycles per second (50 Hz). FCAS provides a fast injection of energy, or fast reduction of energy, to maintain supply and demand
- Wholesale demand response: designed to supply opportunities for consumers to participate in the wholesale market by bidding in demand reductions as a substitute for generation, thereby unlocking under-utilised demand response in the national electricity market.
- Preparing for the summer months, the Australian Energy Market Operator (AEMO) engages with market participants to secure reserve generation and demand management contracts the supports AEMO is maintaining system security and reliability. It is a mechanism available to AEMO to mitigate risk to energy supply during high demand conditions for the National Electricity Market (NEM).

There are implications of installing and managing larger solar systems. For example, where the total capacity of a device exceeds 100kW, the device may be accredited as a power station under the Large-scale Renewable Energy Target (Australian Government, 2019). Organisations managing a power station are required to apply for and meet criteria to obtain a large-scale generation certificate. The requirements of this will need to be further explored and investigated by Council prior to committing to the installation of large-scale solar (Australian Government, 2019).

100% accredited renewable energy

Switching council procurement of energy to renewable energy (i.e., energy sourced from 100% renewable energy sources) represents the greatest reduction in tonnes of CO_2-e emitted into the atmosphere (15,336 tonnes). It also represents a moderate to medium cost to council of $87/t CO_2-e (Table 2). It is noted that a bulk purchase of electricity, facilitated through a Power Purchase Agreement is currently being undertaken by the South Australian Local Government Association (SALGA). The Power Purchase Agreement involves 60 South Australian Councils uniting to broker a new electricity deal through the wholesale electricity market. One of the aims of the PPA is to access lower cost electricity. Many Councils have also committed to accessing 100% renewable energy and as such a new deal may include accessing 100% renewable energy. This aspect of the agreement is yet to be determined. Alexandrina Council as a member of this group can seek to influence other Councils to ensure that the new PPA only accesses 100% renewable energy, however, ultimately the decision is outside of Alexandrina Council's control and will be decided by the SALGA. The new wholesale energy deal with the SALGA is due to come into effect in 2023. The duration of the new contract is yet to be determined.

Low emitting transport

Scope 1 emissions associated with fossil fuel use in Council vehicles represents a major emissions source (29% of all modelled emissions) (see Figure 10). The transition away from combustion engines to electric vehicles, hybrid vehicles and hydrogen powered heavy vehicles requires a pragmatic approach. There are a range of supporting measures that are required to facilitate the transition to electric vehicles and hydrogen fuel cell vehicles. This includes a charging network to allow for electric vehicles to recharge and the installation of electric vehicle charging stations within Council premises. It is recommended that a low emissions vehicle transition plan be developed to support the move away from combustion engine vehicles. Range anxiety associated with electric vehicle use, the anxiety of running out of power, is an issue for some. It is suggested that Council first move to hybrid vehicles, whilst electric vehicle infrastructure and the needs of Council are assessed.

The decision to upgrade the Council fleet to hydrogen fuel cell for heavy vehicles and electric for light fleet, is a key area of decision making. Modelling suggests that electric vehicles are lower cost in terms of CO_2-e abatement potential and can abate more than ten-fold that of switching to hybrid vehicles. Converting the light fleet to electric vehicles will abate 4,194 tonnes of CO_2-e, combined with heavy vehicles being converted to hydrogen abating a further 4,986 tonnes of CO_2-e; compared to 452 t CO_2-e for hybrid vehicles. Converting the light fleet to electric vehicles will cost \$96/t CO_2-e and heavy vehicles to hydrogen could cost \$297//t CO_2-e, making a combined cost of \$393/t CO_2-e. Whereas switching to hybrid vehicles will cost \$363/t CO_2-e (Table 2). While hybrid may appear fractionally more affordable, the carbon abatement of electric and hydrogen vehicles combined is more than twenty times that of hybrid. The hybrid vehicle transition has not been included in the Marginal Abatement Cost Curve as it is not modelled across the same time frame as the other projects, with an assumption that hybrid vehicles will be phased out of Council's fleet by 2028.

It is recommended that Council consider the transition from combustion engine vehicles to EVs, rather than a staged transition from combustion engine vehicles to hybrid vehicles and later to EVs. From an emissions abatement potential the benefits of transitioning early to EVs is far more beneficial.

3.4 Pathway to carbon neutrality

The pathway to carbon neutrality for Council operations requires a combination of both emissions' reduction activities and offsetting. As outlined in Figure 15 below, Council may achieve Carbon Neutral status by the year 2040 through the adoption of the following projects:

- The purchase of power from 100% renewable energy sources.
- The replacement of higher emitting public lighting with LED lighting.
- The transition of council passenger and works vehicles (excluding heavy machinery) to first hybrid vehicles (short-term) and then electric vehicles.
- The transition of heavy machinery and vehicles to hydrogen fuel cell power generation.
- The addition of two 100kW car park solar PV systems (one located at Goolwa Council Chambers and one at the Strathalbyn Works Depot).
- Offsetting the remainder of emissions through local offsetting projects.

Figure 15 demonstrates that of all the emissions reduction projects that Council could undertake to reduce emissions to the year 2040, the greatest reduction in emissions is likely to occur from the decarbonisation of the South Australian Electricity Grid (a reduction of 2,005 tonnes CO_2-e).

Figure 15 shows that Council can significantly reduce emissions produced through operations and service delivery. Post implementation of the modelled projects and the projected reduction in emissions as a result of the decarbonisation of the SA electricity grid, 983 tonnes of CO_2-e will remain (difference). This difference is the quantity of CO_2-e that Council will need to offset to be considered a Carbon Neutral organisation. With the current spot price for Australian Carbon Credit Units at AU\$36 per tonne and likely to rise over time, offsetting is likely to be a considerable cost for Council and further regard of the risks of offsetting will need to be considered (UCL; Trove Research; Liebrich Associates, 2021).

Although South Australia's electricity grid is positioned to have a strong decarbonisation by the target year with close to 100% renewables by 2030, it is important to recognise the role that the purchase of

renewable energy has on reducing emissions. Variations in grid and large-scale generation networks may still follow a slower path, and so Council may not immediately benefit from the lower impact of electricity generation forecasted by the decarbonisation. Purchasing renewable energy will ensure that all emissions associated with the electricity used at any year are abated. Whilst renewable energy will not feature a significant role by FY40, it is essential in the years leading up to the target to reduce the associated emissions of purchased electricity in a still significantly carbonised grid and will provide ongoing financial savings to Council.

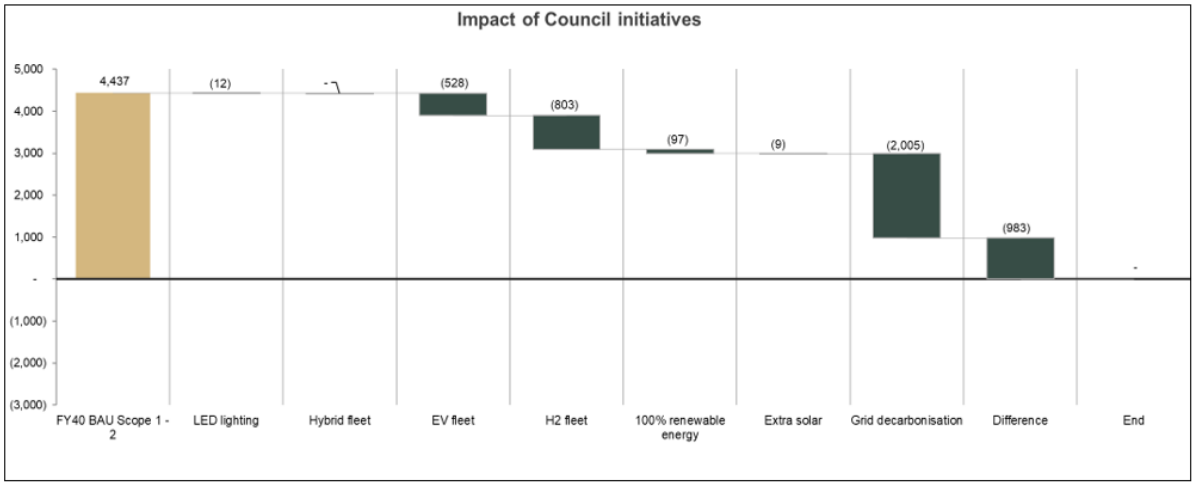

Figure 15. Council's pathway towards carbon neutrality[1]

[1] FY40 BAU Scope 1-2 refers to the business as usual emissions profile for the 2039/40 financial year, limited to the data provided by Council for the purpose of this plan, i.e., primarily Scopes 1 and 2.

4 Findings – Community emissions

For the purpose of this plan, community emissions are distinguished from Council emissions as emissions that are captured through the Snapshot community emissions profile and represent emissions produced by all organisations, residents and visitors within Alexandrina Council area.

4.1 The community's emissions profile

Community emissions contribute 99% of Alexandrina's emissions and it is critical that Council not only act to reduce organisational emissions but also to support the community to reduce emissions (Figure 16). The community emissions profile represented in Figure 17 outlines a total municipal emissions production of 361,000 tonnes of CO_2-e (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019-2020). On road transport represents the largest emitting sector within Alexandrina of 163,000 t CO_2-e (46% of all community emissions), with electricity also representing a significant emitting sector (110,000 t CO_2-e, 30% of all emissions) (see Figure 17 and Table 3) (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019-2020).

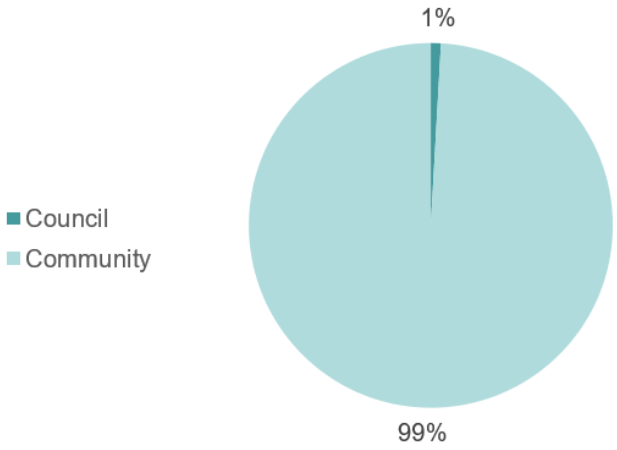

Figure 16. Alexandrina Council emissions generated in 2019/20 compared to the Alexandrina community emissions generated in 2019/20.

In 2019/2020 Agriculture, Forestry and Fishing was the fourth largest employment industry in the greater Adelaide Hills, Fleurieu and Kangaroo Island Regional Development Australia area (.idcommunity demographic resources, 2021). Emissions from agriculture represented 21% of total emissions for the Alexandrina Council with 76,000 t CO_2-e (Table 3) (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019-2020).

Waste produced a total of 12,000 t CO_2-e (Table 3) (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019-2020). Carbon sequestration or storage is accounted for through the Land Use sector (Table 3) (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2020). Table 3 outlines a Land Use sequestration of 5,000 t CO_2-e (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019-2020). Snapshot calculates GHGs emitted or sequestered through land use change (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2020). Data for land use change is sourced from the Department of Environment and Energy Land Use Bioregion (IBRA7) and calculates emissions from the following activities: forest clearing (forestland to cropland) and afforestation (grassland to forestland) (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2020). The impacts of ongoing sequestration from existing forestland such as National Parks is not currently included (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2020).

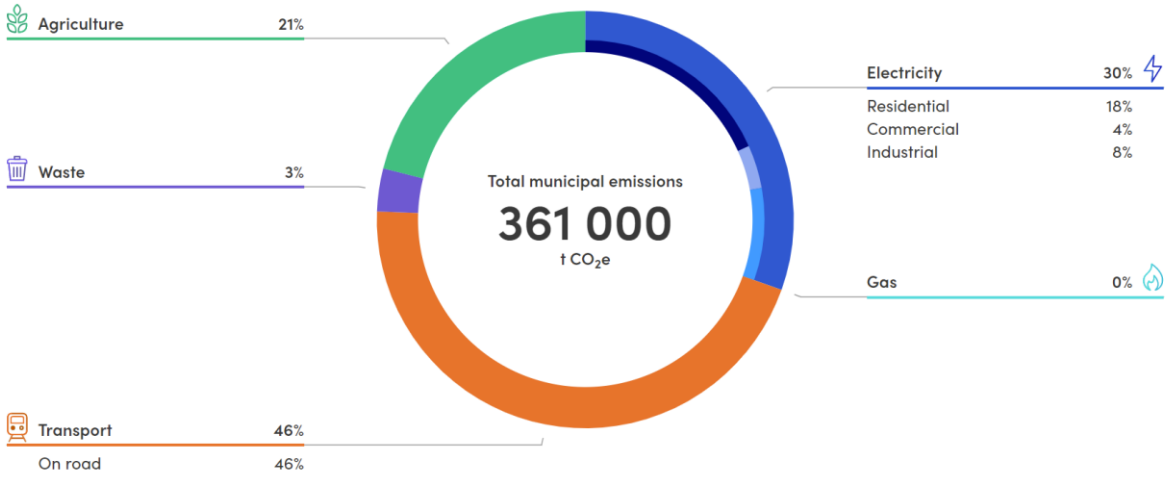

Figure 17. The Alexandrina Council community emissions profile, July 2019 to June 2020 (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019-2020).

Table 3. A breakdown of community emissions produced within the Alexandrina Council by source and sector (Beyond Zero Emissions; Ironbark Sustainability Consultancy, 2019-2020)

Source	Emissions (t CO_2-e)
Electricity	110,000
Transport	163,000
Waste	12,000
Agriculture	72,000
Land use	-5,000*

*The land use emissions figure is negative as it represents a carbon sequestration, i.e. drawing down of carbon from the atmosphere, related to vegetation growth.

4.2 Projected community emissions by the year 2040

Emissions of the community are projected to grow, based on population growth and increased development associated with increased population growth. The population growth rate of 1.4% has been extracted from the '. idcommunity' website (.idcommunity demographic resources, 2021).

Under a BAU scenario, emissions are projected to increase from 361,000 t CO_2-e in the base year of 2019/2020 (FY20) to 483,181 by 2040 (Figure 18). However, the impact of the grid decarbonisation as outlined further in section 3.2, is projected to significantly reduce emissions associated with the mains supply electricity grid. Under a BAU with grid decarbonisation model, by the year 2040 community emissions are projected to decrease from the current total of 361,000 t CO_2-e to 339,633 t CO_2-e (Figure 18). This assumes that by the year 2030, the South Australian mains supply electricity grid will be sourcing net 100% power from renewable energy sources, that do not produce GHG emissions.

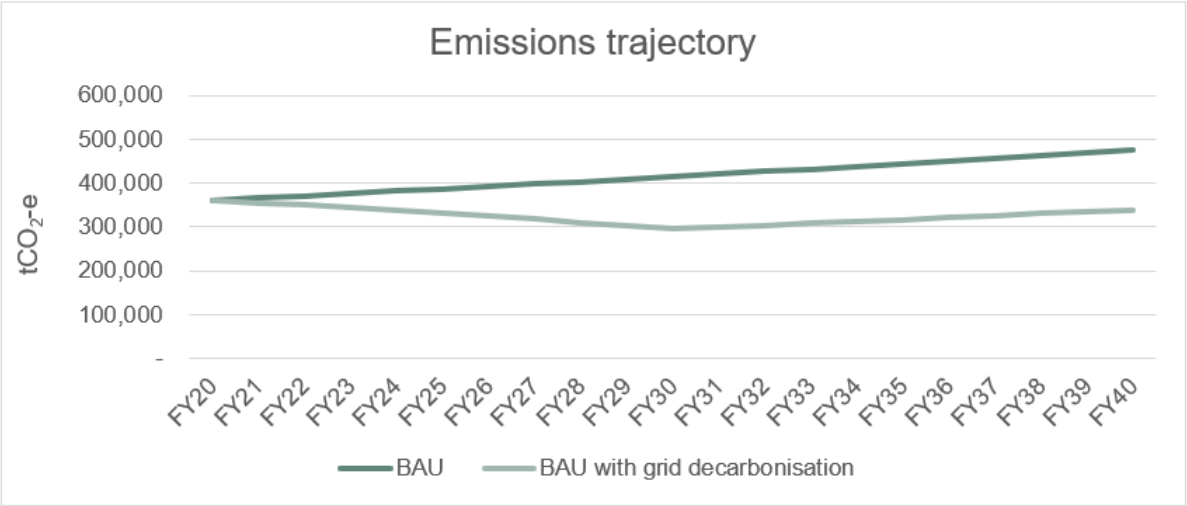

Figure 18. The community emissions trajectory represented as a business-as-usual scenario and a business as usual with grid decarbonisation trajectory.

4.3 Emissions reduction opportunities

Table 4 shows the emissions abatement potential and costs per tonne of CO_2-e abated to model select community projects. The projects are as follows:

- A 50% uptake of solar hot water on all new build housing stock.
- A 100% uptake of electric vehicles by all in the community by 2040, with all electric vehicles to be powered by 100% renewable electricity.
- A 100% uptake of hydrogen fuel cell vehicles for all heavy vehicle transport, resulting in a 100% reduction in emissions from hydrogen fuel cell heavy vehicles.
- The uptake of rooftop solar PV systems across the housing stock in Alexandrina Council by 5% per year, with the understanding that 40% of houses within Alexandrina already have rooftop solar PV systems installed.

The following offsetting scenarios were also modelled separately to the Marginal Abatement Cost Curve in Figure 19:

- The purchase of offsets.

The selection of the projects were guided by Edge's experience and knowledge of emissions reduction projects and priorities. Elected members, Council staff and the Climate Emergency Action Committee (CEAC) members knowledge of the local area and priority of high impact projects were sought and collected through the first workshop. These priorities were considered for modelling by Edge and progressed to modelling, in the event that the projects were both technically feasible and would make a material reduction to Council's emissions profile.

The modelled emission reduction projects only represent projects that are technically feasible to model. Further activities and supportive actions provided to the community through Council are discussed in Section 7.

Table 4. Ranking of community emissions reduction projects according to the cost per tonne of C02-e.

Rank	Mitigation Scenario	t CO_2-e	PV$/t CO_2-e
1	Rooftop Solar Installation	31,976	-$885
4	Hydrogen heavy vehicle	800,478	$212
6	EV community	1,264,297	$409
7	Residential solar hot water	9,249	$1,400

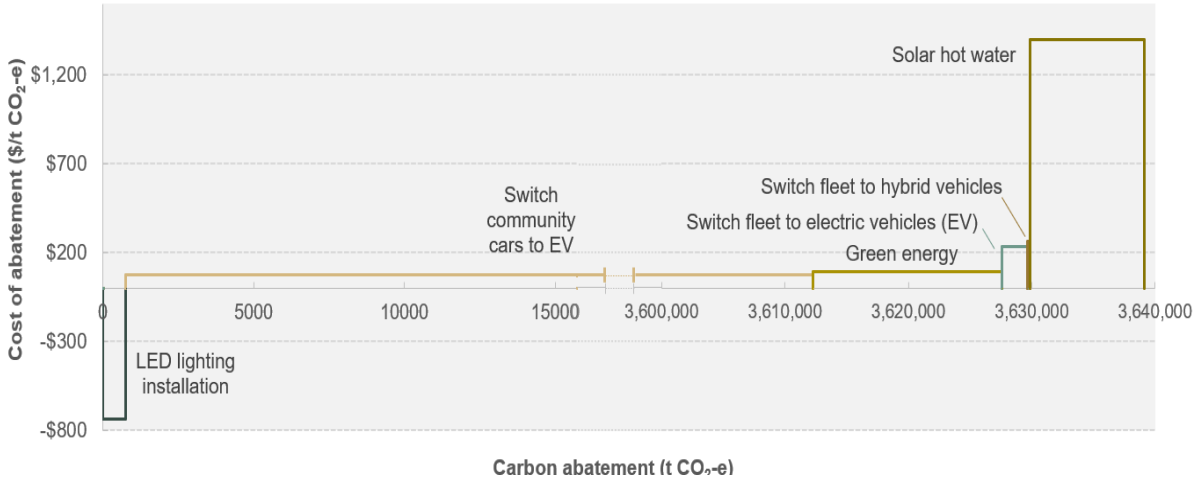

Figure 19. Community emissions Marginal Abatement Cost Curve (MACC)

Solar hot water

A priority for Elected Members, staff and the CEAC is to increase the thermal qualities of buildings in the Alexandrina Council area through the incorporation of ecologically sustainable design (ESD) construction and retrofit principles. The aim of modelling solar hot water is to demonstrate the potential of widespread solar hot water installation in new dwellings as an example of one change associated with passive design. The emissions abatement and associated costs to the community were calculated.

Accurate modelling of ESD is complex due to a range of variables that alter from one building design to another. As such, modelling of generic ESD principles is only considered appropriate for individual building designs and not appropriate to apply broad application of ESD across the Alexandrina community. Any modelling of ESD would include a high number of variables that is unlikely to accurately reflect the application of ESD to different built environments. For this reason, ESD was not modelled as part of the Carbon Neutral Plan.

Hot water represents 25% of household energy expenditure and solar hot water can deliver a 66% reduction in energy requirements. The current solar hot water update is low, with only 9% of South Australian households adopting this technology.

Costs for the solar hot water were calculated based on the population of Alexandrina Council and are represented as a per resident cost. As can be seen in Figure 19, solar hot water represents a significant cost of $548/t CO_2-e and an abatement opportunity of 1.52 t CO_2-e per consumer. Table 5 displays the installation costs, annual savings, net present value and abatement costs to the consumer of installing solar hot water in new dwellings. Abatement costs are defined as the cost of

reducing emissions compared to unconstrained business as usual scenarios, i.e., the costs of doing nothing.

Table 5. Resident installation costs, annual savings, net present value and abatement cost for solar hot water install in new dwellings

Initial cost	Annual savings	Net Present Value 2020-2040	Abatement Cost per tonne of CO2-e
$3,700	$246	$833	$548/tonne CO_2-e

Based on an assumed population growth rate of 1.4%, the total community emissions reduction of residential emissions from the installation of solar hot water systems into new builds from 2020 – 2040 is 9,249 t CO_2-e.

Electric vehicle transition

The transition from internal combustion engines to electric vehicles (EV) represents the greatest emissions reduction project modelled through the MACC (Figure 19). Assuming that the South Australian grid will be decarbonised by 2030, the energy used to power EV's will be close to 100% emissions free by 2030. Furthermore, a range of car manufacturers (Ford, General Motors, Honda, Jaguar, Mini, Volvo and others) have committed to ceasing production of combustion engines over the next 4 to 18 years, depending on the individual car manufacturer (Nicholson, 2021).

The South Australian Government has committed to assisting the transition to EV uptake through a range of stimulus measures, including:

- The first 7,000 Evs purchased in South Australia attract a $3,000 subsidy, and new EVs are exempt from registration fees up to 2025 (Purtrill, 2021).
- Up to 7,500 Smart Charging Subsidies of up to $2000 per households installing EV smart charging systems (Australia, 2020).

In preparation for the transition to increased EV use in the community, Council has already invested in the delivery of EV charging stations at strategic locations across the district, strengthening the feasibility of this transition. In a 2021 journal paper, Dwyer et al. note the key challenges related to the uptake of EVs in the Australian market include:

- Consumer awareness and choice of EV range.
- A lack of charging infrastructure compared to many other countries resulting in a reduced ratio of EV charging stations to people (Australia has one EV charging station per 11,039 people, significantly higher than Canada, The UK, USA, China and New Zealand).

A total of 3,612, 277 t CO_2-e can be avoided through the uptake of EVs within the community. Table 6 represents the resident upgrade costs, annual savings, net present value and abatement costs of switching to 100% EV use by the community.

Table 6. Resident EV upgrade costs, annual savings, net present value and abatement costs

Upgrade cost	Annual savings	Net Present Value 2020-2040	Abatement Cost per tonne of CO2-e
$24,163	$1,187	$43,053	$397/tonne CO_2-e

Modelling assumes that 100% of current drivers can be converted to switch to EVs by the year 2040. This assumption is based off of projections outlined by the Australian Government, Infrastructure Australia, that EV uptake will be between 70% and 100% by 2040 (Australian Government, 2019). The annual fuel savings of switching to EVs offset the high capital costs of the purchase price. The premium cost of purchasing an EV is likely to reduce over time as uptake of more EVs becomes mainstream. The car brands Mini and Jaguar Land Rover have committed to ceasing the production of

combustion engines by 2025 (Nicholson, 2021), with Ford, Bentley, Volvo and Fiat to transition between 2025 and 2030 (Nicholson, 2021) .

The global community is quickly transitioning away from the combustion engine in favour of a range of low emitting alternatives. Through adopting planning measures now, the community can benefit from a smooth transition to EV uptake. The installation of an EV charging network is a priority of the Australian Government, supported by the South Australian Government. Council may choose to install an EV charging network or not.

Hydrogen vehicles

Hydrogen powered vehicles represent an alternative low emissions form of transport to combustion engines and EVs (Baxter, 2020). Whilst EVs dominate the low emissions market for light vehicles, vehicle manufacturers are exploring both electric and hydrogen powered vehicles in the heavy vehicles market. Hyundai are the first vehicle manufacturer to produce hydrogen fuel cell heavy vehicles (Hyundai Trucks, 2020). Singapore's Horizon Fuel Cell is a company mass producing fuel cell technology for buses and trucks primarily for use in China (Kerr, 2021).

Road transport is a significant contributor to emissions within Alexandrina Council, primarily due to the predominantly rural nature of the area and the complexity of transport needs of those living and working in the community. Heavy vehicle transport figures were calculated utilising current average daily transport figures collected by the South Australian Department for Infrastructure and Transport, for the major transport routes in Alexandrina.

Modelling of hydrogen fuel cell heavy vehicle use demonstrates that there is significant potential to decrease emissions associated with heavy vehicle road use within Alexandrina. Modelling assumes a 100% uptake of hydrogen powered heavy vehicles on roads within Alexandrina by 2040. Data captured by the South Australian Government on current daily average road use of major transport routes within the Alexandrina area has been used to calculate potential emissions reduction savings from switching 100% of heavy vehicle use from combustion engine to hydrogen powered vehicles.

Table 7. Hydrogen fuel cell upgrade costs, annual savings, net present value and abatement costs

Initial cost	Annual savings	Net Present Value 2020-2040	Abatement Cost per tonne of CO2-e
$1,008	$1,046	-$14,104	$885/tonnes CO_2-e

Solar panels

The purpose of modelling an increased installation of solar panels in homes is to demonstrate the potential of increased solar installation in the community. Currently 40% of homes in South Australia already have solar installed. The emissions abatement and associated costs to the community were calculated for all remaining homes to install solar power at a rate of 5% increase each year. Under these assumptions, all homes would have solar installed by 2033.

Costs for the solar panel installations were calculated based on the population of Alexandrina Council and are represented as a per resident cost. As can be seen in Figure 19, solar panels represent a significant cost savings of $885/t CO_2-e and an abatement opportunity of 7.20 t CO_2-e per consumer. Table 5 displays the installation costs, annual savings, net present value and abatement costs to the resident of installing solar panels. Batteries to store solar energy were not included, as currently the price is not affordable for a regular resident.

Table 8. Solar panel upgrade costs, annual savings, net present value and abatement costs

Initial cost	Annual savings	Net Present Value 2020-2040	Abatement Cost per tonne of CO2-e
$1,008	$1,046	-$14,104	$885/tonnes CO_2-e

5 Opportunities and risks of offsetting

There are a range of ways in which Council may offset residual emissions. Offsetting presents a variety of potential opportunities and risks, many of which are described further in this section. It must be noted that offsetting can not replace the need for reducing and avoiding emissions (The Grattan Institute, 2021).

Offsetting refers to the process of purchasing carbon credits through carbon markets offered by organisations and businesses selling carbon credits. Carbon credits are the metric utilised by markets to determine the value of one tonne of carbon dioxide equivalent and can be earnt through conducting an activity deemed to compensate for the emission of GHGs into the atmosphere.

Offsets are broadly defined across two categories – Nature-based removals and Industrial removals (The Grattan Institute, 2021). Nature-based removals include removals of atmospheric carbon dioxide by nature-based carbon cycle processes (The Grattan Institute, 2021). This includes vegetation planting and growth, soil carbon and ocean stored carbon.

Industrial removal systems involve using technology to capture carbon dioxide from industrial processes or from the air and lock it away in geological formation or through chemical bonds, effectively forever (The Grattan Institute, 2021).

Purchasing offsets can be conducted through the Australian Government managed Emissions Reduction Fund or through alternative voluntary carbon markets. The Emissions Reduction Fund establishes a price for Australian Carbon Credit Units (ACCU) through bi-yearly reverse auctions, whereby eligible offsetting projects may be bought by the Australian Government (The Grattan Institute, 2021). In turn, the Australian Government sells ACCUs to eligible organisations wishing to offset the emissions they produce. This market is considered highly regulated and predictable. However, purchasing offsets through this means may mean paying a premium price. One ACCU is equivalent to one tonne of sequestered carbon (The Grattan Institute, 2021). ACCUs may be earnt through the following method type: agriculture, transport, energy efficiencies, waste, vegetation, savannah burning and industrial fugitive.

There are multiple voluntary offset markets that offer organisations the opportunity to offset their emissions. These markets are often unregulated, and the validity of the credits bought and sold through these markets is uncertain (The Grattan Institute, 2021).

The offsets associated with transport, energy efficiency, waste and savannah burning are linked with avoiding future emissions released into the atmosphere. However, these types of projects do little to draw down emissions from the atmosphere as carbon credits are generated for activities that are considered to have reduced and/or avoided emissions produced by BAU activities. It is recommended that Council focus on projects that drawdown and store carbon and have added co-benefits, such as biodiversity, soil health and conservation projects. This includes ecosystem restoration, biodiversity plantings, soil carbon projects and revegetation projects.

5.1 Offsetting opportunities within the Alexandrina Council area

There are several opportunities for Council to offset their own emissions through the following projects and schemes:

- Urban greening.
- The Emissions Reduction Fund and voluntary markets.
- Carbon farming opportunities.
- Biodiversity Credit Exchange Program.
- Blue Carbon opportunities.

These are discussed in more detail below.

Urban greening

Modelling of the carbon sequestration value of urban greening (tree planting on public land) has been conducted as part of the Carbon Neutral Plan. It must be noted that the sequestering of carbon through urban greening differs depending on the type of species planted, the conditions the trees are exposed to and the lifetime of each tree. However, based on the assumption that 365 trees will be planted every year from 2022 to 2039, there is the potential to store 1401 t CO_2-e by 2040. This represents a considerable offsetting abatement, considering Council's remaining emissions profile. Planting trees offers other co-benefits, such as habitat for fauna, increased biodiversity and conservation opportunities, shading, water filtration and oxygen production. Furthermore, shading and other cooling benefits offered by trees has been demonstrated to reduce temperatures of local neighbourhoods (Osmond & Sharifi, 2017). This can in turn reduce the need to utilise electricity for air-conditioning, an indirect benefit of planting more trees.

As such, viewing urban greening strictly through the lens of carbon sequestration is not considered holistic or accurate. It is recommended that Council continue to investigate options for an Urban Greening strategy that will provide greater analysis of the benefits of increasing urban greening cover across Alexandrina.

Urban greening has not been included in the Marginal Abatement Cost Curve as it is primarily considered an offset, rather than an emissions reduction project. Assumptions of urban greening modelling are supplied in Table 9 and Appendix B.

Table 9. Assumptions of urban greening modelling

Trees planted/year	Carbon sequestration/tree	Capital costs per tree
365	20.2 kg CO_2-e /a-tree	$520

Emissions Reduction Fund and voluntary carbon markets

Alexandrina Council may elect to offset emissions that are identified in this plan as not being able to be either reduced or avoided. Council may elect to do so through purchasing carbon credits through the Emissions Reduction Fund or voluntary carbon markets.

If Council were to elect to offset emissions produced by Council through local offsetting projects i.e., land existing within the bounds of the Alexandrina Council area, Council would first need to identify landholders in the region willing to sell carbon offsets. Council could then approach these landholders directly or work through an offset broker to determine the validity of the offsetting project. The following principles represent common criteria for certification (The Grattan Institute, 2021). The aim of these principles are to ensure an offsetting market has integrity (The Grattan Institute, 2021).

- baselining – establishing a realistic and credible baseline against which emissions avoidance is measured.
- permanence – assessing the length of time that the carbon dioxide will remain locked up.
- additionality – assessing whether the activity would have taken place in the absence of certification. This can include financial additionality, but also policy additionality (ensuring that an offset is not being certified for an activity that is required by law).
- avoiding double-counting – establishing assurance that the same activity will not be certified twice or counted in two sets of carbon accounts.
- avoiding harm or adverse consequences – ensuring that the activity does not encourage activities that leave society or individuals worse off.
- monitoring, reporting, record-keeping, and verification requirements.

The Emissions Reduction Fund is highly regulated and provides a framework where the aforementioned principles are upheld (The Grattan Institute, 2021). However, this is not necessarily the case for voluntary carbon markets (The Grattan Institute, 2021).

The nature of offsets incentivises landholders to seek out the highest price for offsets. As such, landholders would need to agree a price that is representative of current market prices and agree to

exclusively sell these offsets to Council. However, Council would likely need to pay the market rate for these offsets, regardless of whether the offsets existed with the Council area or not.

Carbon farming opportunities for Council

Alexandrina Council area is over 1,800 square kilometres and includes vast swathes of undeveloped land under private ownership (.idcommunity demographic resources, 2021). There is great potential to combine carbon farming with traditional farming methods. Carbon in our atmosphere can be stored in soils and biomass and drawn down from the atmosphere through revegetation of ecosystems. There is a significant opportunity to utilise agriculture and agroforestry to sequester carbon and to provide other ecosystem and on-farm productivity benefits. Carbon farming includes revegetation, protection and restoration of existing vegetation and the incorporation of carbon into soils.

Increasing soil carbon has significant benefits for soil and plant health and can ensure carbon is stored in the soil, instead of released to the atmosphere. Whilst carbon farming includes a range of practices, there is a need to focus on the practices that are most suitable to the Alexandrina Council area. The most suitable carbon farming opportunities for the Council relate to regenerative agriculture and are outlined further in dot point format below.

The following opportunities are associated with storage of carbon and primarily relate to on-farm opportunities available under the Australian Carbon Farming Initiative. The financial return of investing in carbon farming is likely to increase over time as demand for offsets further inflates the price of carbon credits.

These opportunities include:

- Carbon sequestration through retention of forestry plantations on economically marginal sites (i.e., sites with less than 600mm of average annual rainfall).
- Long term rotations of timber incorporated into traditional farming systems (in areas of suitable rainfall) (must be at least 25 years).
- Excluding stock from vegetated areas (human-induced regeneration).
- Altering cattle feed to reduce enteric emissions through the use of additives such as seaweed, tannins, canola meal, dried distillers' grain, brewers' grain and fats and oils.
- Soil improvement (e.g., no till farming, stubble retention, pasture retention associated with rotational grazing).
- Biodiversity offset plantings.
- Managing regrowth vegetation.
- Management of coastal saltmarsh ecosystems.

A standardised assessment of calculating Soil Carbon Credits is available through the Australian Government Emissions Reduction Fund 'Understanding you soil carbon project'.

Biodiversity Credit Exchange Program

The Biodiversity Credit Exchange Program is a state government initiative whereby land holders may receive income through protecting and maintaining areas of existing vegetation (South Australian Government, 2019). Landholders may be issued credits for doing so (South Australian Government, 2019). The credits are sold to buyers that are required to offset vegetation clearances within the same region (South Australian Government, 2019).

This represents an additional and separate source of income for landholders that may be combined with income from carbon farming. The Biodiversity Credit Exchange Program only exists within certain areas and is not available through large areas of Alexandrina Council (see Figure 20). One of the target areas is land within 25 kilometres of the township of Mount Barker, where recent large scale land clearance has occurred (South Australian Government, 2019). There is opportunity for landholders who are located within Alexandrina Council and within 25 kilometres of Mount Barker to access the Biodiversity Credit Exchange Program.

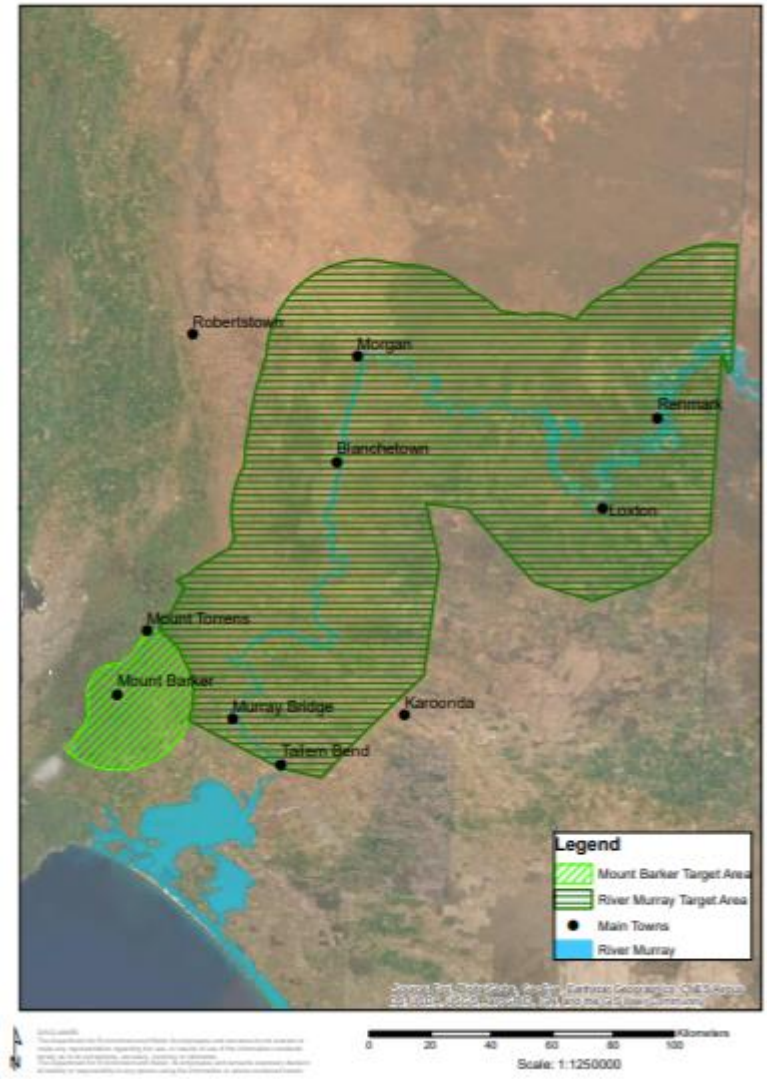

Figure 20. A map showing the target areas of the Biodiversity Offset Program (South Australian Government, 2019)

Blue carbon opportunities

Blue Carbon is carbon that is captured and stored in coastal and marine vegetation and soils including amongst seagrass meadows, saltmarshes and mangroves. Given the coastal and estuarine environment within Alexandrina Council, there may be significant opportunities to pursue opportunities for some seagrass meadow restoration (in estuarine environments) and saltmarsh ecosystems.

The Blue Carbon zone is about twice as efficient in storing carbon as the same area on land and take up atmospheric carbon dioxide at a greater rate than land-based vegetation (The Grattan Institute, 2021). Blue carbon is efficient at storing carbon as above and below ground biomass, i.e., the plants and the soil beneath the plants (The Grattan Institute, 2021).

The details of the operation of a national blue carbon market operating under the Australian Government Emissions Reduction Fund are expected to be finalised by February 2022 (Australian Government, 2021). After the release of the report, Council will have greater clarity of the role that both Council and more broadly the community can play in accessing blue carbon credits.

5.2 Risks and limitations associated with offsetting

Offsetting presents risks to the purchaser of carbon credits. An overview of some of the risks and limitations of offsetting are listed below:

- The price of carbon offsets is likely to increase over time. This represents a significant risk for those currently purchasing offsets, as the commitment to continue to offset emissions is likely to require increased budgets over time. Demand for ACCU's increased by 52% in the March quarter of 2021, compared to the previous year's March quarter (MacDonald-Smith & Greber, 2021). The International Monetary Fund (IMF) estimates prices may increase to $70/tonne by 2030.
- Offsetting is not considered best practice and is one of the lower order climate mitigation priorities. Reducing and avoiding emissions is considered best practice. However, offsetting is essential in slowing climate change, as we can not only reduce and avoid emissions production (The Grattan Institute, 2021).
- Some offsetting activities, such as carbon sequestration (i.e., tree and other vegetation planting) are at risk of unintentional release of carbon back to the atmosphere through natural hazards, such as fire, disease and pests.
- According to the Carbon Farming Initiative Regulations, only areas receiving over 600 mm of rain (according to the CFI rainfall map) and areas where tree planting is unlikely to have a material adverse impact on the availability of water are eligible for tree planting (Australian Government, 2011). This excludes large areas of Alexandrina Council.
- Some carbon farming activities, such as the use of bio char can require processing methods that release CO_2 to the atmosphere. As such, it is important to ensure that the chosen methods align with the intention to reduce emission released into the atmosphere.
- In order for carbon credits to be generated, there is a need to quantify the potential for land-based carbon sequestration. The quantification of offsets can be an expensive and time-consuming process that requires a commitment to continue to monitor offsets over time.
- Farmers and other land holders within Alexandrina may wish to register their property for offsetting purposes. If their property is accepted by the Emissions Reduction Fund or other voluntary carbon markets, the offsets will be sold to an organisation. Once sold, these offsets are not available to be utilised by Alexandrina community or Alexandrina Council as an offset.
- Nature-based offsetting has been regarded as destructive of rural communities as it could lock-up land traditionally used for agriculture and de-populate rural areas (The Grattan Institute, 2021).
- Marine heatwaves cause seagrass meadows to release carbon at an accelerated rate. Projections of increased ocean temperatures as a result of elevated average and extreme temperatures caused by climate change will likely cause a redistribution of seagrass meadows. Planting seagrass meadows in areas of seagrass meadow loss may be expensive and ineffective in sequestering carbon (The Grattan Institute, 2021).

6 Recommended supporting actions

In addition to Council focussing on the emissions reduction projects modelled for Council in Section 3.3 of this report (refer to Table 2), it is recommended that Council also include supporting actions to assist Council and the community transition to a low carbon future (outlined further in Section 9). Hence, achieving carbon neutrality can only be successful if it will be approached holistically; i.e. a combination of emission-reduction modelled projects in combination with supporting actions. These are discussed in more detail below.

6.1 Tracking and reporting emissions

Council currently tracks and report on select categories of emissions, including Scopes 1 and 2. Annual reporting of Council's carbon inventory occurs through carbon accounting software. It is suggested that tracking and reporting of emissions continues from 2022 to 2040. This can be managed within existing resources and will allow Council to track and evaluate whether the actions outlined within this section of the plan are effective in reducing emissions produced through Council's operations. Without the ability to track and report on emissions, the transparency of reporting on emissions produced by Council and the efficacy of the actions outlined below will be unknown. As such, it is critical that Council continue to commit to the annual monitoring of emissions.

6.2 Advocacy and behaviour change

The following four actions are recommended for Council to effectively advocate for and support community and staff to adopt sustainable behaviour:

- Educate, liaise and support community and businesses to move towards carbon neutrality.
- Implement a community behaviour change program.
- Supportive activities to help transition Council operations towards carbon neutrality.
- Continue to participate in the Resilient Hills and Coast regional climate partnership.

Supportive activities to help transition Council operations towards carbon neutrality

As Australia targets an increase in emissions reduction opportunities, there are likely to be significant opportunities to attract funding and financing in the Alexandrina region. It is strongly recommended that Council proactively seek funding opportunities through both the Federal and South Australian governments.

In addition to sourcing funding through government, it is recommended that Alexandrina Council seek to attract business services not currently located within the Alexandrina Council area and investigate options for renewable energy, including:

- EV infrastructure.
- Solar PV.
- Wind generated energy.
- Blue Carbon offsets.
- On-farm offsets.
- Waste management and resource recovery offsets.

As part of the plan to support Council operations reduce emissions, there is a need to embed new actions and behaviours amongst Council staff, Elected Members and the community. A climate action culture is one in which the impacts of all changes to council operations are considered from a climate perspective. The aim is to ensure that emission reductions opportunities are incorporated into decision making frameworks and embedded in BAU practice. A climate action culture can be achieved through

the following actions outlined in Table 10**Error! Reference source not found.**. It is recommended that the actions outlined below in Table 10 and more broadly in this plan are supported by the creation of a Climate Change Officer role within Council. The purpose of developing this role is to ensure that a suitably qualified, experienced and knowledgeable person is employed to conduct the actions required to successfully manage the reporting requirements and proposed actions outlined in this plan.

Table 10. Four key actions of Alexandrina's climate action culture

Lead, support and advocacy pillars	Actions
Implement staff behaviour change programs	Conduct training programs aligned with behaviour related emissions reduction activities, such as energy efficiency, waste and resources disposal and segregation.
Lead by example	It is strongly recommended that Council set targets and establish a pathway to reduce its own emissions, including the establishment of the 2040 carbon neutral commitment.
Monitor, report and promote changes to Council practices and policy	Changes will be monitored, reported and promoted to the community.
Advocate for further change	Through existing and future partnerships, it is suggested that Council continue to advocate for further climate change action in the region.

Continue to participate in the Resilient Hills & Coast region climate partnership

The Resilient Hills & Coasts regional climate partnership is one of eleven Regional Climate Partnerships across South Australia (Resilient Hills and Coasts, 2021). Resilient Hills & Coasts is a collaborative, cross-sector partnership between councils, Landscape Boards, Regional Development Australia and the South Australian Government, working to strengthen the resilience of their communities, economies and natural and built environments to a changing climate (Alexandrina Council, 2022) (Resilient Hills and Coasts, 2021). Alexandrina Council is one of six councils – Adelaide Hills, Alexandrina, Kangaroo Island, Mount Barker, Victor Harbor and Yankalilla.

It is suggested that Council continue to participate in the partnership to benefit from the knowledge sharing and co-funding opportunities available through the ongoing relationship.

Educate, liaise and support community and businesses to move towards carbon neutrality

It is recommended that Alexandrina Council position and promote itself as a clean, green and sustainable community. A communications plan will help to outline Council and regional achievements and establish a plan to showcase potential new technologies and existing practices to the community.

The communications plan will outline the use of locally relevant and international best-practice case studies of those in the community and more broadly leading change in the sustainability space.

As part of the communications plan, it is recommended that Council outline the process to reach carbon neutral status by 2040.

Community sustainability education workshops

One of the key principles of change creation is fostering meaningful relationships and partnerships with a range of organisations who are interested in achieving the same or similar goals. It is for this reason that the Alexandrina Council will target specific organisations to partner with to embed sustainable practices, behaviour and technology across the Alexandrina Council area. Partnership organisation opportunities include:

- Business.

- Sporting and community groups.
- State government departments and agencies.
- Neighbouring Councils.
- The Australian Government.
- The Landscape Board.
- Resilient Hills & Coasts.
- Non-government organisations.

Implement a community behaviour change program

The majority (99%) of the Alexandrina Council's emissions are produced by the broader community. Council is committed to assisting the community transition towards lower emissions practices through:

- Advocacy and education: providing education opportunities for the community.
- Partnership opportunities: developing and continuing to progress strategic partnerships.
- Investment in Alexandrina: actively seeking funding opportunities to create change programs.
- Green economy: developing a long-term roadmap to help the community transition to a low-carbon economy.

It is recommended that Council seek to influence and assist the community transition to lower emissions practices through the development of a communications plan and community education workshops along with the development and sourcing of resources to distribute to the community.

6.3 Events

As part of the City's push to position itself as a sustainable community, it is recommended Council undertake the following two actions:

- Design and investigate options for sustainable evens that include carbon neutral events. It is recommended that this is completed over 2023 and 2024 (Section 9).
- Implementation of Carbon Neutral events within the Sustainable Events Strategy, scheduled from 2025 to 2040 (see Section 9).

It is noted that carbon neutral events will be a challenge for Alexandrina Council, without purchasing carbon offsets or involvement in a scheme, such as a major tree planting project. As there is little or no public transport in the region, event participants have to travel in their own vehicles to the events. Furthermore, most events across Alexandrina's region are not delivered by Council. Hence it is recommended to educate the public and event organisers to be part of a positive change, and be a leader, starting with Council events, such as Australia Day.

Carbon Neutral certification for one off and ongoing events can be accessed through Climate Active. Costs associated with certification are dependent on a range of variables, including the size of the event, duration of the event, the number of people attending the event and the associated footprint of the event. As such, it is difficult to accurately project future costs for events. It is recommended that Council work with Climate Active to better understand the costs of key Council managed events.

6.4 Sustainable Street and public lighting

Modelling suggests that LED lighting upgrades provide both an emissions reduction and a significant cost saving for Council (Figure 14). Whilst upgrades to lighting are important, the use of smart lighting including solar outdoor lighting and sensors can allow Council to reduce costs and emissions over time.

It is recommended that Council commit to the following two tasks to support the implementation of sustainable street and public lighting:

Investigate and plan for the implementation of sustainable and public lighting proposed to be completed during 2022. This includes the following tasks:

- Investigate options for public lighting sensors in appropriate public areas.
- Investigate options for lighting upgrades within Council owned assets.
- Determine options for smart lighting upgrades.
- Implement sustainable public lighting from 2023 to 2025.

6.5 Renewable energy transformation

Renewable energy and the decarbonisation of the South Australian electricity grid represent the greatest modelled opportunity for Council to reduce operational emissions (see Figure 14). The following actions are outlined in the implementation plan to support the transition to renewable energy:

- Advocate for the purchase of 100% accredited renewable energy as part of LGA's procurement for a new power purchase agreement. The agreement is due to commence in early 2023. Continue to investigate and install solar on suitable Council managed buildings, including new buildings..
- Investigate options for car park solar and combined battery use and EV charging station. The South Australian Local Government Association and its member councils are currently negotiating the terms of a new bulk purchase electricity agreement. It is feasible that the purchase of 100% renewable energy will commence in 2023. Alexandrina Council will continue to advocate for the purchase of 100% renewable energy through this arrangement.

It is expected that the need to purchase renewable energy will reduce over time, in line with the decarbonisation of the South Australian electricity grid (i.e., Decarbonisation of the South Australian electricity grid by 2030). This is likely to result in a reduction in the premium price charged for renewable energy.

Solar PV panels are currently utilised by Council to reduce the demand of grid supplied energy. Solar PV is considered an appropriate opportunity to reduce energy demand from high energy demand sources, such as swim centres, public libraries and large sporting facilities. The installation of rooftop and car park Solar PV will provide a renewable energy source and operational cost savings. Whilst the emissions abatement potential of solar PV is expected to reduce in line with the decarbonisation of the South Australian grid, the installation of solar will reduce emissions produced by Council up until the South Australian grid is powered 100% by renewable energy. Furthermore, solar arrays provide ongoing cost savings, reducing the ongoing costs of electricity purchase.

Renewable generation capacity builds a potential strategic priority to reduce Scope 1 (in combination with the use of EVs) and Scope 2 emissions. However, significant steps must first be taken to establish the energy usage baseline and to determine the energy efficiencies that can first be adopted by Council. This includes managing demand to avoid peak network charge times and upgrading older and energy inefficient infrastructure (such as public lighting).

A cost-benefit analysis is recommended in the consideration of any future renewable energy infrastructure investment as well as a staged implementation plan, which considers the energy transition hierarchy (Figure 21).

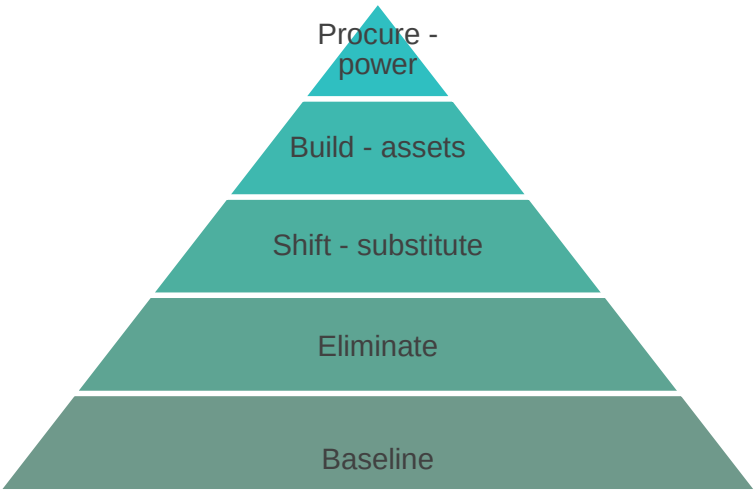

Figure 21. The energy transition hierarchy (source: Maximum Energy)

6.6 Low emissions transport

Transitioning from combustion engine vehicles to first, hybrid vehicles and eventually electric and green hydrogen vehicles is a strategic action required by the Council to eliminate unnecessary emission production. Due to the current high capital costs of EVs and the need to effectively plan and implement a charging network, there is a preference to transition all non-heavy vehicles in a staged manner to first hybrid vehicles and eventually to EVs. It is proposed that all heavy vehicles transition to green hydrogen powered vehicles over a 5-year period.

In order to support the transition away from combustion engine vehicles, the following actions are proposed:

The development of a Fleet Transition Plan over the 2022 to 2029 period. The Fleet transition plan will allow for:

- Further investigation of the capital and operational costs of an EV charging network for Council, and costings for EVs, green hydrogen heavy vehicles and hybrid vehicles.
- Investigation of global and national trends in the purchase and capital and operational costs of electric heavy vehicles compared to hydrogen powered heavy vehicles.
- The time to plan for and implement the supporting infrastructure required to transition away from combustion engine vehicles.
- Update the staff travel policy to include options for car-pooling and the need for in-person meeting attendance compared to videoconference attendance.
- Promote emissions reduction savings associated with reduced transport requirements and/or fleet vehicle transition.
- The purchase/lease of hybrid vehicles from 2022 to 2027, transitioning combustion engine vehicles to hybrid, according to the timing of Council procurement cycles.
- The installation of EV charging stations for the charging of fleet vehicles at select locations across Council. This will need to be completed in conjunction with the purchase of EVs. The proposed schedule is listed as 2025 to 2029.
- The purchase/lease of EVs is suggested for the 2025 to 2032 timeframe. It is expected that the capital costs of EV purchase/lease will decrease considerably over time, as more and more EVs are produced and bought on the market.

- The purchase of hydrogen powered heavy vehicles and plant equipment is scheduled for the 2030 to 2034 period. It is important to note that as hydrogen vehicle technology improves over time, it is likely that costs will decrease. The advancement of EV technology in the heavy vehicle market will also occur from now to 2030. Delaying the purchase of heavy vehicles will allow Council the opportunity to investigate the benefits and risks of transitioning to hydrogen or electric heavy vehicles.

6.7 Offsetting emissions

Figure 23 demonstrates the potential remaining emissions required to be offset by Council by the year 2040. Once all emissions reduction modelled projects have been implemented, there is the option to offset the remaining emissions. Included within this plan are the following three offsetting actions:

- Investigate Alexandrina's tree canopy cover to inform an Urban Greening Strategy.
- Conduct Urban Greening through strategic plantings on Council managed roadside verges and parks and gardens.
- Consider the purchase of verified offsets.

The investigation of Alexandrina's tree canopy cover will allow Council to better understand and quantify the current and projected future benefits of tree planting.

Urban greening provides a range of benefits for the community including oxygen production, pollution removal, urban cooling and habitat for fauna. Urban greening is also a source of carbon sequestration and can offset some of the emissions produced by Council and/or the community (140 tonnes of CO_2-e). It is important to note that using urban greening as an offset option is currently not recognised through formal carbon accounting systems or offsetting markets. The offsetting potential of urban greening is outlined in Section 5**Error! Reference source not found.**. The modelling of urban greening only considered public land available for planting and considered a thirty-year maturity time for trees planted today.

The purchase of offsets is likely a considerable cost to Council, estimated to be at least $50/tonne by 2040 on the voluntary carbon market (UCL; Trove Research; Liebrich Associates, 2021). As such, the remaining 842 CO_2-e may require an estimated payment of AU$42,100 per annum, in order to fund the offsets required to achieve Carbon Neutral status for the organisation.

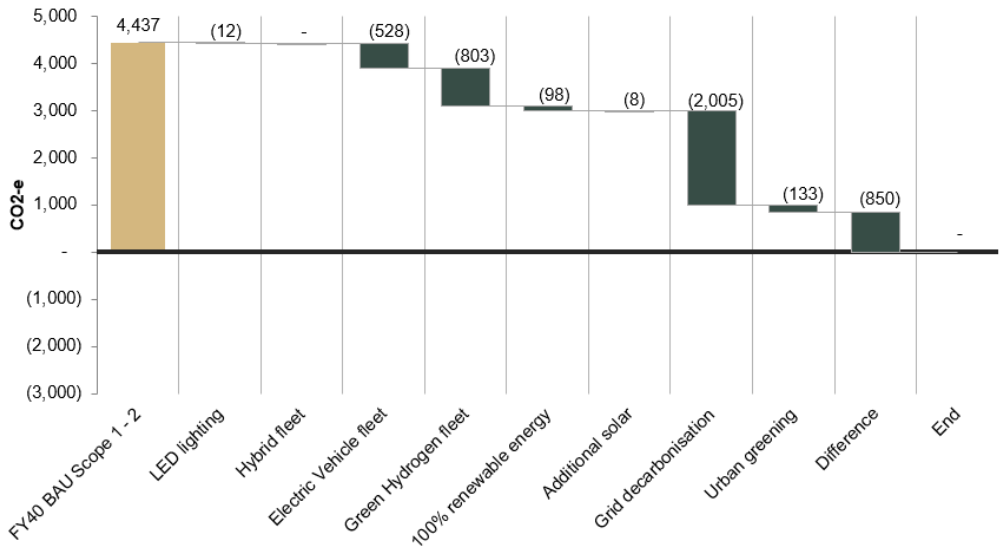

Figure 22. The impact of Council's modelled emissions reduction projects[2]

[2] FY BAU Scope 1 - 2 is defined as the 2039/2040 financial year business as usual scenario, including the emissions outlined in section 2.2 of this plan.

7 Recommended community priority themes

99% of all emissions produced within Alexandrina Council are not produced by Council, but by the broader community. Limiting the projected 483,181 tonnes of CO_2-e produced by the community to 129,467 tonnes CO_2-e by 2040 is achievable through the implementation of several modelled projects and the electricity grid decarbonisation (see Figure 23). Achieving carbon neutrality for the Alexandrina community is possible, however, based on modelling it will require the use of offsets. Council do not control the actions, behaviours and choices that members of the community take. As such, Council must seek to support and enable the community to reduce the production of emissions. It is not appropriate or recommended that Council establish a target for community carbon neutrality. Council will need to determine the level of support provided to the community and the ways in which Council can empower the community. It is beyond the scope of this report, and it is understood that Council will develop a plan to drive change within the community, pending resourcing.

Future actions to assist both Council and the community to reduce emissions may require additional funding and resources to drive the desired change. This includes Council staff. It is recommended that a Climate Change Officer or equivalent is resourced to undertake the actions outlined in this plan and future plans. Council would benefit from the experience, knowledge and skills of a dedicated Climate Change Office. Currently it is expected that the array of tasks outlined in this plan, will not be able to be completed without further resourcing.

There are multiple actions that an individual or collection of individuals can take to reduce emissions produced through their actions and behaviour. The following projects have been modelled in order to demonstrate the significant opportunities that exist for the community to reduce emissions through collective action. Substantial reductions in emissions are feasible through the adoption of existing and emerging technologies, which have been modelled.

However, there is also a considerable opportunity to support these actions with behaviours that can drive down emissions. It is for this reason, that as stated in Section 6.2, it is strongly recommended that Council support the community through a range of advocacy and behaviour change programs.

The selected modelled projects if implemented will reduce the Alexandrina community emissions profile from 483,181 tonnes CO_2-e to 268,266 tonnes CO_2-e (Figure 23). Emissions may be further reduced with the decarbonisation of the South Australian mains supply electricity grid by a further 138,800 tonnes CO_2-e. This would reduce the total projected emissions produced by the community to 129,467 tonnes CO_2-e (Figure 23). The following projects, previously described in Section 4 are as follows:

1. Residential hot water uptake. Based on a modelled assumption of a 50% uptake of residential solar hot water use, replacing gas powered hot water, will assist the community to reduce emissions by 242 tonnes of CO_2-e by 2040.
2. Rooftop solar installation. The installation of rooftops solar, based on a modelled assumption of a 5% increase in the uptake of household rooftop solar per annum would produce an emissions saving of 1,156 tonnes CO_2-e by 2040.
3. Based on the modelling assumption that 100% of light combustion engine vehicles will convert to EV by the year 2040, it is feasible for 74,731 tonnes CO_2-e to be reduced by 2040.
4. Based on the modelling assumption that 100% of heavy vehicles will convert to green hydrogen powered heavy vehicles, it is feasible for 138,786 tonnes of CO_2-e to be reduced by 2040.

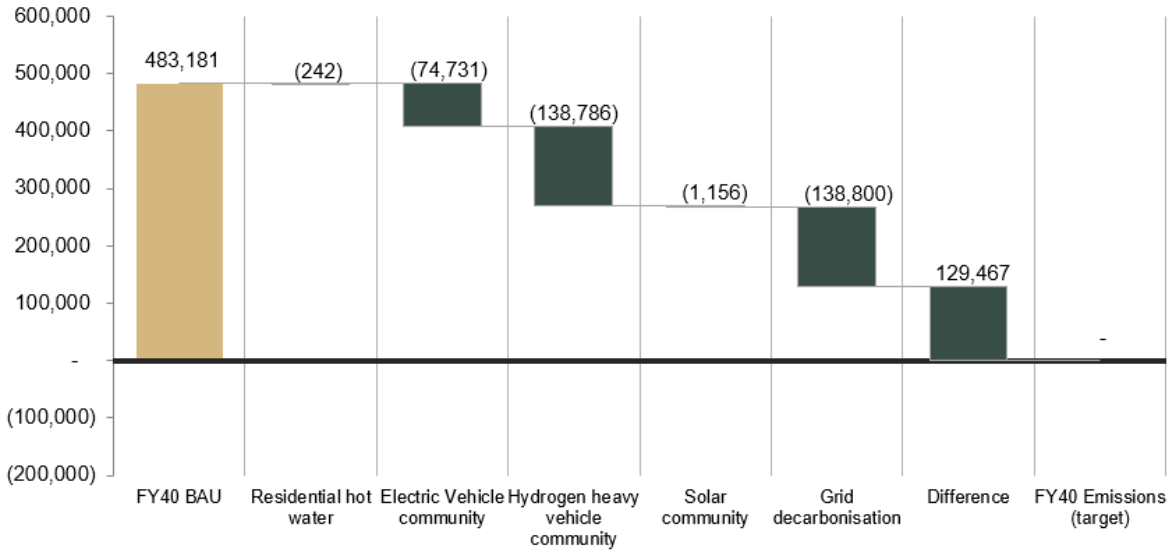

Figure 23. The impact of modelled community targeted emissions reduction projects, based on a 2040 emissions scenario.

7.1 Grid decarbonisation

In addition to the emissions reductions that can be achieved through the community, uptake of low emissions transport options, solar hot water and rooftop solar panel use, emissions are projected to rapidly decrease as the South Australian electricity grid is decarbonised.

The projected emissions reductions arising from grid decarbonisation is 138,800 tonnes of CO_{2}-e (see Figure 23).

The decarbonisation of the electricity grid as a result of the addition of further renewable energy power generation will reduce emissions produced from the production and consumption of electricity in South Australia.

7.2 Offsetting

Post implementation of the aforementioned modelled projects and the reduced emissions projected from the decarbonisation of the electricity grid, there will be a projected 129,467 tonnes of CO_{2}-e still remaining. These emissions will need to be either further reduced through alternative emissions reduction behaviours or offset. Offsetting of community emissions is the responsibility of the community, not Council. It is important that community members consider the capacity for localised offsetting projects and the need for regular and ongoing carbon accounting services to determine the value of each local offsetting project. Emissions reduction projects should be prioritised as the ongoing expense of paying for community offsets by the community is considered financially unviable and unrealistic.

For more information related to the risks and benefits of offsets, please view Section 5.

8 Funding opportunities

The following represent funding and financing opportunities for Council, individual, businesses and community groups that aim to either directly or indirectly reduce carbon emissions:

- Green Industries SA (GISA) Council Modernisation Grants – Funding is available for councils to improve waste management and recycling services. All Councils and waste management subsidiaries can apply for funding. $20,000 - $100,000 is available per project.
- GISA Kerbside Performance Plus Food Organics Incentives Program – a grants program targeting efficient food organics recycling systems. Funding is available to all Councils. $1.3 million is available.
- GISA Recycling Infrastructure Grants – Funding is available for local governments that recover, handle and process recyclable materials. The aim of the grants is to improve efficiencies through infrastructure and technology upgrades. Grants are available for between $50,000 and $250,000.
- Clean Energy Finance Corporation (CEFC) – The CEFC is an Australian Government backed corporation that provides debt finance for investment in, typically innovative, emissions reduction technologies and projects. This includes low emissions transport, clean energy solutions, battery and solar projects, clean finance and ESD housing developments.
- Landscapes SA Hills and Fleurieu – Grassroots Grants are available for eligible projects that improve or protect the environment. The grants are made available to support individual landholders, schools, volunteer organisations, First Nations and not-for-profit groups. In 2021/22 a total grant funding pool of $220,000 was made available.
- Australian Government - Business. Grants are currently available for improving the energy efficiency of small to medium food and beverage manufacturers. Grants of up to $25,000 are available for businesses seeking to improve energy efficiency practices and technologies and better manage energy consumption to reduce their power bills.

9 Communications Plan

This section outlines a recommended high-level plan for Council to communicate the process and outcomes of the Carbon Neutral Plan to residents, business, staff, suppliers, partners and other government organisations. It is understood that upon receival and approval of this plan by Council, a Council driven community engagement plan, including key communications messaging is proposed. The information provided below is included for consideration of incorporation into the Council produced plan and is not designed as a detailed communications plan.

It is important to recognise the elements of this plan that Council can control, those which it can influence and those outside of Council's control. This is described further below (see Figure 24):

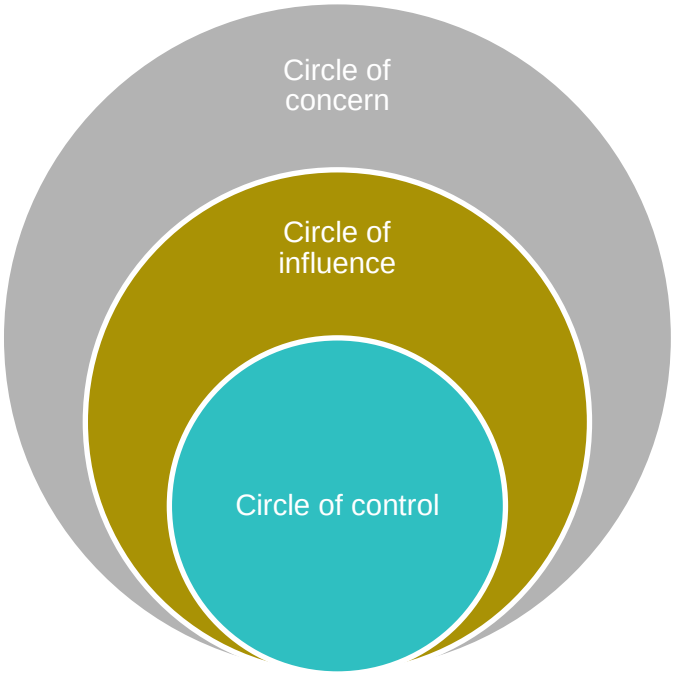

Figure 24. Circles of control, influence and concern

Circle of control – The projects and actions over which Council can directly control. For example, developing a climate change policy or transitioning Council's fleet to EV.

Circle of influence – The projects and actions over which Council does not control but may influence, such as community emissions reduction modelled projects.

Circle of concern – Projects and actions that Council has little to no ability to influence. An example of this may be broader international policy settings.

Each circle requires separate communications messaging. The messaging for projects and actions within the Circle of Control predominantly aim to communicate the progress and achievements of Council, whilst the messaging for Circle of Influence projects and actions relates primarily to altering the thoughts and behaviour of the community.

Target audience

Council may like to consider how to inspire and create change across the following areas:

- Inwards action – staff, contractors.
- Upwards action – Influencing state government, federal government.

- Sideways action – Influence surrounding Councils and organisations operating outside of Alexandrina Council.
- Downwards action – Influencing residents, businesses, organisations located within the Alexandrina Council.

Separate messaging is required for each target audience group. However, there are some common links between messages for all target groups. It is recommended that Council ensure that the issue of climate change is made relevant to all groups. It is important to consider how each group will be affected and influenced by climate change and articulate how the actions that Council are taking now will help the broader community in the future.

Council should make the information by providing to the community relevant to them and use plenty of analogies from everyday life to connect with the intended audience. This should touch on issues that are relevant to the audiences such as job security, economic growth, housing prices, quality of life, etc. This tells the audience (who might not see climate change as a big priority given current circumstances) that this is relevant to them today. Ensure the message you are sharing with the community is consistent. It is important that you are clear about the scientific consensus of climate change. Avoid “muddying the waters.” Be clear, consistent and ensure that you do not engage in debate. Focus on the impacts of climate change on people, the environment, infrastructure, and the solutions that Council are adopting.

Stories and images are powerful drivers of change. Seek out and communicate stories of residents, businesses, groups taking action to reduce their impact. Focus on how to interpret technical language commonly found in scientific reports. An image can help others to better understand the impacts of climate change, just as well as a chart. Charts can also be used to create relevancy to the general community (see Figure 25).

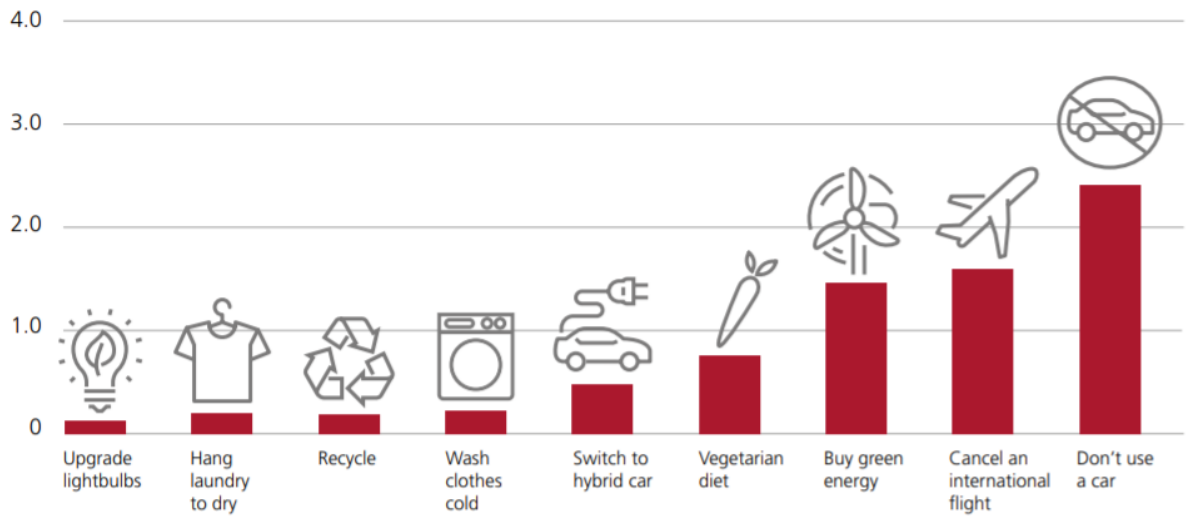

Figure 25. Choices to reduce personal contribution to climate change (City of Yarra, 2020-2024)

Start the conversation with the community. Many people do not commonly talk or think about climate change. Presenting information through signage, events and local media can raise the profile of climate change and ensure that the public is engaged.

Focus on the positives. Seek to inspire hope. There are many significant opportunities that arise from sharing both Council’s and the community’s emissions profile and emissions reduction actions with the Alexandrina community. Use this information to commence conversations with the community regarding actions that individuals and groups can take to reduce their own emissions.

Suggested messaging for select groups is as follows:

Residents

Climate change is an issue for residents, not just in the future, but today. Find out about our plan to support the community. Get informed, get inspired, get involved.

Business

Climate change is a risk to business. Alexandrina Council is acting now to protect jobs and ensure continued economic prosperity for our community. Get informed, get inspired, get involved.

Staff

Council is taking action to plan for and respond to the risks and impacts of climate change. Get informed, get inspired, get involved.

Suppliers/contractors

To safeguard the community and business from the impacts of climate change, Council is asking all suppliers to support us on our journey. Get informed, get inspired, get involved.

Linking engagement to the community

Consider ways to pull out the key findings and identify opportunities in formats beyond the plan including upcoming events, website, social channels, letter drops and other existing community, council, and business touch points to connect with the community.

Quick reference guide

Council may like to consider the use of a community targeted quick reference guide, i.e., a short one-page document outlining the plans of Council and the ways in which acting now will help to protect the community in the future.

10 Proposed Implementation Plan

A proposed implementation plan for Council emissions reduction projects and initiatives is presented below (Table 11).

Table 11. Council's Proposed Implementation Plan

= **proposed years of delivery** ** = **Already occurring and/or included within existing budgets**

Project and Initiative description	Existing Budget/Resources	Additional Cost	Additional Staff Resources	Estimated Capital Cost	Proposed implementation timeframes (Financial Year)																		
					2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
1. Low emissions transport																							
1.1 Fleet transition plan			✓	Within existing resources																			
1.2 Purchase / lease hybrid vehicles as transition to electrical vehicles (fleet vehicles)		✓		20 vehicles @ $35,000 /vehicle = $700,000 over 6 years																			
1.3 Install electric charging stations for charging of fleet vehicles		✓		$700 / charging station x 32 charging stations = $22,400 over 5 years																			
1.4 Purchase / lease electric vehicles (fleet vehicles)		✓		31 vehicles @ $40,000 = $1,55 million over 8 years																			
1.5 Purchase / lease hydrogen powered		✓		42 vehicle @ $100,000 per vehicle = $4.2																			

Project and Initiative description	Existing Budget/Resources	Additional Cost	Additional Staff Resources	Estimated Capital Cost	Proposed implementation timeframes (Financial Year)																		
					2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
heavy vehicles and plant equipment				million over 5 years																			
2. Sustainable Street and public lighting																							
2.1 Investigate and plan for the implementation of sustainable and public lighting	✓			Within existing resources																			
2.2 Implement sustainable public lighting		✓		$400/lamp replacement																			
3. Renewable energy																							
3.1 Advocate for the purchase of 100% accredited renewable energy as part of LGA's procurement for a new power purchase agreement that is due early 2023**	✓			Within existing resources																			
3.2 Purchase of 100% accredited renewable energy as part of LGA's new		✓	✓	Within existing resources.																			

Project and Initiative description	Existing Budget/Resources	Additional Cost	Additional Staff Resources	Estimated Capital Cost	Proposed implementation timeframes (Financial Year)																		
					2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
power purchase agreement (commencing early 2023)																							
3.3 Investigate installation options for solar on suitable Council managed buildings, including new buildings			✓	Indicative installation costs likely to be $240,000.																			
3.4 Investigate options for car park solar and combined battery use and EV charging stations			✓	Indicative costs - $916,000 for solar car park installation and battery storage.																			
3.5 Install car park solar arrays and battery at Goolwa and Strathalbyn*		✓	✓	Indicative costs - $706,000 for a 210 Kw system spilt across the Goolwa and Strathalbyn Council assets.																			
4. Tracking and reporting emissions																							
4.1 Annual reporting of Council's carbon	✓			$1300 membership per annum and extensive staff time																			

Project and Initiative description	Existing Budget/Resources	Additional Cost	Additional Staff Resources	Estimated Capital Cost	Proposed implementation timeframes (Financial Year)																		
					2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
inventory and emissions**				requirements to complete ICLEI accounting requirements																			
4.2 ICLEI climate reporting		✓	✓	$1300 membership per annum and extensive staff time requirement to complete ICLEI accounting requirements																			
5. Advocacy and behaviour change																							
5.1 Participate in the Resilient Hills and Coasts regional climate partnership**	✓			Within existing resources																			
5.2 Educate, liaise and support community and businesses to move towards carbon neutrality**		✓	✓	TBC - Costs dependent on actions taken																			
5.3 Implement the community behaviour change program		✓	✓	TBC - Costs dependent on actions taken																			

Project and Initiative description	Existing Budget/Resources	Additional Cost	Additional Staff Resources	Estimated Capital Cost	Proposed implementation timeframes (Financial Year)																		
					2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
5.4 Supportive activities to help transition Council operations towards carbon neutrality**		✓	✓	TBC - Costs dependent on actions taken																			
6. Events																							
6.1 Design and investigate options for sustainable events that include carbon neutral events	✓			Within existing resources																			
6.2 Implement Carbon Neutral events within the Sustainable Events Strategy**		✓	✓	Dependent on the number of events and the emissions produced by the events. Estimates range from $2000 - $10,000 per event.																			
7. Offsetting Emissions																							
7.1 Investigate Alexandrina's tree canopy cover to inform an	✓			Investigations initiated																			

Project and Initiative description	Existing Budget/Resources	Additional Cost	Additional Staff Resources	Estimated Capital Cost	Proposed implementation timeframes (Financial Year)																		
					2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Urban Greening Strategy**																							
7.2 A2040 KPI Urban Greening – Increased township greening		✓	✓	Operational costs for tree planting and maintenance is $500/tree*.																			
7.3 Consideration of purchase of offsets		✓	✓	Current prices vary between $16 - $36/tonne. Projected at $50/tonne by 2040.																			
8. Staff resourcing																							
8.1 Dedicated Climate Change Officer		✓	✓	$120,000 per annum																			

*The $500/tree figure is based off of Edge's experience conducting urban canopy cover modelling and other urban heat projects delivered for councils. It is representative of what other councils in South Australia apply to the costs of per tree planting and basic maintenance (i.e., watering over the establishment period of the tree).

Appendix A: Carbon footprint assessment results

Table 12. Alexandrina Council Operational 2020 Scope 1 emissions baseline

Scope 1 emissions				Scope 1 & 2	Scope 3
Fuel combustion - mobile	Type	FY20	Unit	tCO_2-e FY20	tCO_2-e FY20
	Petrol/Gasoline (transport)	56,667.75	L	135.08	6.98
	Diesel (transport)	320,914.40	L	873.30	44.59
	LPG (transport)	5,363.57	L	8.64	0.51
Fuel combustion - stationary	Diesel (stationary energy)	63,726.87	L	173.17	8.86
	LPG (stationary energy)	79,174.04	L	123.31	7.33
				1,313.51	**68.26**
Fuel combustion - mobile	Fleet	FY20	Unit	tCO_2-e FY20	tCO_2-e FY20
	Petrol/Gasoline (transport)	56,667.75	L	135.08	6.98
	Diesel (transport)	320,914.40	L	873.30	44.59
	LPG (transport)	5,363.57	L	8.64	0.51
Fuel combustion - stationary	Diesel (stationary energy)	63,726.87	L	173.17	8.86
	LPG (stationary energy)	864.20	L	1.35	0.08
Fuel combustion - stationary	Sporting Facilities	FY20	Unit	tCO_2-e FY20	tCO_2-e FY20
	LPG (stationary energy)	68,311.88	L	106.39	6.32
Fuel combustion - stationary	other	FY20	Unit	tCO_2-e FY20	tCO_2-e FY20
	LPG (stationary energy)	9,997.96	L	15.57	0.93

Table 13. Alexandrina Council Operational 2020 Scope 2 emissions baseline

Scope 2 emissions

Purchased electricity	State	FY20	Unit	tCO_2-e FY20	tCO_2-e FY20
	SA Electricity	3,911,774	kWh	1,682.1	391.18
				1,682	**391**

Purchased electricity	Sporting Facilities	FY20	Unit	tCO_2-e FY20	tCO_2-e FY20
	SA Electricity	1,173,686	kWh	504.7	117.37

Purchased electricity	Street Lighting	FY20	Unit	tCO_2-e FY20	tCO_2-e FY20
	SA Electricity	927,396	kWh	398.8	92.74

Purchased electricity	Admin and Libraries	FY20	Unit	tCO_2-e FY20	tCO_2-e FY20
	SA Electricity	550,090	kWh	236.5	55.01

Purchased electricity	Water Treatment and Pumping	FY20	Unit	tCO_2-e FY20	tCO_2-e FY20
	SA Electricity	915,975	kWh	393.9	91.60

Purchased electricity	Other	FY20	Unit	tCO_2-e FY20	tCO_2-e FY20
	SA Electricity	344,627	kWh	148.2	34.46

Appendix B: Technical notes

There are a range of limitations to modelling projects, including applying current and past data to future scenarios. A list of assumptions utilised in modelling is outlined below.

Projection assumptions

Baseline year is the 2019/2020 financial year.

The target year is 2040.

As this was the first year a carbon footprint was conducted for Alexandrina, there were a number of assumptions and estimations that had to be made to give a realistic estimate of FY19 emissions. In some cases, high quality data was available, but this data was not able to be allocated to particular Alexandrina entities and as such a lower quality data source was used. The table below outlines the recommendations to Council for improving the quality and consistency of data provided for future footprints for each emissions category.

Table 14. Project assumptions

Target year	2040	Source
Activity growth	Population growth from 28,012 to 36,907	id.com.au
Grid decarbonisation	SA electricity grid is 100% renewables (assumed achieved by 2030)	Climate Council

The data collection, analysis and calculation process is described below in further detail.

Table 15. Key assumptions and description of modelled projects

#	Project	Community or Council	Description	Key Assumptions
	Across all projects:			In reference to carbon footprint
				Discount rate at 6.5%
				Start year: As per implementation plan.
				End year: 2040
1	Residential Hot Water	Community	Encourage new builds to install solar hot water or heat pumps. For council to encourage the consideration emissions in construction guidelines/green developers.	50% uptake in new builds (currently ~9% uptake across existing stock).
				Approximately 25% of residential electricity consumption is for water heating
				Federal rebate for solar hot water system of AUD$1300
				Solar hot water reduces hot water electricity consumption by 66%.
2	LED lighting	Council	Replacement of non-LED street lighting to LED	Extrapolated from public streetlight data in 2018.
				A 63% energy saving when converting fluorescent lamps to LED. A 75% energy saving when converting high pressure sodium or mercury vapour lamps to LED.
				Average lifetime of lamps according to existing ranges in literature (Mercury/sodium lamps – 1.2 years, fluorescent – 2.4 years, LED – 8.55 years).
3	Hybrid fleet	Council	Switch Council passenger vehicles to hybrid vehicle (heavy plant and machinery excluded)	Change in embodied emissions has not been considered in the modelling
				Only select section of fleet can change to hybrid version. Construction and other specialised vehicles were not considered.

#	Project	Community or Council	Description	Key Assumptions
				Inflation not considered.
4	EV fleet	Council	Switch Council passenger vehicles to EV vehicles (heavy plant and machinery excluded)	Change in embodied emissions has not been considered in the modelling
				EV uses 100% renewables for charging
				Only select section of fleet can change to hybrid version. Construction and other specialised vehicles were not considered.
				Inflation not considered.
5	EV community	Community	Modelling of impact of population switch to EV. Includes cost to Council for installation of charging stations across council	Distance and emissions per driver do not change over time
				Only passenger vehicles and light commercial vehicles considered in assumptions
				Embodied emissions of charging infrastructure excluded from analysis
6	H2 fleet	Council	Switch heavy fleet in Council to hydrogen vehicles	100% emissions reduction from hydrogen fuel cell vehicles
				Heavy vehicles include trucks, tractors and any construction/specialised type vehicle
				Costs do not represent the cost of setting up hydrogen infrastructure
7	H2 community	Community	Modelling of impact of population switch of heavy vehicles to hydrogen-powered vehicles	100% emissions reduction from hydrogen fuel cell vehicles
				Heavy vehicles include trucks, prime movers, commercial trailers, buses, tractors, and trailers

#	Project	Community or Council	Description	Key Assumptions
				Costs do not represent the cost of setting up hydrogen infrastructure
8	Urban greening	Council	Increasing the urban canopy across the council	No operational or maintenance cost associated per tree
				Trees planted in all existing parks of Alexandrina and a percentage of urban sections
				Cost per tree does not vary with species
9	100% renewable energy	Council	Switch to a 100% renewable energy plan	Renewable energy is a surcharge of $0.028/kWh
10	Extra solar	Council	Installing 2 new PV arrays in Goolwa and Strathalbyn, based on indicative costs from the quote provided by Specialised Solutions for a combined 210 kW system. i.e., Two solar arrays of 105 kW.	Alexandrina electricity cost $0.17/kWh, 5 solar batteries could be installed at Goolwa and six at Strathalbyn.
11	Grid decarbonisation	Council	The South Australian grid is increasingly utilising renewable energy. The SA Government has listed a 100% net renewable energy target by 2030	The South Australian electricity grid will be powered exclusively by renewable energy sources by the year 2030
12	Extra solar + battery	Council	Installing 2 new PV arrays in Goolwa and Strathalbyn, as per quote provided by Specialised Solutions and include battery storage.	Alexandrina electricity cost $0.17/kWh, 5 solar batteries could be installed at Goolwa and six at Strathalbyn.
13	Solar community	Community	5% yearly uptake of 4kW solar installations by households in Alexandrina	Unused electricity is fed back into the grid providing cost savings to the residents. 40% of households already have solar installed.

Table 16. A description of emissions and data required for Scope 1, 2 and 3 emissions

Scope	Category	Data used	Description of emissions
Scope 1 emissions	Fuel combustion	Quantity and type of fuel used.	Direct emissions from activities owned or controlled by the company in the baseline year (e.g., fuel combustion from company vehicles, fertilisers, refrigerants, water treatment)
Scope 2 emissions	Purchased electricity	Quantity of electricity consumed per site.	Indirect emissions associated with the company's consumption of purchased electricity in the baseline year
Scope 2 emissions	Renewable Energy	Quantity of electricity generated per site.	Indirect emissions associated with the company's generation of renewable energy in the baseline year
Scope 3 emissions	Cat 3: Fuel- and energy-related emissions	Same data as Scope 1 and 2	The emissions related to extraction, production and transportation of fuels and energy purchased or acquired by the company in the baseline year

Glossary

Term	Meaning
Abatement cost	The cost of reducing emissions compared to unconstrained business as usual scenarios.
Blue carbon	Blue carbon is the carbon captured by living organisms in coastal (e.g., mangroves, salt marshes, seagrasses) and marine *ecosystems*, and stored in *biomass* and sediments (Masson-Delmotte, et al., 2018).
Business as Usual Scenario	A description of what would most likely occur in the absence of a carbon reduction actions, also referred to as the 'baseline scenario'.
Carbon Dioxide (CO_2)	Carbon dioxide is a greenhouse gas: a gas that absorbs and radiates heat (National Oceanic and Atmospheric Administration, 2020)**.**
Carbon Dioxide Equivalent (CO2-e)	Carbon dioxide equivalent is a measure used to compare the emissions from various greenhouse gases based upon their global warming potential. For example, the global warming potential for methane over 100 years is 21. This means that emissions of one million metric tons of methane is equivalent to emissions of 21 million metric tons of carbon dioxide (OECD, 2013).
Carbon footprint	The amount of greenhouse gases and specifically carbon dioxide emitted by something (such as a person's activities or a product's manufacture and transport) during a given period (Merriam Webster Dictionary, 2021). In the case of this project, a Carbon Footprint refers to the CO_2-e emitted from both either Council's operations, assets and services or the community's actions and assets.
Carbon neutrality	When CO_2 emissions caused by humans are balanced globally by CO_2 removals over a specified period (Source: IPCC SR15). This does not apply to other greenhouse gases.
Carbon sequestration	The process of storing carbon in a carbon pool (Masson-Delmotte, et al., 2018).
Climate Change	Climate change is a long-term change in the average weather patterns that have come to define Earth's local, regional and global climates (NASA, 2021).
Greenhouse gas (GHG)	Gases that trap heat in the atmosphere are called greenhouse gases (US Environmental Protection Authority, 2021).
Green hydrogen	Hydrogen produced by splitting water into hydrogen and oxygen using renewable electricity (World Economic Forum, 2021).
Grid decarbonisation	Decarbonising the grid means decreasing the emissions per unit of electricity generated. The electricity grid will decarbonise over time thanks to South Australia generating more and more energy from renewable energy sources, whilst reducing reliance on non-renewable, high emitting sources.
Marginal Abatement Cost Curve (MACC)	A framework commonly used to summarise information of potential mitigation effort, and can help in identifying the most cost-effective managerial and technological GHG mitigation options (European Commission, 2018).
Offsetting	An action or activity (such as the planting of trees or carbon sequestration) that compensates for the emission of carbon dioxide or other greenhouse gases to the atmosphere (Merriam-Webster Dictionary, 2021).

Term	Meaning
Scope 1	Direct emissions from activities owned or controlled by the organisation in the baseline year (e.g., fuel combustion from company vehicles, refrigerants).
Scope 2	Indirect emissions associated with the organisation's consumption of purchased electricity in the baseline year.
Scope 3	All indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.

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