Circular Economy Opportunities **Murraylands and Riverland**

Regional Development Australia
MURRAYLANDS & RIVERLAND SA

Government of South Australia
Green Industries SA

November 2022

Circular Economy Opportunities Limestone Coast

This project was delivered by BDO EconSearch in partnership with Hudson Howells and Rawtec.

Acknowledgement of country

We acknowledge and respect the Traditional Custodians whose ancestral lands we live and work upon and we pay our respects to their Elders past and present.

We acknowledge and respect their deep spiritual connection and the relationship that Aboriginal and Torres Strait Islanders have to Country. We also pay our respects to the cultural authority of Aboriginal and Torres Strait Islander people and their nations in South Australia, as well as those across Australia.

*Cover: The River Vista, Riverland - **@ebony.forsyth - Ebby Designs***

Contents

Foreword

Green Industries SA is delighted to partner with the Regional Development Australia Murraylands and Riverland (RDAMR) to develop this Circular Economy Opportunities report. This regionally focussed study will enable local businesses and communities to unlock the potential of the circular economy. By examining the existing policies, priorities and people living and working in this specific region, we have identified areas of strength and potential that offer the greatest and the fastest pathways for sustainable development in the region. This regional approach will deliver change at scale and empower the key sectors through the embedded connectedness, the relationships already in place and the synergies across sectors and supply chains identified.

This report highlights unique opportunities for improved circularity that exist across agriculture, and food and drink value chains in the Murraylands and Riverland. There is real opportunity to recapture the value of food loss at farms and at manufacturing sites that may otherwise be destined to become waste.

Working with the RDAMR was crucial to use their close working relationships with the businesses and people of the region.

The report is the culmination of the first stage of the transition to a circular economy and identifies high-level action plans reflective of the local economic drivers and aligned with local strategic priorities in the Murraylands and Riverland region. From here the RDAMR will continue to work closely with regional partners and the State Government to deliver the engagement activities, tools and support that will help the business communities of the Murraylands and Riverland embrace circularity. Achieving this will deliver ongoing financial and social value while reducing carbon emissions that contribute to climate change, and regenerating the natural environment that the region is proudly regarded for.

I look forward to the next steps of building on our partnerships in the region, led by RDAMR and helping to unlock the circular economy opportunities identified in this report for a sustainable future.

Professor Ian Overton
Chief Executive
Green Industries SA

'Our vision for the next decade is that the Murraylands and Riverland is recognised internationally as a vibrant, world leading circular economy with high-performing businesses, resilient communities and individuals with a deep sense of wellbeing and connection with the world around us.'

Fostering the transition to a more Circular Economy supports our region to manage and prepare for a changing climate. Understanding, educating and activating the economic, social and environmental changes needed brings challenges for all levels of regional activity. The important first step we take in understanding how circularity can operate in the region has the potential to unlock many and varied business, community, and social opportunities, setting us on a pathway to having a connected region with a resilient and sustainable future.

Jodie Hawkes
Chair
RDA Murraylands & Riverland

Executive summary

The Circular Economy is an innovative model that allows us to rethink the way we use resources to allow us to balance important social, environmental, and business needs more sustainably. The model is regenerative by design, aiming to keep resources circulating in use for as long as possible in order to extract the maximum value out of them.

Australia is a large consumer of resources, with a significantly higher material consumption rate per capita when compared with most countries in the OECD and the region. In addition to this, Australia has lower productivity and domestic supply chain sufficiency than other OECD countries and those in the Asia-Pacific region, as well as a higher rate of waste to landfill than similarly developed economies[1].

RDA Murraylands and Riverland (RDAMR) and Green Industries SA (GISA) have recognised the important economic, social and environmental potential of developing circular economy strategies at a regional level to create a more resilient and sustainable regional economy and community. This study is not intended to be an academic exercise in providing a complete understanding of the economic and material flows – the available data does not allow this. This is a review of the major sectoral opportunities that exist and a means of presenting these opportunities in a meaningful and engaging way.

This is the beginning of a strategic approach to regional circular economy being delivered by RDAMR and GISA. It will involve the further development of the opportunities presented here through collaborations between the RDAMR, GISA and other stakeholders to implement the recommendations detailed within this study. The intention of this report is to facilitate an engagement process with businesses and communities within the region and identify the key stakeholders who will be instrumental in delivering circular economy opportunities across the Murraylands and Riverland.

The Murraylands and Riverland region has a population size of approximately 73,000 people and is home to 4.1 per cent of the SA population2. In 2018/19, the region contributed an estimated 4.3 per cent ($4,467m to South Australia's Gross State Product (GSP), providing 4.3 per cent of employment in the state (6,177 fte jobs).

The Murraylands and Riverland region has a strong dependence on primary production (agriculture) within the regional economy, with around a quarter of the Gross Regional Product (GRP) and 16 per cent of employment coming from primary production.

Manufacturing also plays a larger part in the region's economy in comparison with SA as a whole. Within the Murraylands and Riverland, manufacturing contributes an estimated 8.0 per cent to GRP and 11.5 per cent to employment.

Within the Murraylands and Riverland region, sectors where we have identified economic opportunity to reduce resource use and emissions are Agriculture, Manufacturing, Utilities, Construction and Households.

Sector and Non-sector Opportunities

The key circular economy opportunities we identified in the Murraylands and Riverland are summarised below.

Food and Drink Value Chain

Opportunity 1 **Value-adding reject fruit and vegetables**

Food waste is a complex problem, taking place across different parts of the food system and supply chain, requiring varied, tailored solutions. This opportunity focusses on the first major source of food waste, when harvesting and grading crops. It is estimated that 77% of the food waste in South Australian agriculture is produce that is not harvested and/or is ploughed in[2]. Across all crop sectors (Vegetables, Grains, and Fruit and Nuts) in the Murraylands and Riverland region, we found there is potentially 80,000 t of crops that could be recovered and value-added.

Opportunity 2 **Value-adding food waste from food processing for human consumption**

There are several opportunities to add value to the by-products of food processing and move the food waste going to disposal, animal feed or composting, to uses higher up the waste hierarchy/value chain. Various crops in the region, including citrus, stonefruit, almonds, potatoes, onions, carrots and seeds from processed winegrapes, can be used for their nutraceutical and bulk food properties, extracting elements such as antioxidants, carotenoids, glucose, flavonoids, starch and bio-oils. These products have a range of applications in different industries including cosmetics, food and beverages, pharmaceuticals and nutraceuticals.

Opportunity 3 Converting food waste to high-quality animal feed

Some countries (e.g., Japan, South Korea) produce animal feed from mixed food waste sources by treating it and turning it into a safe, purpose-designed animal feed. This opportunity could specifically tackle large volumes of waste from food processing by industrially converting it into standardised, safe animal feed.

Opportunities also exist to convert mixed food waste into high-quality animal feed using bioconversion technologies, where waste is fed to insects and larvae which are then used to create protein-based feed for the pet, aquaculture, and livestock markets. Additionally, the manure by-product of the larvae (called frass) can be collected, composted, and used as an organic fertiliser, continuing the circular process of food creation.

Opportunity 4 Adopting regenerative agricultural practices

Regenerative agriculture is quickly growing in popularity as an alternative system of farming practices, aimed at rehabilitating farm ecosystems by improving resource use, with a particular focus on soil health. Soil is one of the earth's most important natural resources and is essential for healthy plant growth, food production and ecosystem services such as clean, plentiful water and air. Soils help regulate the earth's climate and are the largest store of land-based carbon, making soil regeneration a key plank in efforts to combat climate change

Opportunity 5 Using seaweed supplementation in livestock to reduce methane emissions and improve productivity

Our study estimated that approximately 80 per cent of total regional GHG emissions are generated by livestock subsectors, of which the main contributors are Sheep (285,300 tCO_2e, 31%), Beef Cattle (270,800 tCO_2e, 29%), Pigs (111,400 tCO_2e, 12%) and Dairy Cattle (68,100 tCO_2e, 7%). These emissions are driven by enteric fermentation. Research has shown that, when fed to ruminant livestock, the seaweed from the genus *Asparagopsis* provides an overwhelming reduction of methane in their digestive process. Adding around 5g of *Asparagopsis* seaweed per kg of dry feed matter lowers methane emissions by over 80%[3]. Not only does seaweed consumption reduce methane emissions, it has also been shown to improve animal health, feed conversion and productivity.

This technology has created a significant opportunity for the agricultural sector across Australia to contribute to reducing methane emissions, with the bonus of increasing livestock productivity.

Opportunity 6 Adopting circular alternatives to linear CCA products

Many industries in South Australia widely use Copper chromated arsenate (CCA) timber. An economically and environmentally sound disposal technology for managing large quantities of this timber once it reaches the end of its useful life is currently not available across South Australia. This is leading to growing quantities of treated timber waste being generated and stockpiled. It is estimated that 1 million CCA treated timber posts were being stockpiled in South Australia each year. There is a major opportunity to identify a comprehensive solution to the mounting problem of hazardous CCA timber posts. Alternatives to CCA posts are available but are yet to be widely adopted in practice by industry. Alternatives include "Tanaposts" manufactured by a Limestone Coast business, as well as small diameter posts and droppers made from steel, recycled plastic and other materials.

Utilities

Opportunity 7 **Better management of commonly recyclable materials locally**

Commonly recyclable materials include green waste, food waste, glass, paper, plastic, metals and textiles produced by both households in regional towns and on farms and managed by regional councils. Approximately 38% by weight (8,800 tonnes) of the waste in the kerbside general waste bins in the Murraylands and Riverland is organics, mainly food waste, presenting a significant opportunity for councils in the Murraylands and Riverland to roll-out a comprehensive food-waste-green-waste (FOGO) service. Combined with other significant volumes of organic waste produced across various sectors in the region, these wastes can be readily processed by the organics recycling sector in the region and sold back as compost into local agriculture where demand for soil improvement products is significant.

There is also an opportunity to improve collection and processing infrastructure and incentives to collect, aggregate/sort and process single streams of clean, marketable waste in the region.

Manufacturing

Opportunity 8 **Developing recycled plastics manufacturing**

Every Australian generates an average of 101 kilograms of plastic waste per year, including 59 kilograms of single-use plastic waste. However, less than 12% of Australia's plastic waste is recycled with about 85% ending up in landfill, and an estimated 130,00 tonnes leaking into the marine environment each year. New regulations have been designed to kickstart Australia's domestic plastic recycling infrastructure to help meet global and domestic demand for recycled plastics4. With nationwide policy encouraging the remanufacture of used plastics within Australia, there is a major opportunity for the Murraylands and Riverland region to develop mature, local plastic processing and remanufacturing capabilities.

*Murray River Landscape, Murray River, Lakes & Coorong - **South Australian Tourism Commission/Adam Bruzzone***

Construction and the Built Environment

Opportunity 9 **Developing modular, affordable housing from sustainable materials**

Housing affordability (rental and owner-occupier) and availability are key issues across regional Australia. Increasing the availability of affordable housing in regional communities can provide numerous benefits to regional communities and economies. One way to do this is through the use of modular housing, where environmentally friendly, energy efficient building modules are constructed off site and then joined together on site to build a home. There is an opportunity to establish modular housing manufacturing enterprises in regional locations.

Opportunity 10 **Deconstructing and re-using construction modules and materials**

Our study estimated that the construction sector in the Murraylands and Riverland region generates approximately 11,800 t annually of construction and demolition waste (C&D). Whilst much of this material is diverted from landfill, there is an opportunity to increase processing of C&D materials for beneficial reuse. Moving forward it is important that buildings are designed for deconstruction to optimise the reuse and recycling of construction materials. There is also an opportunity to develop and establish C&D recovery and recycling centres in regional locations to reduce freight movement and generate local employment opportunities.

Households and Communities

Opportunity 11 **Creating a regional Circular Hub**

The circular economy involves keeping products and materials in circulation for as long as possible, and individuals can facilitate this through processes such leasing equipment instead of purchasing new (e.g. tools and machinery), repairing their own broken items, or salvaging used items to give them a second life. However, a lack of skills and knowledge on how to repair items, and a lack of access to circular products and services can be limiting. There is the opportunity to assist residents in living circular lifestyles by developing a community-based 'Circular Hub' in the region, which would provide convenient access to circular products and services and can bring together a range of community partners.

Strategic non-sectoral opportunities

In addition to sector-based opportunities, we have identified several strategic opportunities that will support local government, RDAMR, business groups and communities to transition towards a more circular regional economy. These include: social advocacy campaigns to raise awareness of the circular economy to the environment; supporting and promoting circular businesses in the region; training and education aimed at supporting the transition to a circular economy; various programs and strategies aimed at accelerating adoption of circular economy action; capitalising on advocacy by local councils to lead by example; and developing additional regional innovation and collaboration hubs to encourage innovative businesses to stay in the region and contribute to circular economy opportunities.

Banrock Station Wine & Wetland Centre, Riverland - ***Accolade Wines***

Recommendations

Within this report's Sector Action Plans, several next step actions are recommended to further develop the circular economy across the Murraylands and Riverland region.

It is expected that these recommendations would be delivered using a collaborative approach involving the stakeholders detailed in the Sector Action Plans and through mechanisms including:

- stakeholder collaboration,
- sectoral and cross sectoral knowledge sharing,
- setting regional conditions for a circular economy,
- establishing some circular economy indicators, and
- regional circular economy procurement.

Together RDAMR and GISA can help drive these next steps through a combination of regional industry education and engagement, facilitation of collaborative networks and partnerships, and identification and signposting for businesses towards sources of support and investment.

1 Introduction

1.1 Importance of the circular economy

The Circular Economy is an innovative model that allows us to rethink the way we use resources to allow us to balance important social, environmental, and business needs more sustainably. The model is regenerative by design, aiming to keep resources circulating in use for as long as possible in order to extract the maximum value out of them. The aim of the circular economy model is to gradually decouple economic activity from the consumption of finite resources, using three key principles: design out waste and pollution; keep products and materials in use at their highest value rather than disposing of them; regenerate natural (and social) systems[5]. It has demonstrated potential to deliver significant economic, environmental and social benefits in Australia and elsewhere[6].

Australia's current economic model can be described as being 'linear'. In a linear economy, creating value follows a "take-make-use-dispose" model that means raw materials are extracted, then manufactured into products that are used and discarded as waste[7]. The world's growing population and limited supply of resources is expected to have significant impacts on environmental health as well as our ability to continue to meet growing demands and sustain economic development[8]. As a result, Australia's linear economy model is increasingly being accepted as being unsustainable, particularly since the Australian recycling industry fell into crisis following Chinese restrictions on waste material imports[9].

Australia is a large consumer of resources, with a significantly higher material consumption rate per capita when compared with most countries in the OECD and the region. In addition to this, Australia has lower productivity and domestic supply chain sufficiency than other OECD countries and those in the region, as well as a higher rate of waste landfill than similarly developed economies[10]. Although recycling has been adopted more rigorously over recent years as a way to recover some resources, the circular economy model offers much more than that. By shifting the way we design, make, use and repurpose products and materials, we can tackle several of these issues at once. We can reduce emissions and keep our existing resources in circulation for as long as possible while allowing them to retain their highest value, therefore balancing our social, environmental and economic needs.

Tarac Technologies (Nurioopta, Berri and Griffith)

Tarac Technologies was established in 1930 to tackle the immense amount of waste generated from the wine industry. Tarac Technologies exists with the purpose of creating sustainable value, by transforming things that others don't need or value, into things that they do. Tarac performs a vital service for the Australian Wine Industry, treating around 130,000 tonnes of grape marc, more than 40 million litres of liquid waste and approximately 3,000 tonnes of solid waste annually. In doing so, they tackle the important environmental issue of disposing of this amount of waste, while also value-adding solid and liquid winemaking residuals in a range of ways. All the products they create are repurposed back into the wine industry, creating a closed loop system. These include grape alcohol (added to fortified wines), tannins, tartaric acid, grape juice concentrate and grape seeds. They also produce processed grape marc which has broader agricultural applications, including as stock feed and supplementation, or for mulching and soil conditioning. Tarac's broad repurposing of an industry's by-products provides an excellent example of circular economy in action.

RDA Murraylands and Riverland (RDAMR) and Green Industries SA (GISA) have recognised the important economic, social and environmental potential of developing circular economy strategies at a regional level to develop a more resilient and sustainable regional economy and community.

This study is not intended to be an academic exercise in providing a complete understanding of the economic and material flows – the available data does not allow this. This is a review of the major sectoral opportunities that exist and a means of presenting these opportunities in a meaningful and engaging way.

This is the beginning of a strategic approach to regional circular economy being delivered by RDAMR and GISA. It will involve the further development of the opportunities presented here through collaborations between the RDAMR, GISA and other stakeholders to implement the recommendations detailed within this study. The intention of this report is to facilitate an engagement process with businesses and communities within the region and identify the key stakeholders who will be instrumental in delivering circular economy opportunities across the Murraylands and Riverland.

This study focused on the local authority areas within the Murraylands and Riverland region, namely:

- The Berri and Barmera Council,
- Renmark Paringa Council,
- Mid Murray Council,
- Rural City of Murray Bridge,
- District Council of Karoonda East Murray,
- District Council of Loxton Waikerie,
- The Coorong District Council,
- Southern Mallee District Council.

1.3 Importance of a regional economy

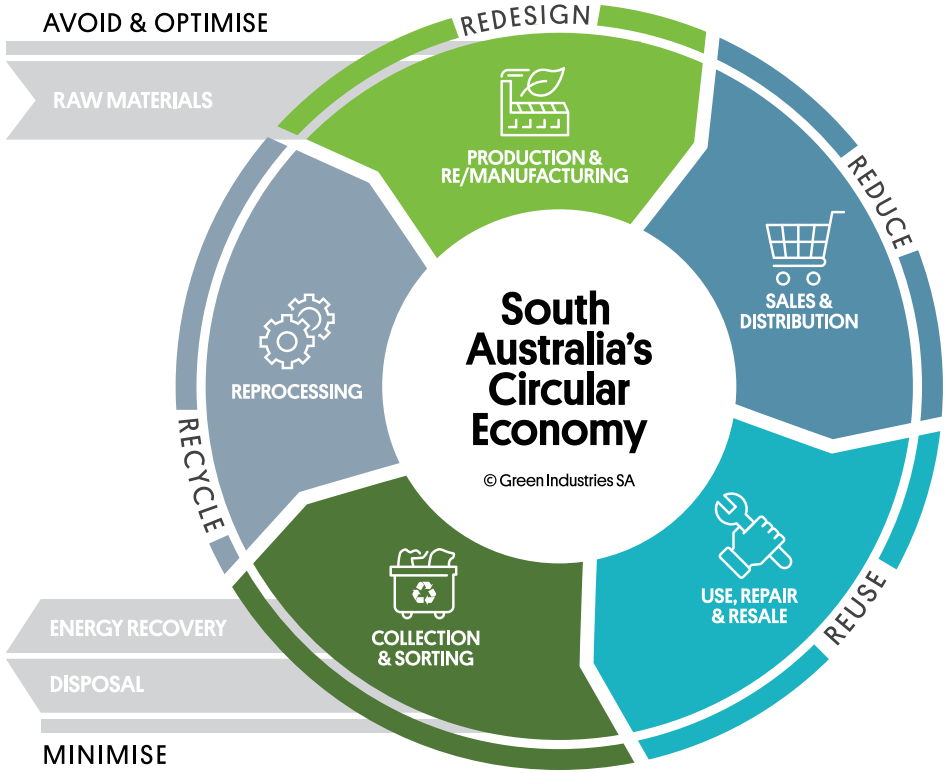
Circular economy principles are often adopted at a local or business level, and several businesses in the Murraylands and Riverland indicated they are already trialling actions to become more circular within their organisations. While this approach is important, it is also important to understand the circular economy from a regional perspective. Regions offer economies of scale that make opportunities more viable than at a smaller, local level. As a result, a regional approach can enable larger scale changes towards a more circular economy, affecting more than one sector. There are a range of advantages that come from taking a regional approach to circular economy thinking. For example:

1. Material flow data are often better understood on a regional level.
2. Links can be established with relevant activities, policies and initiatives taking place at a regional level.
3. Sector-based approaches can be embedded.
4. Opportunities arise to build relationships between stakeholders on a larger scale.
5. There is an opportunity to maximise potential synergies between businesses from different sectors.
6. It enables opportunities to raise awareness and share resources, information and ideas at a larger scale.

The transition towards a circular economy can play a crucial role in improving the resilience and self-sufficiency of regional communities, including the Murraylands and Riverland. It offers an opportunity to build ongoing economic and social value while regenerating the natural environment that Murraylands and Riverland is proudly regarded for.

Once a significant and measurable momentum has been achieved in adopting circular economy principles, the region may be in a position to leverage its circular economy credentials when selling local produce and manufactured goods. Market access for goods and services is changing rapidly in the face of increased demand for environmental and social sustainability.

Enhancing the "green and sustainable" capacity of the Murraylands and Riverland region will also help in attracting tourists to the region and make it a location of choice for new residents and workers. Likewise, businesses and industries who adopt circular economy principles and practices will be better placed to attract and retain employees, helping address a critical issue for many industries.



2 Approach

This study sought to identify linkages between economic and material flows to highlight where the most beneficial circular economy opportunities could be developed.

Step 1: Resource and Economic Profiling

A profile of resource and economic flows was created to understand the priority sectors in the region. A combination of environmental and economic data were gathered and analysed to help identify priority sectors for further investigation in the Murraylands and Riverland. Priority sectors were identified based on greatest economic activity that have the greatest impact through resource use (water, raw material and energy), waste generation (solid waste, GHG emissions) and transport use.

Step 2: Understand Regional Priorities

The next step in the project was to understand the regional priorities, through both a desktop study and direct consultation with key stakeholders. The objective of this step was to gain comprehensive understanding of the appetite, ambitions and priorities for a circular economy in the region. Following the desktop study, key stakeholders were interviewed to better understand the inputs and processes involved in the circular economies of the Murraylands and Riverland.

Step 3: Identify Priority Sectors

The third step of the study was to identify the priority sectors and sector interfaces, and which aspects to focus on within those sectors going forward. The 'size of the opportunities' in these sectors were identified by quantifying the potential gross resource use savings, avoided waste production and avoided transport kilometres by sector. This process involved:

- A literature review of case studies to identify percentage range of reductions
- Gathering information on resource and transport use reductions and waste generation reductions for local circular economy case studies
- Quantifying (in $ value and physical units) potential gross resource use savings, avoided waste production and avoided transport kilometres by priority sector
- Identifying the longlist of priority sector opportunities.

Step 4: Identify and Map Circular Economy Opportunities

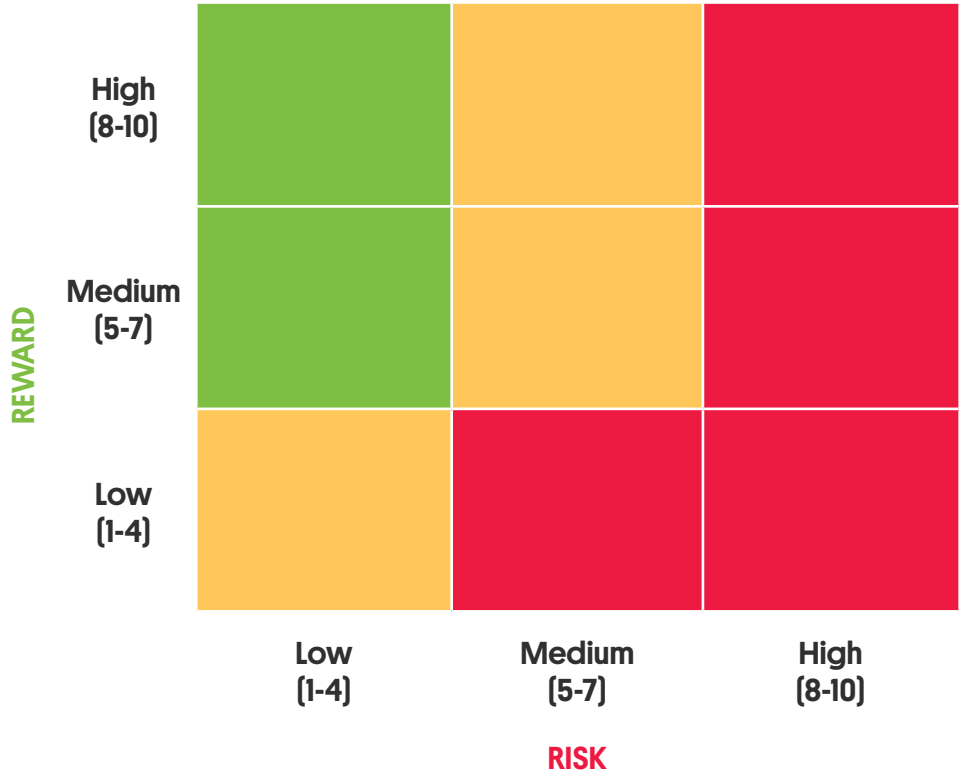
The outputs from the previous step were then used to undertake a high-level mapping exercise for each priority sector and sector interface (value chain sectors) to identify circular economy opportunities, using a framework based around the following circular economy principles: refurbish/remanufacture; re-use; recycle/regenerate; prevent (e.g. resource/product sharing, design for disassembly, product-as-service and maintenance) and regenerate natural systems[11]. This mapping exercise led to the development of a longlist of circular economy opportunities, which were then surveyed by the Project Working Group and the Stakeholder Advisory Group members to identify the political appetite for various initiatives.

Step 5: Impact Quantification and Develop a Shortlist of Opportunities

The fifth step of our approach was to further prioritise the circular economy opportunities identified in the longlist from Step 4. In doing so, a shortlist of favoured opportunities maximising the economic, social and environmental benefits was developed. This shortlist was guided by a qualitative scoring mechanism based on the following key impact indicators:

- Cost savings/additional profits
- Additional employment
- Resource savings (avoided waste and energy savings)
- Avoided GHG emissions or environmental toxicity
- Regional feasibility (likelihood of implementation in the region).

The opportunities were then ranked in relation to risk and reward as illustrated by the following matrix.



The shortlist was presented to the project working group and finalised in joint consultation.

Step 6: Develop Sector Action Plans

Selected opportunities identified in Step 5 were researched and developed into mini action plans, detailing the key aspects, benefits, case examples, relevant stakeholders and next steps. This was carried out in collaboration with the RDAMR (via the Project Working Group). These mini action plans were compiled for each priority sector to form the sector action plans. The next stage of this study is for the action plan to be used by the RDAMR to engage with businesses and key stakeholders to develop and implement the identified opportunities.

3 Understanding the local agenda

The value of this stage was to understand the regional and local priorities in terms of the economic, environmental and political drivers to help identify the priority sectors.

The Murraylands and Riverland region has a population size of approximately 73,000 people and is home to 4.1 per cent of the SA population[12]. In 2018/19, the region contributed an estimated 4.3 per cent ($4,467m to South Australia's Gross State Product (GSP), providing 4.3 per cent of employment in the state (6,177 fte jobs)[13].

The Murraylands and Riverland region has a strong dependence on primary production (agriculture) within the regional economy, with around a quarter of the Gross Regional Product (GRP) and 16 per cent of employment coming from primary production. In comparison, at the state level primary production contributed an estimated 5.1 per cent of GSP and 3.5 per cent of employment in 2018/19[14].

Manufacturing also plays a larger part in the region's economy in comparison with SA as a whole. Within the Murraylands and Riverland, manufacturing contributes an estimated 8.0 per cent to GRP and 11.5 per cent to employment. In comparison, at the state level manufacturing contributed an estimated 6.6 per cent of GSP and 8.5 per cent of employment in 2018/19[15].

*Canoe Adventures, Riverland - **South Australian Tourism Commission***

*Lake Bonney, Riverland - **Ben Goode***

The Murraylands and Riverland's strategic growth plan has a focus on growth in primary production/agribusiness, though the region also places emphasis on developing its other industries. Other growth sectors include manufacturing, health and aged care, tourism, biomass and wind-based renewable energy generation.

The Murraylands and Riverland has a regional natural resource management board, now known as the Murraylands and Riverland Landscape Board, which devised a Landscape Plan to outline the region's environmental priorities:

- Sustainable agricultural and pastoral landscapes
- Sustainable water use
- Healthy rivers, lakes and wetlands
- Healthy natural landscapes
- People at the heart of landscape management.

As the main industries in the region are in primary production, the opportunity areas for growth are predominantly related to these industries. Some of the key environmental considerations relevant to the priorities identified above are:

- Solid waste generation
- Greenhouse gas emissions
- Transport
- Water use.

4 Resource use and emissions in the region

A combination of environmental and economic data were gathered and analysed to help identify priority sectors for further investigation within the region. These sectors are defined as those where the greatest economic activity occurs and that have the greatest impact through resource use (water, raw material and energy), waste generation (solid waste, GHG emissions) and freight demand.

Across all the profiles developed in this study there is general lack of published regional data, with most data available at the state level only. We have estimated the regional shares based on best fit proxy measures such as regional share of industry value of output at the state level and, similarly, regional share of population. The measures chosen aimed to closely approximate the drivers of resource use, however they were constrained by data availability/quality. This general, top-down, approach is practical within the resources and timeframes available to this project. It is also 'fit-for-purpose, providing a confident measure of the relative contribution of individual sectors to resource use and waste generation, providing the necessary information to identify which sectors, circular opportunities and pathways to prioritise for the region.

Our estimates of annual regional resource use:

Water use **357.2 GL**

Freight demand **1.2 billion tkm**

Energy use **11.7 PJ**

Greenhouse gas emissions **934.8 $KtCO_2e$**

Locally produced raw material use **1,970.3 Kt**
(imported raw materials, unknown)

Solid waste generations **444.3 Kt**

Within the Murraylands and Riverland region, sectors with consistently high resource use and emissions are Agriculture, Manufacturing, Utilities, Transport and Construction plus households.

4.1 Agriculture, Forestry and Fishing

	Agriculture		Other AFF	
Water use	67%	240.9 GL	Nil	
Freight use	20%	237.7 Mtkm	1%	16.3 Mtkm
Energy Use	25%	2.9 PJ	1%	0.2 PJ
Greenhouse gas emissions	51%	477.6 $KtCO_2e$	1%	5.9 $KtCO_2e$
Local raw material use	13%	263.5 Kt		<1 Kt
Solid waste generation	44%	196.5 Kt	1%	3.2 Kt

Agriculture

Agriculture in the region is a major industry, generating some 1,400 Kt of raw materials (value of output $2,039 million in 2018-19). It is also a major resource consumer, using an estimated 67 per cent and 25 per cent of water and energy resources, respectively, and 13 per cent of regional use of locally produced raw materials[16]. Agriculture is also a significant component of the regional freight demand (20% of regional freight use), and major source of greenhouse gas emissions and solid waste generation (51% and 44% of regional generations, respectively).

An estimated 80 per cent of regional GHG emissions are generated by the livestock subsectors (sheep, 31%, beef, 29%, pigs, 12%, and dairy cattle, 7%), which is driven mainly by emissions arising out of enteric fermentation[17]. Overall, cropping and horticulture generate negative emissions (-29% of regional emissions) and therefore offset some of these emissions within agriculture.

There are major opportunities to make agricultural production less resource intensive (which we explore in Opportunity 4 and 6 in Section 5.1), generate less GHG emissions (explored in Opportunity 5 in Section 5.1) as well as to make better use of the fruit and vegetables produced by the farming community (explored in Opportunity 1 in Section 5.1)

4.2 Manufacturing

	Food & beverage manufacturing		Other manufacturing	
Water use	1%	3.3 GL		<1 GL
Freight use	18%	211.9 Mtkm	9%	104.2 Mtkm
Energy Use	5%	0.6 PJ	14%	1.6 PJ
Greenhouse gas emissions	5%	48.3 $KtCO_2e$	5%	42.5 $KtCO_2e$
Local raw material use	19%	375.4 Kt	41%	815.1.0 Kt
Solid waste generation	15%	68.7 Kt		Not estimated

Food and beverage manufacturing

Food and beverage manufacturing in the region is a significant industry, with a value of output of $966 million in 2018-19. This sector also adds value to regional agricultural production by comprising 19 per cent of regional use of locally produced raw materials. Food and beverage manufacturing is also a significant component of the regional freight demand (18% of regional freight use).

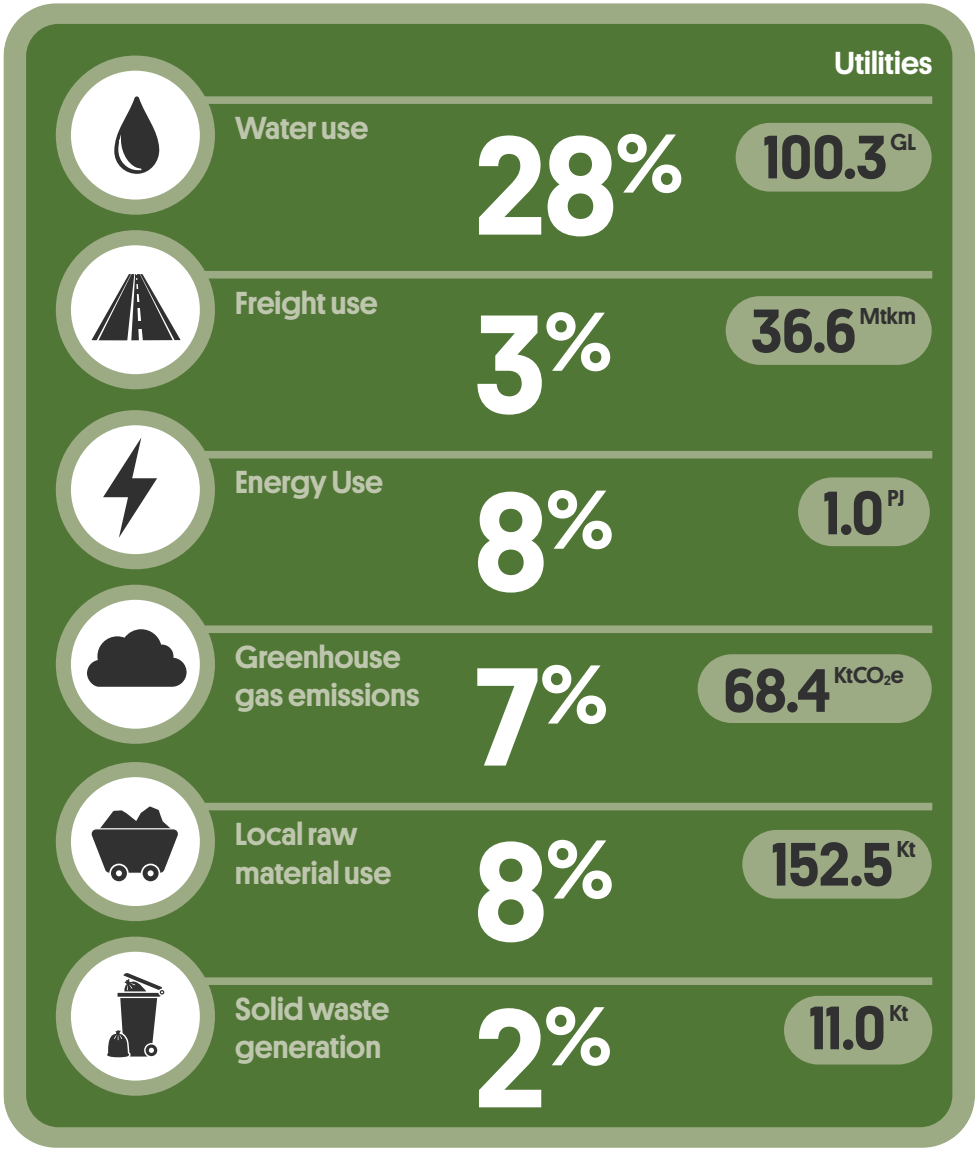
This sector generates an estimated 15 per cent of the region's solid waste, however much of it is recovered for a variety of uses, such as bone meal, tallow, industrial alcohol, animal feed and compost. However, there are potential opportunities to both recover more waste and develop higher value uses of those wastes, which we explore through opportunities 2 and 3 (in Section 5.1).

Other manufacturing

Other manufacturing has a combined value of output of $338 million in 2018-19 (4% of regional output). It is a significant energy consumer, using an estimated 14 per cent of energy resources and comprises 41 per cent of regional use of locally produced raw materials. Other manufacturing is also a significant component of the regional freight demand (9% of regional freight use) and contributes about 5 per cent of the region's GHG emissions.

There is a small, but growing sector recycling used plastics, which could potentially grow further, which is explored in opportunity 8 (Section 5.3).

4.3 Utilities



The value of output of the Utilities sector, which comprise electricity, gas, water and waste services, was approximately $535 million in 2018-19. It is a significant consumer of regional resources, using an estimated 28 per cent of regional water resources (mainly in the water supply sector[18]) and 8 per cent of energy resources (mainly in the electricity generation and supply sector) and 8 per cent of regional use of locally produced raw materials. The Utilities sector is a significant contributor to regional GHG emissions (7%), mainly from fuel combustion during electricity generation and fugitive emissions during landfilling activities.

There are opportunities to reduce the GHG footprint of the Utilities sector through diverting recyclable material from landfill (explored through opportunity 7, Section 5.2).

4.4 Construction

Construction

Water use		<1 GL
Freight use	5%	55.3 Mtkm
Energy Use	3%	0.3 PJ
Greenhouse gas emissions	2%	22.7 $KtCO_2e$
Local raw material use	11%	225.6 Kt
Solid waste generation	3%	11.8 Kt

The value of output of the Construction sector in the Murraylands and Riverland region was approximately $602 million in 2018-19. It is a moderately significant consumer of regional resources, using an estimated 3 per cent of energy resources, 11 per cent of regional use of locally produced raw materials and 5 per cent of regional freight demand.

The construction sector produces long-lived assets, which can have a significant impact on resource use and emissions by other sectors, and in particular, households, by the way these assets are used and perform over their lifetime. We explore opportunities around design for deconstruction/reuse (opportunity 9 and 10, Section 5.4).

4.5 Households

	Households
Water use	3% — 10.0 GL
Freight use	8% — 92.2 Mtkm
Energy Use	25% — 2.9 PJ
Greenhouse gas emissions	15% — 140.4 $KtCO_2e$
Local raw material use	1% — 28.1 Kt
Solid waste generation	8% — 35.0 Kt

Households in the Murraylands and Riverland region are significant consumers of regional resources, using an estimated 25 per cent of regional energy resources and 7 per cent of regional freight demand. Households are also significant contributors to GHG emissions in the region at 15 per cent of emissions.

Households are an integral part of regional economies, being the significant purchasers of goods and services. They can significantly influence the resource use and emissions footprint of a region and therefore are an integral stakeholder in the transition towards a circular economy. We explore how households can participate readily in stimulating a transition to a circular economy through the community circular hub concept (opportunity 11, Section 5.5).

Houseboat - Younghusband, Murray River, Lakes & Coorong - ***South Australian Tourism Commission/Adam Bruzzone***

5 Sector action plans

Following a stakeholder consultation, feedback was used to reduce the longlist of circular economy opportunities to a focused shortlist. The criteria used to assess the opportunities centred on environmental/social and economic impact, and the likelihood of implementation.

The shortlist of opportunities covers the four priority sectors (food and drink value chain, utilities, manufacturing and construction and the built environment) and households and communities. For each of these, a sector action plan has been developed that highlights the scale of the opportunities, the key stakeholders and suggested next steps and are detailed below.

5.1 Food and Drink Value Chain

5.1.1 Opportunity 1 - Value adding reject fruit and vegetables

What	Add value to fruit and vegetables that would otherwise be rejected
CE strategy	Design out waste
Main industries/partners	Farmers, food manufacturers, food distributors, aged care facilities, hospitals, and other food service
Expected outcomes	• Increased farm profitability • Investment in the region and job creation for new upcycled food product lines • Lower food costs for food service businesses • Reduced food waste volumes • Reduced climate impacts

Background

Food waste is a complex problem, taking place across different parts of the food system and supply chain, requiring varied, tailored solutions. This opportunity focusses on the first major source of food waste, when it is time to harvest crops and grade them.

A national study[19] quantifying food waste across the food value chain estimated that 77% of the food waste in South Australian agriculture is produce that is not harvested and/or is ploughed in. The remaining 23% is recovered via food rescue and diversion to animal feed.

Across all crop sectors (Vegetables, Grains, and Fruit and Nuts) in the Murraylands and Riverland region, this study found there is potentially 80,000 t of crops that could be recovered and value-added. Additional volumes of biomass from crops (not food waste/loss) are generated in the region. This material is typically left in-situ for soil conditioning (i.e., protecting topsoil, nutrient recovery, and carbon retention) and was not included in the waste volume estimates.

Why does this happen?

One of the reasons is strict specifications for the uniformity, quality or size of fresh produce, which are common in farmer-retailer contracts. Due to these aesthetic standards, a lot of edible produce is downgraded to a value not worth harvesting without identified new markets and challenges in scale for individual farmers entering new markets. Other reasons for on-farm waste include untimely loss or damage due to pests, diseases or weather; a fall in the market price that makes it economically unviable to harvest; a change in consumer taste and preference; and lack of market access.

The Opportunities

There are a number of opportunities and ways to add value to reject fruit and vegetables in the region. Importantly, there is the opportunity to grow the manufacturing sector by value-adding reject fruit and vegetables, therefore improving productivity and value-add in the region.

One way to simultaneously add value to fruit and vegetables and reduce food waste is to find a market for imperfect produce that would otherwise be discarded. There are opportunities to work with local manufacturing businesses to create products using imperfect produce (e.g. pre-made mashed potato or chopped frozen vegetables), as well as working with hospitality businesses to supply cosmetically imperfect produce for food preparation (e.g. menu items where the consumer does not see the produce in its whole form). Childcare and residential care services are examples of large-scale production of food in which the consumer only sees the prepared meal, much of which are processed past their original form (e.g. chopped, soups, purees). Supplying cosmetically imperfect produce to these businesses in an opportunity to add value to otherwise discarded produce.

Another opportunity is to pursue whole of crop purchasing, particularly where exclusive supply arrangements are in place. This type of procurement shares the risk more evenly between growers and purchasers and can reduce some of the risk factors that lead to on-farm food waste, like over planting. This also aligns with National Food Waste Strategy Feasibility Study and overcomes any instances where there is an exclusive supply arrangement in place which may restrict finding markets for excess produce. Reported realised benefits include increased crop utilisation, increased profits for farmers (through 'right sizing' of crops), reduced unit costs for buyers and minimal crop wastage[20].

There are also opportunities to market imperfect produce directly to the consumer, by bringing awareness to issues of food waste and shifting the focus away from aesthetics and towards more inclusive approaches (e.g. 'the odd bunch' range[21]).

Potatoes are a significant crop in the region, yet up to 40% of potatoes are rejected because they do not meet market specifications. This large waste volume is currently used for animal feed where it receives $10/tonne or it is disposed in landfill at a cost. However, graded out potatoes could become products that already have a market such as functional foods (anti-oxidants, glucose and starch), bioplastics, packaging materials, coatings and adhesives[22], with some of these products, such as starch, able to fetch over $75/tonne[23].

What next?

- Identify farms and produce with value-adding potential in the region
- Engage with businesses (e.g. hospitality, aged care, food manufacturers and distributors) to assess potential for wholesale relationships sourcing 'imperfect' produce, likely at a slightly reduced cost, therefore benefiting both farmers and businesses
- Identify manufacturers with capacity and desire to value-add otherwise discarded products
- Educate and support farmers to value-add their own produce
- Work with peak industry bodies to support their growers in negotiating appropriate 'whole crop purchasing' agreements
- Consider more marketing and education targeting consumers to promote the purchase of aesthetically imperfect produce.

Key stakeholders

- Fight Food Waste CRC
- CSIRO
- Citrus SA
- Potatoes SA
- Onions Australia
- Horticulture Coalition of SA
- Ausveg SA.

Case study: Woodlane Orchard, Mypolonga

Woodlane Orchard purchase surplus and 'seconds' fruit, vegetables and grains locally in the Murraylands and Riverland region, to create a range of value-added food products. Some of their products include ready-made, dehydrated meals (e.g. one pot, add water); snacks (e.g. dried fruit); garnishes (e.g. dried citrus for drinks); cordial syrups, and cocktail mixes. All of their products can be stored without refrigeration which can also reduce consumer waste and are made from produce that would otherwise be discarded. Any by-products of their food preparation are then returned to farmers for animal feed. This model ensures that all produce is given the opportunity of a second life, and only the very last by-products are sent to feed.

5.1.2 Opportunity 2 - Value adding food waste from food processing for human consumption

What	Value add food waste from food processing for human consumption
CE strategy	Design out waste
Main industries/partners	Local food growers, food manufacturers
Expected outcomes	• Reduce food waste volumes • Attract investment in the region for development of new upcycled products • Create a revenue stream for materials that would otherwise go to waste

Background

Food waste takes many forms, and one type of food waste that can be overlooked is the by-products from food processing. When processing food for human consumption, often only certain parts of the crop (vegetables, grains, and fruit and nuts) are used, with the remainder discarded as waste. An example of this is the processing of whole potatoes to create products such as French fries or hash browns, where potato peel is often leftover as a waste product.

Much of this food processing waste is either disposed of, used as animal feed, or turned into compost. Although the latter two are environmentally sound options, there are opportunities to add further value and extend the life cycle of the products, generating added revenue for manufacturers. With some creativity and innovation, almost every part of a crop can have a potential high value use.

Our study found that annually, Wine and Spirit manufacturing, Fruit and Vegetable Product manufacturing and Food Product manufacturing in the Murraylands and Riverland region generate an estimated 18,000 t, 16,700 t and 9,300 t of organics waste, respectively. Current uses include stock feed, compost and industrial alcohol (winery waste).

The Opportunities

There are a number of opportunities to add value to the by-products of food processing and move the food waste to uses higher up the waste hierarchy/value chain. A number of crops in the region, including citrus, stonefruit, almonds, potatoes, onions, carrots and seeds from processed winegrapes, can be used for their nutraceutical and bulk food properties, extracting elements such as antioxidants, carotenoids, glucose, flavonoids, starch and bio-oils. These products have a range of applications in different industries including cosmetics, food and beverages, pharmaceuticals and nutraceuticals. For example, antioxidants have been recognised for their anti-inflammatory and anti-cancer properties[24]. Similarly, carotenoids have been found to offer a range of health benefits and have commercial pharmaceutical applications and are also widely used as natural food colourants[25]. Flavonoids are a class of antioxidant found in various fruits and vegetables. They have a range of health benefits and can be extracted and added to food and beverages[26]. A common by-product for the wine industry in the region are grape seeds and skin, the extract of which contains antioxidants and nutraceuticals and can be sold for use in dietary supplements[27]. Glucose has been found in high levels in potato, citrus and carrot, and is utilised in a range of industries such as food and beverage, pharmaceuticals, cosmetics, paper making, etc[28]. Starch and modified products have a wide range of applications including food and beverage, paper manufacture and pharmaceuticals. Potato starch is a particularly relevant opportunity for the region as a significant amount of potato waste is generated annually[29].

Finally, bio-oils provide an opportunity to value-add underutilised by-products. The use of bio-oils can help to reduce our dependence on fossil based petro-chemicals. Most bio-oils are biodegradable and renewable, and, if their production uses wastes, does not compete with existing food, land or water resources. Bio-oils derived from food waste have the added benefit of using cheap and easy to access raw material (i.e., food

waste), in turn reducing the amount of food waste being disposed of. A range of crops in the Murraylands and Riverland have bio-oil production potential, including citrus, stonefruit, almonds, potatoes, onions and carrots.

These value-adding opportunities can offer significant benefits to the regions. For example, the *Transforming Riverland Food Loss and Industry Waste into Profit* project identified some 75,000 tonnes of processing waste (almond skin and shell, grape marc), currently used as stockfeed and as a compost input, which could generate a potential $40 million or more in sales[30] in high value products (nutraceuticals) if appropriate investments were made in the region.

What next?

- Identify crops with value-adding potential in the region
- Identify manufacturers with capacity and desire to value-add otherwise discarded products
- Gauge the interest in value-adding waste in the region by undertaking an expression of interest study with relevant stakeholders
- If by-products can be refined within the region, identify a market for these extracted products (e.g. carotenoid, starch)
- Determine investment required to enable high-value processing / markets
- If capacity to process and value-add cannot be identified within the regions, identify manufacturers elsewhere and assess costs and logistics of transporting food processing by-products elsewhere for further processing/extraction.

Key stakeholders

- Fight Food Waste CRC
- CSIRO
- Citrus SA
- Potatoes SA
- Onions Australia
- Riverland Wine
- Almond Board of Australia
- Ausveg SA.

Case study: Simple Syrup and Viva Olives (Riverland)

Simple Syrup is an example of how innovative and creative strategies can add value to existing by-products from food processing. Olive brine is a key ingredient in the dirty martini cocktail, and bartender Jason Crawley, a Sydney based bartender, noticed that when using the traditional jarred olives as a source of brine, he was left with a surplus of dried olives. Instead of continuing to waste these remaining olives, he contacted olive companies and farmers directly and asked for their surplus brine. He settled on Viva Olives, based in the Riverland, as the supplier of olive brine. Olive brine is salty and fermented, requiring filtration at the producers' expense prior to disposal. This value-adding opportunity therefore allows bartenders to purchase isolated brine for their cocktails (i.e. the Simple Syrup product) without wasting olives, while providing olive producers the opportunity to sell a product that they would otherwise pay to dispose of.

Case study: Tarac Technologies (Nurioopta, Berri and Griffith)

Tarac Technologies was established in 1930 to tackle the immense amount of waste generated from the wine industry, treating around 130,000 tonnes of grape marc, more than 40 million litres of liquid waste and approximately 3,000 tonnes of solid waste annually. In doing so, they tackle the important environmental issue of disposing of this amount of waste, while also value-adding solid and liquid winemaking residuals in a range of ways. All the products they create are repurposed back into the wine industry, creating a closed loop system. These include grape alcohol (added to fortified wines), tannins, tartaric acid, grape juice concentrate and grape seeds. They also produce processed grape marc which has broader agricultural applications, including as stock feed and supplementation, or for mulching and soil conditioning. Tarac's broad repurposing of an industry's by-products provides an example of circular economy in action.

5.1.3 Opportunity 3 - Converting food waste to high-quality, safe animal feed

What	Turning food waste into high quality, safe animal feed (or animal feed ingredients)
CE strategy	Design out waste
Main industries/partners	Food growers, food manufacturers and food service businesses
Expected outcomes	• Reduce food waste volumes • Attract investment in the region for development of facilities to process food waste into animal feed • Displace conventional animal feed products and lower associated environmental impacts • Create a revenue stream for materials that would otherwise go to waste

Background

Australia currently produces an estimated 17.8 million tonnes of food waste per annum, of which 6.5 million tonnes is diverted to animal feed[31]. The food waste used for animal feed can be a combination of on-farm waste or food processing by-products and is often fed to animals as is. In addition to the waste leftover from food processing for human consumption, mixed food waste is created by consumers at the household or commercial level at later stages in the supply chain. If the right waste management systems are in place, food scraps from restaurants and commercial kitchens can be separated as organic waste and turned into mulch and compost, otherwise it is often sent to landfill. While composting is better than sending food waste to landfill, where the food waste stream is appropriate, animal feed is a higher value use than turning food waste into compost.

The Opportunities

Although some food waste is used as animal feed, livestock in Australia are mostly fed cereal and cereal by-products, and other food waste streams are limited due to associated food safety/biosecurity risks. Where food waste is used, it is often an informal arrangement between the primary producer and business with transport costs and quantities negotiated as required. It is critical that food waste sent for animal feed is uncontaminated and any feeding of material to animals must conform to the *Livestock Act 1997*. Material fed to animals generally comes from consistent, less mixed sources such as food manufacturing[32].

Some countries (e.g., Japan, South Korea) produce animal feed from mixed food waste sources by treating it and turning it into a safe, purposefully designed animal feed. For example, in doing so, Japan recycles 52 per cent of food industry surplus into safe and nutritious animal feed[33]. As omnivores, pigs can consume a range of products, making the pork industry a useful way to dispose of food waste. Many other livestock, however, are herbivorous, and their feed should ideally be made of plant matter. Using the example of Japan's recycled animal feed industry as inspiration, the opportunity exists to treat food waste and convert it into safe, purpose-made animal feed. This opportunity could specifically tackle large volumes from food processing to industrially convert waste into standardised, safe animal feed.

Opportunities also exist to convert food waste into high-quality animal feed using bioconversion technologies, where waste is fed to insects and larvae which are then used to create protein-based feed for the pet, aquaculture, and livestock markets. Bioconversion is a sustainable way to add protein and nutrients to animal feed, while simultaneously disposing of food waste.

For example, black soldier fly (BSF) larvae consume four kilograms of mixed food waste per one kilogram of larvae in their two-week lifespan. They require very little land and water, leaving a minimal environmental footprint and can be harvested after two weeks and turned into animal feed[34]. Furthermore, BSF is not an invasive species. Once they reach adulthood, they do not eat, but rely on the nutrients they absorbed as larvae, and so do not attack crops[35]. Technologies to turn mixed food waste into animal feed using

BSF are highly scalable. They range from small and modular (less than 2,000 tonnes per year)[36] to large scale (greater than 20,000 tonnes per year)[37].

Insects and larvae are rich in protein and nutrients and adding them to animal feed is an innovative way to simultaneously increase feedstock quality while reducing food waste. Additionally, the manure by-product of the larvae (called frass) can be collected, composted, and used as an organic fertiliser, continuing the circular process of food creation.

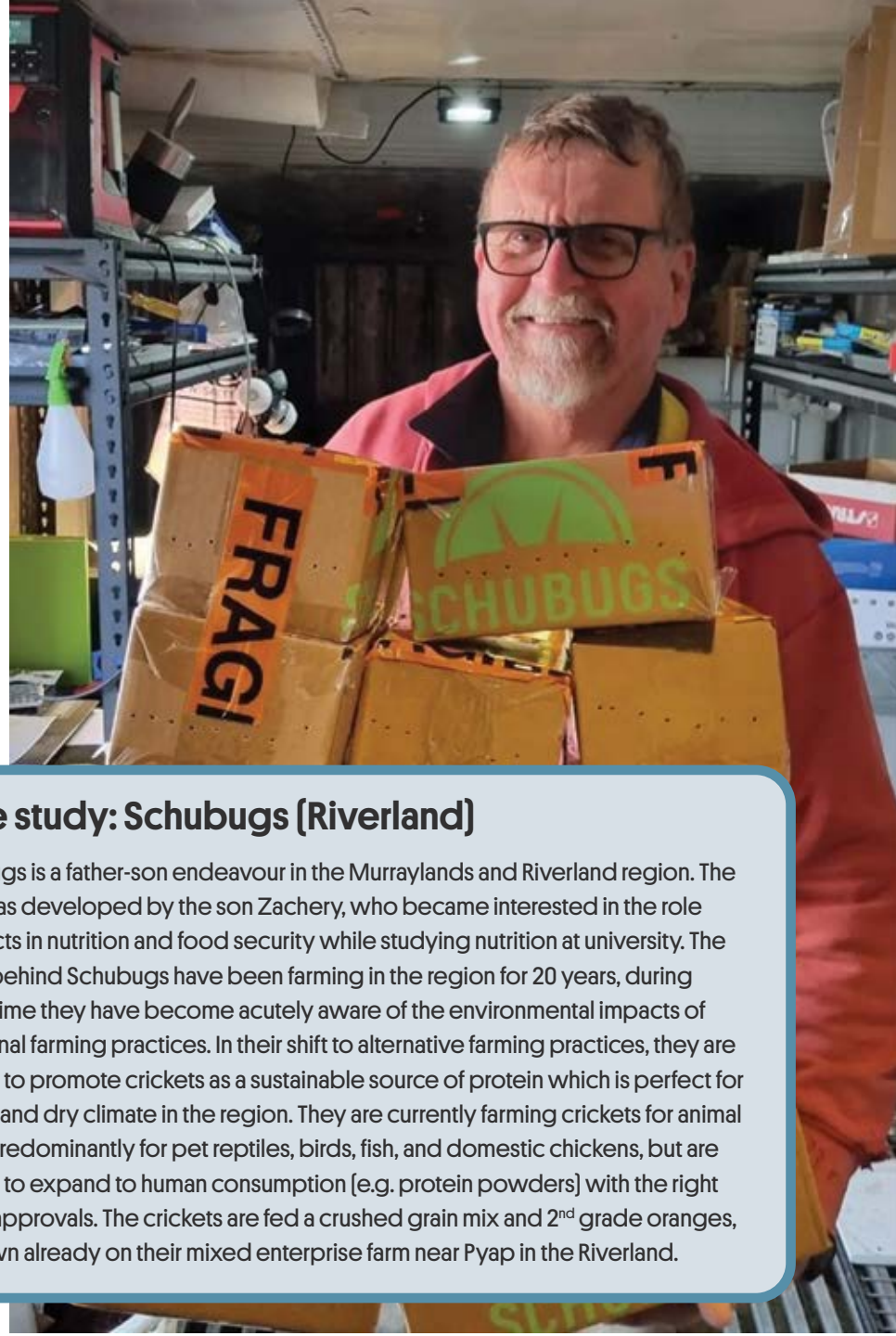
Crickets are another example of a quick growing and low impact insect, rich in protein and vitamins. While crickets are used for human consumption in many parts of the world, they are mostly used as animal feed in Australia at this stage. Unlike BSF, crickets are more selective in the food waste that they will consume. They are bred as feed for pets such as reptiles, fish and birds, but producers are aiming for human consumption of crickets in the future due to their value as a sustainable source of nutrition.

What next

- Identify sources of food waste in the region that could be value-added into animal feed (e.g. commercial kitchens, farms with large scale waste, breweries with leftover brewing mash, etc.)
- Identify enterprises that have the capacity or desire to turn food waste into animal feed
- Gauge the interest in value-adding waste in the region by undertaking an expression of interest study with relevant stakeholders
- Educate farmers and large-scale waste producers about the process of bioconversion, allowing them to explore the option of value-adding their own food waste
- Promote the purchase and use of insects and larvae as animal feed among both individuals (e.g. pet owners) and farmers (e.g. livestock).

Key stakeholders

- Fight Food Waste CRC
- CSIRO
- Citrus SA
- Potatoes SA
- Onions Australia
- Riverland Wine
- Almond Board of Australia
- Ausveg SA.



Case study: Schubugs (Riverland)

Schubugs is a father-son endeavour in the Murraylands and Riverland region. The idea was developed by the son Zachery, who became interested in the role of insects in nutrition and food security while studying nutrition at university. The family behind Schubugs have been farming in the region for 20 years, during which time they have become acutely aware of the environmental impacts of traditional farming practices. In their shift to alternative farming practices, they are hoping to promote crickets as a sustainable source of protein which is perfect for the hot and dry climate in the region. They are currently farming crickets for animal feed, predominantly for pet reptiles, birds, fish, and domestic chickens, but are hoping to expand to human consumption (e.g. protein powders) with the right health approvals. The crickets are fed a crushed grain mix and 2nd grade oranges, all grown already on their mixed enterprise farm near Pyap in the Riverland.

5.1.4 Opportunity 4 - Adopting regenerative agricultural practices

What	Adopt regenerative agricultural practices
CE strategy	Reclaim, retain, and regenerate natural systems
Main industries/partners	Farmers, organics processors
Expected outcomes	• Increased farm profitability through reduced farming inputs (water, agrichemicals and fertiliser, fuel) and increased productivity • Increased resilience to extremes of weather (drought, flood) and farm input supply and price fluctuations • Increased sequestration of carbon in agricultural soils and improved soil health

Background

Soil is one of the earth's most important natural resources and is essential for healthy plant growth, food production and ecosystem services such as clean, plentiful water and air. Soils help regulate the earth's climate and are the largest store of land-based carbon[38], making soil regeneration a key plank in efforts to combat climate change and increasing extremes of weather. However, Australian soils are degraded and are prone to further degradation and reduced productivity through erosion and loss of soil function[39]. This threatens not just farm productivity and profitability, but also our food security, access to water and ecological health.

There is a need to support a growing movement of farmers and rural leaders dedicated to farming in ways that improve soil and bring life and improved productivity back to the land through regenerative agricultural practices.

Why have our soils been degrading?

Many of our agricultural systems have not been designed with maintenance or regeneration of soil health as a priority. For example:

- Historical overgrazing has led to loss of protective groundcover making soil more prone to erosion, increased salinity, and decreased soil and water quality[40].
- Practices such as repeated tilling can erode the soil and release large amounts of carbon dioxide into the atmosphere. Some tillage may be necessary, however, repeated ploughing becomes counterproductive, as it degrades the soil structure and destroys the soil biology resulting in compacted, low carbon soil that holds less water and nutrients. This degraded soil then requires heavy fertilizer application to produce crops or pasture, which damages it even further and can contribute to soil acidification.
- If paddocks are repeatedly sown with one type of crop/pasture and no other ground cover, this homogeneity limits the variety of soil microbes and nutrients returning to the soil, creating a build-up of some nutrients and a lack of others. Disrupting the balance and natural health of the soil can lead to a reliance on fertilizers or pesticides, which then perpetuates the problem[41].

The Opportunities

Regenerative agriculture is quickly growing in popularity as an alternative system of farming principles, aimed at rehabilitating farm ecosystems by improving resource use, with a particular focus on soil health. Key regenerative agriculture practices include low- or no-till farming, mixed crop rotations, ground cover, rotational grazing, and the use of organic fertilisers and manure. By adopting low- or no-till practices, farmers minimize soil disturbance which increases levels of organic matter over time and creates healthier and more resilient soil. Low- or no-till practices also avoid carbon that is otherwise stored in the ground from being released into the atmosphere and adding to global GHG emissions. Rotating mixed crops and adding ground cover crops ensures that the soil is infused with more diverse organic matter, creating rich and nutrient-dense soil which can promote higher crop yields. Rotational grazing is a livestock management practice where herds are moved between pastures to ensure each area has time to rest to avoid over-grazing and related issues with soil health. The use of recycled organics products like compost, organic fertilisers and manure instead of chemical and acid-based fertilisers can improve soil health by balancing the natural nutritional composition and reduces chemical risks to crop and livestock health. The idea of regenerative agriculture is to give the land the opportunity to restore itself naturally and promote longevity of the soil as a natural resource.

A recent study[42] estimated that 123,400 dry t of recycled organics is applied to agriculture soils across 21,500 ha in South Australia annually, resulting in additional 34,700 tonnes of soil organic carbon on-going and $190 million in additional GSP from improved farm productivity. These productivity benefits came from reduced irrigation demand/improved water use efficiency, reduced reliance on inorganic fertilisers over time, increased quality and consistency of crop yield, improved pasture feed quality, improved shelf life of crops post-harvest and reduced fuel use and wear on machinery used for inputs and tillage.

There are numerous benefits of regenerative agriculture practices. For example, increased soil biodiversity and organic matter leads to more resilient soils that can better withstand climate change impacts like flooding and drought. Healthy soils produce stronger yields and more nutrient-rich crops, increasing productivity, profitability and food security. Regenerative agriculture also diminishes erosion and runoff, resulting in improved water quality both on and off the farm. Additionally, regenerative agriculture practices help fight climate change by taking carbon from the atmosphere and sequestering it in the ground. Plants take carbon dioxide from the air and transform it into carbon used to grow leaves, stems, and roots. Excess carbon is then transported down the plant and is stored in the surrounding soil, sequestering the carbon in the ground. This carbon in the soil feeds microbes and fungi, which then provide nutrients for the plant. If the ground is not ploughed or tilled, this carbon can remain stored in soils for thousands of years.

There is the opportunity to increase the use of regenerative agriculture practices in regional farms, improving soil health and environmental sustainability while simultaneously increasing yield and profitability. The regenerative approach can include any system of principles, practices and decision-making aimed at rebuilding soil and landscape health, and the opportunity exists for every farmer to take steps towards more sustainable practices.

What next?

- Educate farmers about the importance of regenerative practices. This could include workshops, training, videos, etc. to clearly and effectively present the benefits of shifting to regenerative agriculture.
- Emphasise the way regenerative practices will benefit the farmers directly, such as improved yield and profitability of their crops, as well as the increased resilience of healthy soil (e.g. resilient to impacts of drought or excessive rainfall).
- Include larger-scale benefits such as carbon sequestration as a tool to fight climate change, and the benefit this will have for farmers (e.g. better resilience during extreme weather events)
- Showcase existing regenerative projects in the region, highlighting applicability to their own region, agroecological zone and enterprise type
- Option to subsidise required tools or training for farmers to get them started with regenerative practices
- Option to organise study tours for farmers to travel to other regions in Australia and see regenerative farming in action across a range of soil types and climates
- Look to the Soils For Life project 'Paddock Labs'[43] in the Northern & Yorke and Eyre Peninsula districts of South Australia, and implement something similar in the RDAMR region.

Key stakeholders

- Landscape Boards
- Agricultural Bureau of South Australia and local branches
- Ag Excellence Alliance
- Regen Farmers Mutual
- Lucerne Australia
- Department of Primary Industries and Regions (PIRSA)
- SARDI
- Grasslands Society of Southern Australia
- SA No-Till Farmers Association
- Society of Precision Agriculture Australia
- Pulse Australia
- Sheep Connect SA
- Dairy SA.

Case study: Gurra Downs, Gurra Gurra

Gurra Downs is an organic date palm plantation located in the Murraylands and Riverland RDA. They focus of regenerative and sustainable practices and have been fully certified organic since 2003. Gurra Downs use grazing sheep, geese, turkey and guinea fowl as pest and weed control, eliminating reliance on herbicides and insecticides. They also use intercropping as a means to maintain soil health, by planting cereal and legumes between their date palms which are then used as geese and sheep feeds, as well as pomegranates and figs which provide wind breaks and an additional income source. The self-sustaining system applied at Gurra Downs is an example of regenerative agriculture in practice, relying on natural means to enhance soil health and, in turn, healthy crops and yield.

5.1.5 Opportunity 5 - Using seaweed supplementation in livestock to reduce methane emissions and improve productivity

What	Feed livestock seaweed feed additive to reduce their GHG emissions and improve productivity
CE strategy	Increase performance/efficiency of product + design out waste (emissions)
Main industries/partners	Livestock industry
Expected outcomes	• Reduce the carbon footprint of the livestock industry • Improve animal health, feed conversion and productivity

Background

There are several greenhouse gases which have been attributed to climate change, one of which is methane (CH_4). It has been suggested that methane has contributed to roughly 30 per cent of global warming since pre-industrial times and is proliferating at a rapidly growing rate[44]. Livestock (mainly ruminants, such as cattle and sheep) are responsible for 5.8 per cent of total greenhouse gas emissions globally[45] and research indicates that a reduction in farming-related methane emissions will play a key role in climate change mitigation. Ruminants produce methane as part of their digestive process, called 'enteric fermentation'[46], so beef and lamb are regarded as having a high carbon footprint. As the global population grows, the demand for meat and dairy increases. There are currently about 1.5 billion cattle globally, with each animal releasing 70 to 120kg of methane into the atmosphere each year. It is estimated that, when combined, the global population of grazing animals (including cattle) contribute about 40 per cent of the annual methane gas emissions[47]. One way to reduce the carbon footprint associated with livestock is to produce and eat less meat. However, a multi-pronged approach is needed to tackle this challenge and there are emerging technologies that might provide innovative solutions.

Reducing the amount of methane emitted by the animals themselves would significantly reduce the carbon footprint of the livestock industry.

Our study estimated that approximately 80 per cent of total regional GHG emissions are generated by livestock subsectors, of which the main contributors are Sheep (285,300 tCO_2e, 31%), Beef Cattle (270,800 tCO_2e, 29%), Pigs (111,400 tCO_2e, 12%) and Dairy Cattle (68,100 tCO_2e, 7%). These emissions are driven by enteric fermentation.

Research has shown that, when fed to ruminant livestock, the seaweed from the genus *Asparagopsis* provides an overwhelming reduction of methane in their digestive process. Adding around 5g of *Asparagopsis* seaweed per kg of dry feed matter lowers methane emissions by over 80[48]. It works because, when fed to ruminants, compounds in the seaweed disrupt the enzymes of their gut microbes that produce methane during digestion[49]. The process was scientifically tested and demonstrated by CSIRO, James Cook University, and Meat & Livestock Australia, who have since created FutureFeed Pty Ltd. Not only does seaweed consumption reduce methane emissions, it has also been shown to improve animal health, feed conversion and productivity.

The Opportunities

This technology has created a significant opportunity for the agricultural sector across Australia to contribute to reducing methane emissions, with the bonus of increasing livestock productivity. There are currently three companies licenced to produce and sell *Asparagopsis* for input into feed supplements for ruminant livestock in Australia. International company CH4 Global was the first company to get an IP licence from Future Feed Pty Ltd. to produce seaweed supplements using their technology. CH4 has launched a hub in Adelaide and, working alongside SARDI, aims to commercialise seaweed production in SA projected as a $140 million industry. They are developing a manufacturing facility on the Eyre Peninsula, ensuring the whole production chain from seaweed harvest to processing can occur within SA.

The opportunity exists for livestock farmers in the region to purchase the seaweed-based livestock feed supplements and improve their productivity while marketing the sustainability of their products. Marketing products as sustainable and having a low carbon footprint could also help to improve sales or increase product value, as consumers are more environmentally conscious and drawn to green marketing[50]. Additionally, manufacturing seaweed supplements for livestock within SA creates the opportunity for local suppliers to sell the products, expanding the supply chain (see case study).

We have estimated that the Murraylands dairy sector could potentially reduce GHG emissions using this technology by approximately 38,500 tCO_2e annually. Likewise, the cattle in the region, if supplement feeding *Asparagopsis* seaweed for finishing steers could potentially reduce GHG emissions by around 16,000 tCO_2e annually.

There is potential for use in the sheep sector, too, however as sheep aren't routinely supplement fed this opportunity is not quantified.

What next

- Educate farmers about the emerging technology, and encourage them to try it
- Once available, incentivise farmers to use the product, including marketing and financial incentives. This might include supporting the development of a methodology to claim Australian carbon credit units via appropriate seaweed-based feed supplementation.
- Educate the general public about the product, including the reduction to their carbon footprint if they purchase meat and dairy from farms who use the product. This might incentivise them to choose these products.
- Investigate appropriate certified labels (similar to organic certification) that allows consumers to accurately identify brands that use seaweed supplements to reduce livestock GHG emissions.

Key stakeholders

- CSIRO Future Feed
- Meat & Livestock Australia
- CirPro
- CH4 Global
- Regional livestock farmer groups.

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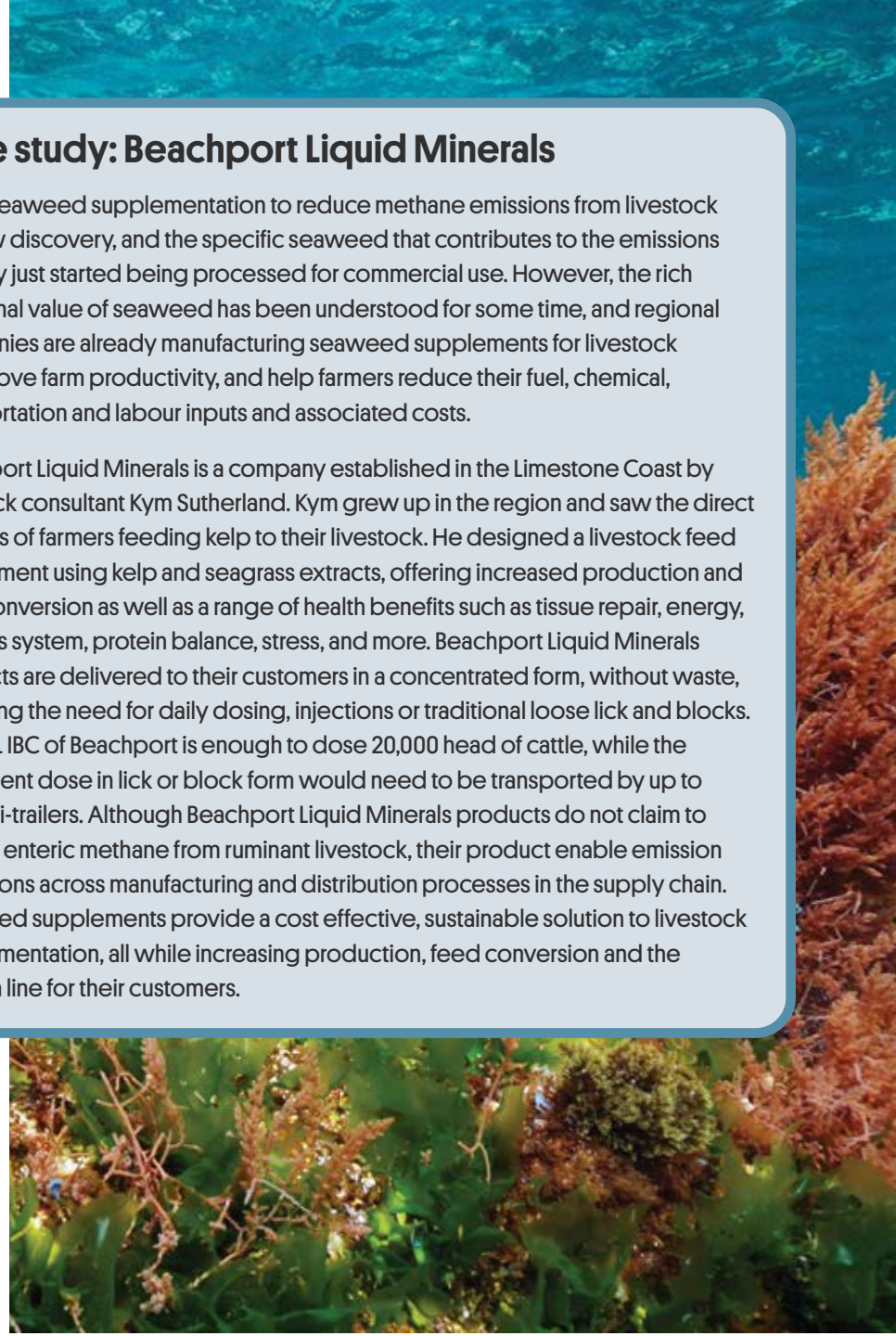
Case study: Beachport Liquid Minerals

Using seaweed supplementation to reduce methane emissions from livestock is a new discovery, and the specific seaweed that contributes to the emissions has only just started being processed for commercial use. However, the rich nutritional value of seaweed has been understood for some time, and regional companies are already manufacturing seaweed supplements for livestock to improve farm productivity, and help farmers reduce their fuel, chemical, transportation and labour inputs and associated costs.

Beachport Liquid Minerals is a company established in the Limestone Coast by livestock consultant Kym Sutherland. Kym grew up in the region and saw the direct benefits of farmers feeding kelp to their livestock. He designed a livestock feed supplement using kelp and seagrass extracts, offering increased production and feed conversion as well as a range of health benefits such as tissue repair, energy, nervous system, protein balance, stress, and more. Beachport Liquid Minerals products are delivered to their customers in a concentrated form, without waste, removing the need for daily dosing, injections or traditional loose lick and blocks. A 1,000L IBC of Beachport is enough to dose 20,000 head of cattle, while the equivalent dose in lick or block form would need to be transported by up to six semi-trailers. Although Beachport Liquid Minerals products do not claim to reduce enteric methane from ruminant livestock, their product enable emission reductions across manufacturing and distribution processes in the supply chain. Their feed supplements provide a cost effective, sustainable solution to livestock supplementation, all while increasing production, feed conversion and the bottom line for their customers.



5.1.6 Opportunity 6 - Adopting circular alternatives to linear CCA products

What	Substitute a hazardous timber preservative (CCA) with more sustainable alternatives in common agricultural/ outdoor applications
CE strategy	Toxic material substitution
Main industries/partners	Forest Products, Grape Growing and Horticulture industries
Expected outcomes	• Address a mounting hazardous waste problem • Investment in the region and job creation through alternative products and services

Background[51]

Treated timber is commonly used as a trellis for grape vines, orchards, as well as fence posts, garden furniture, structural applications, paths and boardwalks. There are a number of treated timber options, designed for different applications and weather conditions, pests or fungi.

Copper chromated arsenate (CCA) timber, also called 'permapine' is commonly used and contains a water-based heavy metal mixture including arsenic, chromium and copper. An economically and environmentally sound disposal technology for managing large quantities of this timber once it reaches the end of its useful life is currently not available across South Australia.

Many industries in South Australia widely use CCA timber, leading to growing quantities of treated timber waste being generated and stockpiled. Given the recent global reviews of CCA-treated timber for toxicity risk assessment and leachate generation, the EPA promotes precautionary management of waste CCA timber. In 2008, it was estimated that 1,000,000 CCA treated timber posts were being stockpiled in South Australia each year[52].

Burnt treated timber posts and treated timber ash is also highly hazardous. The heavy metals in treated timber ash present risks to ground- and surface-water quality, human and animal health, and soil quality. Accumulation of these heavy metals may make the land unsuitable for agriculture. Thousands of CCA posts were burnt in the 2020 bushfires in South Australia across over 400 properties and required careful and expensive clean up by the State and Federal Government and landholders.

Replacing even a small percentage of hazardous CCA timber with more sustainable and circular alternatives would benefit the environment and the economy in South Australia.

In South Australia, the one currently available disposal option for CCA posts is to send to a suitably engineered and licenced landfill. The cost of sending CCA posts to landfill is an important part of considering the overall cost of ownership. This is because CCA timber is considered a hazardous material and is costly to responsibly dispose of. When the cost of transport, labour, landfill fees and handling is factored in, the overall disposal cost of CCA can be almost as high as the cost of purchasing the post.

Partial or complete restriction of CCA occurs in a number of countries including Japan, Indonesia, Sweden and Germany[53].

The Opportunities

There is a major opportunity to identify a comprehensive solution to the mounting problem of hazardous CCA timber posts. Ideally, this solution will:

- Identify/develop substitute products with the same performance qualities as CCA but without the environmental risks and costs involved with responsibly managing hazardous materials.
- Design such substitute products with a cradle-to-cradle lens, allowing them to be recovered for further use at the conclusion of their useful lives, potentially through repurposing the products or through further processing such as converting to biochar.

- Be readily available to those areas that are traditionally large consumers of treated timber products, for example vineyards.
- Provide for the environmentally safe disposal of existing stockpiles of used CCA treated timber.
- Provide opportunities for regional investment and generate employment opportunities.

What Next?

- Work towards the replacement of traditional CCA timber products through establishing a working group of key stakeholders to develop and implement solutions to address this major environmental issue.
- Explore the opportunity to introduce sunset legislation on the use of traditional CCA timber products.
- Engage with South Australian councils to explore procurement policies that prohibit the purchase of traditional CCA timber products.
- Engage with businesses that are major consumers of traditional CCA timber products to promote the use of alternative environmentally sustainable products.
- Explore more circular business models for the posts. For example, a model where farmers can 'lease' posts rather than buy them, and the supplier is responsible for post installation, maintenance, replacement, and end-of-life management. This model would incentivise suppliers to maximise the useful life of the posts by designing for repair, refurbishment, recycling etc. It would also minimise upfront costs that farmers would need to pay to replace existing posts.

Key stakeholders

- RDAMR and associated councils
- GISA
- PIRSA
- Environment Protection Agency South Australia)
- Green Triangle Forest Industries Hub
- National Institute for Forest Products Innovation (Mt Gambier Centre)
- Forest Research Mount Gambier (UniSA)
- Forest and Wood Products Australia
- South Australian Wine Industry Association
- Wine Australia
- Wine Industry Suppliers Association
- Regional grape and fruit growers.

Case Study: Roundwood Solutions

Roundwood Solutions, based near Mount Gambier, has moved away from the typical hazardous chemicals that CCA/H4 treatment contains and from the carbon emissions that process is responsible for. Compared to traditional creosote posts, its product, using a world-class treatment with carbon-neutral properties, offers:

- 90% less exposure to free creosote
- Vastly reduced odour
- Vastly reduced skin irritation upon handling
- Dry to touch.

Roundwood Solutions is leading the treated timber industry in helping the world achieve net-zero carbon emissions by providing environmentally friendly, superior treated timber products that are carbon neutral as well as being recyclable for the rural and viticulture industries. When its Tanapost® treated timber product reaches the end of its life Roundwood Solutions can take it back and turn it into another product, biochar, which then becomes a carbon soak for a further thousand years.

5.2 Utilities

5.2.1 Opportunity 7 - Better management of commonly recyclable materials locally

What	Manage commonly recyclable materials locally
CE strategy	Design out waste
Main industries/partners	Local government, recyclers
Expected outcomes	• Increased resource recovery • Increased diversion of resources from landfill • Aggregating material for local recycling industry

Background

Commonly recyclable materials include green waste, food waste, glass, paper, plastic, metals and textiles produced by both households in regional towns and on farms and managed by regional councils.

In 2018-19, of the 49 regional council areas in South Australia, 24 councils offered a 3-bin kerbside waste collection service (i.e. general, recyclables and green waste collections) which is a significant improvement on one regional council offering such a service 15-years earlier. Only seven regional councils offer a one-bin (general waste) service, a significant change from 2003-04 when there were 33 regional councils doing so[54]. Regional areas remain a strong contributor of recovered resources to SA's recycling activity in 2019-20, providing 0.68 million tonnes of recovered material and responsible for 0.26 million tonnes of waste disposed to landfill in SA (a recovery rate of 72.6%). However, within this overall picture, household kerbside performance across regional SA is lower at a recovery rate of 37.7%[55].

Our study estimated that households in the Murraylands and Riverland region generate about 35,000 tonnes of waste. Of these wastes, an estimated 34 per cent is recovered and approximately 66 per cent is sent to landfill. Of the estimated 23,200 t unrecovered waste approximately 12,000 t are materials that are potentially recoverable.

Local government waste management services in the Murraylands and Riverland managed 16,000 tonnes of general waste, 4,500 tonnes of comingled recycling, 4,000 tonnes of organics recycling and 21,000 tonnes of materials through transfer stations in 2020. A 35% landfill diversion rate was achieved from materials collected from kerbside bins across the region[56].

Local governments were already facing significant waste and recycling challenges from growth in waste generation before the additional impact of China's restrictions on waste imports. These challenges are compounded by growing community expectations for recycling.

The Opportunities

Our study estimated that approximately 38% by weight (8,800 tonnes) of the waste in the kerbside general waste bins is organics, mainly food waste. A significant opportunity exists for councils in the Murraylands and Riverland to accept food waste, where this isn't already occurring[57], into the kerbside green waste bins (where this service is offered) and to roll-out a food-waste-green-waste (FOGO) service in areas where a 2-bin service is offered currently. Combined with other significant volumes of organic waste produced across various sectors in the region, these wastes can be readily processed by the organics recycling sector in the region and sold back as compost into local agriculture where demand for soil improvement products is significant (refer regenerative agriculture opportunity). Besides the obvious 'circularity' of this

opportunity, there are multiple benefits to councils and local communities, including preserving precious landfill space, significantly reducing the amount of leachate and landfill gas that needs to be managed, reducing greenhouse gas emissions (from landfill gas), lowering the risk of ground water contamination (from leachate), improving local agricultural soils and helping local residents recycle. The frequency of the FOGO and residual waste bin collections has a large influence on the effectiveness of organics recovery, which should be considered at the time of any system change.

There is also an opportunity to improve collection and processing infrastructure and incentives to collect, aggregate/sort and process commonly recyclable materials locally in the region. Rather than adopting metropolitan systems (which are based on large volumes from a relatively small geographic area), new models focussed on cost-effectively aggregating single streams of marketable waste and avoiding contamination are needed in the region. There are many tools and approaches that can be investigated and applied, including:

- Waste separation at source (see, for example, the Precycle case study in this report)
- Easy, free drop-off of separated, clean recyclable/reusable materials via well designed transfer stations, circular hubs (see Opportunity 11 and Brinkley ReUse Centre case study), 'muster' events or other convenient locations (e.g. schools, retail outlets, etc.)
- Incentives to bring clean, separated recyclables to aggregation points (e.g. container deposits) and disincentives to dump (e.g. vigorous enforcement of anti-dumping measures, education, etc.)
- Incubating directed innovation/new business models to address the challenges presented by regional waste management.

This opportunity needs to be addressed holistically in terms of waste collection, waste sorting and waste processing and at a scale that is both functional and cost-effective for the region. Ideally, this solution will provide regional communities with:

- An option that is attractive in terms of ease of use, cost and satisfying the community's appetite for recycling waste at a local level.
- Opportunities for regional investment and employment.

What next?

- Investigate rolling out Food Organics and Garden Organics (FOGO) kerbside collections in areas where the service is not available
- Investigate opportunities for greater source separation of municipal recyclables to deliver cleaner material streams that can be used locally (where opportunities exist – see opportunity 11) or be baled and sent to recycling markets.

Key stakeholders

- RDAMR and associated councils
- GISA
- Murraylands and Riverland Local Government Association
- Local waste, recycling and resource recovery service providers.

5.3 Manufacturing

5.3.1 Opportunity 8 - Developing recycled plastics manufacturing

What	Add value to waste plastics
CE strategy	Design out waste
Main industries/partners	Plastic recyclers, local government
Expected outcomes	• New or expanded business opportunities • Investment in the region and job creation for new, upcycled plastic products • Reduced plastic waste volumes • Reduced climate and plastic pollution impacts

Background

Every Australian generates an average of 101 kilograms of plastic waste per year, including 59 kilograms of single-use plastic waste. An estimated 130,000 tonnes of plastic leaks into the marine environment each year in Australia alone. Less than 12% of plastic waste is recycled and about 85% of plastic waste ends up in landfill. With new plastic waste export rules in place, innovative technologies are critical for supporting the increased recovery and domestic processing of Australia's plastic waste. Australia could help meet global and domestic demand for recycled plastics[58].

Strict rules governing the export of plastics, amounting to a virtual ban, came into effect on July 1, 2020, and further conditions were placed on exported plastic from the start of the 2022–23 financial year. Currently waste plastic can only be exported if it is sorted into single resin or polymer type or processed with other materials into processed engineered fuel. From July 1, 2022, only waste plastics that have been sorted into single resin or polymer type and further processed, for example flaked or pelletised, or processed with other materials into processed engineered fuel can be exported. The regulations have been designed to kickstart Australia's domestic plastic recycling infrastructure to ensure 70% of plastic packaging waste is either recycled or composted[59] by 2025[60].

There is a major opportunity for recycled plastics manufacturing in Australia. Examples of companies in Australia involved in recycled plastics manufacturing include:

- Ecoplas - collects and processes empty bottles (HDPE), and plastic bags / film (PE), into small flakes and granules which are then blended with a master-batch containing colour and UV-stabilisers, before extruding the final products such as durable poly fence droppers and park furniture. Based in Mount Gambier.
- Transmutation - hosts a plastic recycling workshop that can recycle the seven types of thermoplastics that are currently in the marketplace. Based in Robe
- Tenison Woods College's Project Recology - hosts an onsite plastic recycling depot with students creating large and small gardening pots, Christmas decorations, chopping boards and more recently sheets of colourful plastic. Located in Mt Gambier.
- Geofabrics - turns recycled plastic bottles into geotextiles for use in major construction and infrastructure projects. Based in Wingfield, SA.
- Integrated Recycling - turns recycled plastic and polystyrene into Duratrack railway sleepers. Based in Mildura, VIC.

- Plastic Forests - turns soft plastics into innovative products for a wide range of uses – from on the farm, to carparks and landscaping.
- The Green Pipe - turns recycled milk bottles into irrigation and drainage pipes.
- Enviromesh - turns recycled plastic into eMesh fibre reinforcement for concrete.
- UCI - turns PET bottles into workstation screens and acoustic panels.
- PACT Reuse - turns recycled plastic into freeway noise walls.
- Replas - turns soft plastic into Polyrok – recycled plastic aggregate.

The Opportunities

With nationwide policy encouraging the remanufacture of used plastics within Australia, there is a major opportunity for the Murraylands and Riverland region to develop mature, local plastic processing and remanufacturing capabilities. This opportunity will create demand for, and value add in the region with, opportunities to collect (Opportunity 11 – circular hubs) and separate into clean single material wastes locally (Opportunity 7 – sorting and processing commonly recyclable materials locally). Ideally, the development of mature, recycled plastics manufacturing capability in the region will provide regional communities with:

- An option that will satisfy the community's appetite for recycling plastic waste at a local level.
- Opportunities for regional investment and employment.

It is expected that there will be on-going support for projects investing in plastics remanufacturing through the State Government's Recycling Infrastructure Grants scheme[61].

What Next?

- Identify a suitable recycled plastics manufacturing demonstration project/s.
- Identify sources of funding for demonstration project/s feasibility study.
- Undertake the feasibility study and assuming viability, engage with potential funding sources to secure grant funding.
- Launch the recycled plastics manufacturing project/s which can then be used as a demonstration project for future projects.

Key stakeholders

- RDAMR and associated councils
- GISA
- Murraylands and Riverland Local Government Association
- CSIRO Ending Plastic Waste Mission
- The Association of Plastic Recyclers.

Case Study: Ecoplas[62]

Ecoplas, located in Mount Gambier, collects and processes used HDPE products into small flakes and granules. HDPE includes bottles for milk, cream, laundry detergent, shampoo, conditioner, bottle lids and poly pipe. These materials are then blended with a master-batch containing colour and UV-stabilisers, before extruding the final products.

Ecoplas products include fence droppers, picnic tables and benches. Ecoplas claims their products are strong, durable and long-lasting (with a life expectancy of 40+ years) and can be recycled again into new products, closing the loop on an otherwise problematic waste.

5.4 Construction and the Built Environment

5.4.1 Opportunity 9 - Developing modular, affordable housing from sustainable materials

What	Developing modular, affordable housing from sustainable materials
CE strategy	Design out waste
Main industries/partners	Residential builders, homeowners, social and affordable housing organisations, local government
Expected outcomes	• increase the speed of construction, ensure the quality and consistency of output and reduce the wastage of materials per build • Affordable, with flexibility to modify easily as homeowners needs change • Designed for easy deconstruction at end-of-life • Constructed from sustainable materials

Background

Housing affordability (rental and owner-occupier) and availability are key issues across regional Australia. Increasing the availability of affordable housing in regional communities can provide the following benefits:

- Supporting employers seeking to attract workers who require accommodation.
- Increasing the opportunities for retirees/downsizers to stay in a town where they are close to friends and family and the services they are accustomed to.
- Enabling people to move from rental accommodation to home ownership.

Prefabricated housing (prefabs or transportables) where homes are constructed off-site and delivered either in one piece or in several pieces which are joined together on site is already well established. Modular construction is somewhat similar in that building modules are constructed off site and then joined together on site to build a home.

This technique has the potential to increase the speed of construction, ensure the quality and consistency of output and reduce the wastage of materials. In regional locations, where trades can be difficult to source, it means that carpenters, electricians, tilers and plumbers aren't required to be brought in from areas outside of the region. Another advantage is that modular housing can be constructed in warehouses so tend to be unaffected by unfavourable weather conditions.

Modular housing also has several other potential advantages:

- Homes are expandable ranging from micro-housing to large family homes. That is, a more affordable home can be built initially, for example a two-bedroom home with one bathroom can be expanded to a three-bedroom, two-bathroom home with a larger living room as the family grows.
- End-of-life considerations can be factored in at the design stage.
- Modules can be constructed from sustainable materials, ideally sourced near the construction site.

The Opportunities

There is an opportunity to establish modular housing manufacturing enterprises in regional locations, particularly in those areas where sustainable building materials can be sourced. Ideally, modular housing manufacturing enterprises will:

- Provide opportunities for regional investment and generate employment opportunities
- Provide communities with access to affordable housing options constructed from sustainable materials, including mass-engineered wood, with end-of-life considerations factored in at the design stage.

The Limestone Coast region is a significant source locally produced mass-engineered timber (e.g. glue laminated timber and cross laminated timber products), and there is a significant opportunity to use these materials in building modules in the region.

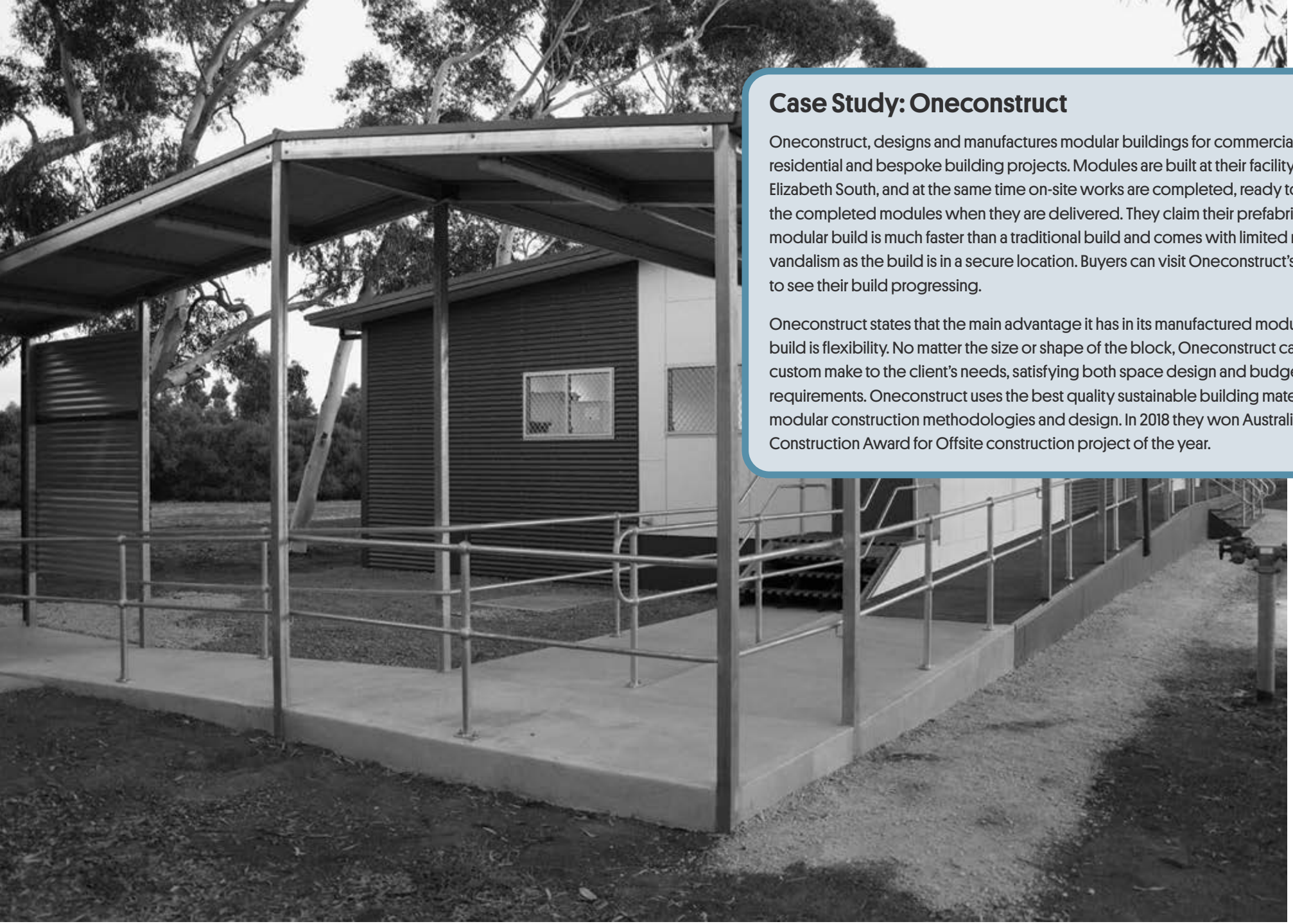
Given the current housing affordability and availability challenge in the regions, there is a key opportunity for local government to facilitate these types of construction by working closely with developers and builders to ensure compliance with planning and building regulations as defined by the *Planning, Development and Infrastructure Act 2016*, and where impediments to the development of affordable housing are identified, lobbying for relevant changes to the Act.

What next?

- Identify potential locations for the establishment of modular housing manufacturing enterprises.
- Identify potential investors with the relevant skill sets.
- Undertake a pre-feasibility study to determine the viability of the enterprise/s.
- Assuming viability, undertake a comprehensive feasibility study and prepare a business case including an assessment of the capital required and the project viability.
- Assuming financial viability, secure funding for the project and develop and establish the modular housing manufacturing enterprise/s.

Key stakeholders

- RDAMR and associated councils
- GISA
- SA Housing Authority
- Junction Australia
- Believe Housing Australia.



Case Study: Oneconstruct

Oneconstruct, designs and manufactures modular buildings for commercial, residential and bespoke building projects. Modules are built at their facility at Elizabeth South, and at the same time on-site works are completed, ready to take the completed modules when they are delivered. They claim their prefabricated, modular build is much faster than a traditional build and comes with limited risk of vandalism as the build is in a secure location. Buyers can visit Oneconstruct's facility to see their build progressing.

Oneconstruct states that the main advantage it has in its manufactured modular build is flexibility. No matter the size or shape of the block, Oneconstruct can custom make to the client's needs, satisfying both space design and budget requirements. Oneconstruct uses the best quality sustainable building materials, modular construction methodologies and design. In 2018 they won Australian Construction Award for Offsite construction project of the year.

5.4.2 Opportunity 10 - Deconstructing and re-using construction modules and materials

What	Deconstruct buildings smartly and maximise reuse of building components and materials
CE strategy	Design out waste
Main industries/partners	Construction industry, building designers, civil and quarry contractors, local government
Expected outcomes	• Reduced construction and demolition (C&D) material to landfill • Reduced cost of waste removal from construction and demolition sites • Increased use of secondary materials – reduced embodied carbon in buildings and infrastructure • Investment in the region and job creation for additional material recovery services

Background

In 2018 19 about 22.9 Mt, or 909 kg per person, of waste masonry materials were generated in Australia[63]. The masonry materials category includes heavy waste types such as concrete, bricks and rubble and is mostly recorded in the construction and demolition (C&D) stream. Masonry materials are recovered from most large demolition projects but less so from smaller projects, which often generate mixed material loads that are sent directly to landfill. Ideally reusable and recyclable waste will be separated onsite to minimise the amount of waste sent to landfill.

The 2018-19 recycling rate for masonry materials was 82% (18.7 Mt) nationwide, rising from 62% in 2006 07 and 76% in 2016 17. There are good markets for recycled concrete aggregate for use as road base, aggregates and hardstand areas. Recycled concrete aggregate 'packs down' well and forms a harder and more stable hardstand than pure virgin aggregate. There are also good options for recycling bricks and asphalt.

Our study estimated that the construction sector in the Murraylands and Riverland region generates approximately 11,800 t of construction and demolition waste (C&D), approximately three per cent of the region's total solid waste generations. Whilst much of this material is diverted from landfill, there is an opportunity to increase processing of C&D materials for beneficial reuse. This could involve processing the material to a specification and using it for civil applications in place of virgin products.

Ideally at end-of-use, the disassembly of buildings/structures will be undertaken as opposed to demolition. This results in higher value material being recovered and reduces waste. Reuse of construction components and materials also reduces the demand for virgin materials and the energy needed to produce them. This process can save up to 30% of material costs, while increasing associated labour costs by only approximately 5%[64].

It is important that there is a consistent supply of recycled material. Regional areas can be highly suited as low-cost land is available and recovery and recycling centres generate local employment opportunities.

The Opportunities

Moving forward it is important buildings are designed for deconstruction to optimise the reuse and recycling of construction materials. A building that is designed to be taken apart at the end of its life offers greater opportunities for resource recovery and, with time, design for deconstruction principles may be applied further up the supply chain to materials and building components[65]. In mass building products this can be achieved more readily through modularisation (see Opportunity 9).

There is also an opportunity to encourage recycling services that can support builders/demolishers on smaller projects to reduce and to separate waste on-site (see the Precycle case study below).

There is an opportunity to develop and establish C&D recovery and recycling centres in regional locations. This opportunity is best delivered by a quarry or civil contractor, who has capability, suitable equipment and end markets for the recycled products. The C&D volumes in a regional context are not generally large enough for cost effective processing by a standalone facility. Civil contractors can also control the deconstruction process to minimise contamination of reusable materials[66]. Ideally, these centres will:

- Minimise the amount of masonry waste being diverted to landfill.
- Make recycled C&D materials available locally to reduce freight movements and the associated environmental and social impacts.
- Provide opportunities for regional investment and generate employment opportunities.

Measures will need to be undertaken to prevent receival of asbestos, and asbestos containing materials, at the C&D recovery centre. These controls are imperative to mitigate the risks of asbestos management.

What next?

- Work with local building industry to develop a demonstration deconstruction process that is practical to the regional context
- Encourage recycling services that can support builders/demolishers on smaller projects to reduce and to separate waste on-site
- Undertake research to determine demand for demolition and rescued materials, potential user preferences and propensity to pay.
- Identify a suitable location for C&D recovery and recycling centre demonstration project.
- Develop the C&D recovery and recycling centre concept based on the research findings.
- Prepare a business case including an assessment of the capital required and the demonstration project viability.
- Assuming financial viability, secure funding for the project and develop and implement the demonstration C&D recovery and recycling centre.
- Assuming commercial viability, replicate the model in other regional locations.

Key stakeholders

- RDAMR and associated councils
- Master Builders Association of South Australia
- Green Building Council of Australia
- GISA
- Local civil and quarry contractors.

Case Study: Precycle

Precycle, based in Salisbury South Australia, is a successful service that removes and recycles discarded building materials from home construction sites and, importantly, has introduced the concept of the circular economy to an industry that has traditionally seen all waste as just waste. Precycle is not a recycler in the traditional sense; it collects the product and provides it to companies which will end up recycling or repurposing it.

An independent review showed an increase in landfill diversion of 76% for the Precycle process compared with 10% for a business-as-usual approach, and a reduction in the number of skip bin empties per house from of 3.8 to 1.1 (or 15m3 of mixed waste to 4.5m3). This equates to an estimated 1.4 tonnes of CO_2e avoided and 19.7 GJ of energy and 4.1 kilolitres of water saved per site.

Precycle undertakes predetermined recycling of building materials from the site at set stages. For example, when the footings are finished, Precycle comes in and collects unwanted reinforcing material; once the carpenters have the framework complete, Precycle comes in for timber or steel, and so forth. The key to the process is that each type of material is kept apart from the others, and what can be recycled is separated from the genuine waste, which goes into a bin in the usual way. The Precycle team works with builders and their contractors to get their processes right.

The Precycle business model works because, in most cases, it charges less than it would cost the builder to have multiple skip bins removed. Other benefits raised by builders include, neater, cleaner and safer work sites, reduced risk of illegal dumping, marketing as an environmentally conscious builder, less need for equipment such as bobcats, and a cleaner site makes it easier for stock estimation and delivery.

Precycle is a real alternative for building companies to adopt a modern, responsible and cost-effective approach to waste management on their sites.

5.5 Households and Communities

5.5.1 Opportunity 11 - Creating a regional Circular Hub

What	Community circular hub
CE strategy	Extend product life through reuse, maintenance; close finite material loops by remanufacturing, repurposing, recycling or recovering
Main industries/partners	Local government, local businesses, not-for-profit's/ community organisations, TAFE
Expected outcomes	• Reduced cost of living by enabling residents and businesses to borrow, repair, maintain, and salvage items rather than buy them new • Improved facilities and/or increased exposure for organisations delivering circular products and services • Intergenerational and intercultural transfer of skills and knowledge, strengthening community connection • Reduced demand for virgin materials and resources, and lower climate impacts

Background

The circular economy involves keeping products and materials in circulation for as long as possible. Residents can contribute to the circular economy in a range of ways, such as:

- Borrowing or leasing specialised equipment (like camping gear, and tools)
- Repairing broken items (like mending old clothing)
- Salvaging used items and giving them a second life (like rescuing old doors and other materials from buildings about to undergo demolition)

However, residents face barriers preventing them from living circular lifestyles, such as a lack of skills and knowledge on how to repair items, and a lack of access to circular products and services.

The Opportunities

The region has an opportunity to develop a community-based 'Circular Hub' which provides residents with convenient access to circular products, and services and can bring together a range of community partners together. The types of services and facilities potentially available at a Circular Hub are summarised in the table below.

Table 1: Circular Hub activities, facilities, and potential partners

Circular Hub activities	Circular Hub facilities	Potential partners
Repair broken items and upcycle items	Makerspace	TAFEs and local community groups
Borrow / lease specialist tools and equipment	Tools library	Local businesses and community
Buy recycled materials (e.g. compost, aggregate)	Circular shop (recycled materials department)	Councils, local composting facilities
Drop off materials/good for reuse and recycling	Resource Recovery facility	Council, charity, private operator
Buy salvaged building materials	Circular shop (salvaged materials department)	Local builders
Buy second-hand clothing and bric-a-brac	Circular shop (Op shop department)	Charities
Education on how to live more circular lifestyles (e.g., cooking classes)	Circular workshops	TAFEs and community groups
Grow vegetables	Community garden	Community groups

Developing a circular hub is expected to provide many benefits to the community. This includes:

- Reduced cost of living by enabling residents and businesses to borrow, repair, maintain, and salvage items rather than buy them new
- Improved facilities and/or increased exposure for organisations currently delivering circular products and services through the circular shops
- Intergenerational and intercultural transfer of skills and knowledge through the makerspace, community garden and workshops. In turn, this is expected to strengthen community connection and improve mental health and wellbeing of residents.
- Reduced demand for virgin materials and resources, and lower climate impacts.

There is a potential to co-locate the Hub with existing facilities where there are synergies, for example with resource recovery centres/transfer stations.

Inspiration for circular hubs

Retuna[67], in Sweden, provides inspiration for setting up circular hub. It claims to be the world's first recycling mall. Old items (which can be deposited for free at the mall) are given new life through repair and upcycling. Everything sold is recycled or reused or has been organically or sustainably produced. Another, quite different example, is Ceres[68] – an environmental education centre, community garden, urban farm and social enterprise hub spread across four locations, linked by the Merri and Darebin Creeks on Wurundjeri Country, Melbourne. Their social enterprises include Fair Wood which supplies salvaged timbers, and Ceres also hosts a weekly Makers and Flea Market where businesses can trade handmade, vintage, up-cycled and pre-loved goods.

What Next?

- Identify potential partners for setting up a circular hub, including investors, service providers, non-profit organisations, local businesses, other. This could be done through an Expression of Interest.
- Explore possible locations for establishment of circular hub. This could include co-location with existing sites, such as transfer stations.
- Explore potential operational models for the circular hub, and identify funding model
- Develop concept for circular hub and attract investment / grant funding
- Develop detailed design for circular hub
- Build circular hub
- Promote and support circular hub.

Key stakeholders

- Murraylands and Riverland Local Government Association and member councils
- Local businesses (e.g. local builders, composters, recyclers etc.)
- Not-for-profits – such as those organisations running op shops
- Community organisations – such as men's sheds
- TAFE.

Case Study: Brinkley ReUse Centre - Murray Bridge Council

The Brinkley ReUse Centre (located next door to the Brinkley Waste and Recycling Facility) is a volunteer-run centre established to facilitate the reuse, re-purposing and re-homing of products and materials that are otherwise destined for landfill. Members of the community are encouraged to donate items to the centre when something is too good to go to landfill. The initiative is promoted to the community using both sustainability principles and financial incentivisation. Dumping waste at either landfill or the waste transfer station in Murray Bridge comes at a cost, depending on types of waste, size of the load, etc. while donating items to the ReUse centre is free. This incentivises the community to bring in items they no longer have a need for instead of dumping them as waste, extending the lifespan of existing products. Donated items are assessed by volunteers and then either sold 'as is', repaired and re-sold, or upcycled into a new product. The centre stocks furniture and electrical, white goods, garden equipment, building materials, bric-a-brac, retro items, collectables and more. Regular awareness raising community events are also held by the centre.

Case Study: Men's Sheds in the Murraylands and Riverland

The Men's Shed movement can be found across the country, with four sheds located in the Murraylands and Riverland region (at Berri, Loxton, Barrmera and Waikerie). The focus of the Men's Shed movement is to provide a space for men to socialise and come together, as a way to support men's mental health. Men's Sheds provide a space for men to come and use a range of high-quality communal tools for wood and metal working projects. The tools can be used for community projects such as building a shed for the community or toy making, or just for fixing items they have brought with them. The Men's Shed also has several sustainability benefits from a circular economy perspective. The shared space facilitates the reuse and upcycling of broken items that might otherwise be discarded, develops skills in making and repairing and the use of communal tools removes the need for individuals to purchase items they might only use a handful of times.

6 Strategic non-sectoral opportunities

In addition to sector-based opportunities, we have identified a number of more strategic opportunities that will support local government, RDAMR, business groups and communities to transition towards a more circular regional economy.

6.1 Social Advocacy Campaign

A community wide circular economy social advocacy campaign aimed at increasing awareness of the importance of the circular economy to the environment, is a key foundational activity. To be effective, this campaign will ideally be well-funded and sustained. It is noted that the National Tobacco Campaign was launched in 1997 and is still running. It is envisaged this campaign would be targeted at households, businesses, local government and state government agencies. Ideally the campaign would be a collaborative effort between local government, RDAMR and the state government with additional funding from the federal government.

6.2 Training and Education

Our stakeholder consultation revealed strong demand for circular economy capacity building. Developing and implementing a series of training and education programs aimed at supporting the transition to a circular economy will be well received. Areas of interest include, but not necessarily limited to:

- Staff mentoring.
- Understanding what constitutes best practice.
- Procurement and influencing suppliers (key area of demand for education and training).
- Recycling, in particular households and commercial and industrial waste.
- Securing support and funding to assist with the transition to a circular economy.
- Community wide education incorporating sustainable agriculture and regional innovation and manufacturing.

6.3 Accelerating Adoption

To accelerate the adoption of circular economy action there are a number of strategic opportunities aimed at:

- Developing and delivering programs tailored to the various audiences (residents, private and public sector organisations) aimed at informing these audiences of the benefits of embracing the circular economy across the entire lifecycle of raw material extraction, product design, production and remanufacturing, consumption and waste management (waste to secondary materials).
- Developing regional and/or sector specific toolkits and resources to build awareness and practical educational materials for organisations to adopt circular economy practices.
- Providing readily accessible and affordable information, advice and technology to assist with the transformation of existing business models including the procurement of environmentally sustainable products.
- Fostering and establishing partnerships (linkages) to achieve economies of scale that will make the procurement of products produced from non-virgin materials price competitive.
- Encouraging local investment (start-ups) and re-investment to minimise the reliance on transport and create local employment opportunities. Access to capital is a key consideration.

6.4 Capitalising on Advocacy

Encouraging councils (individually and/or collaboratively) to lead by example through the development and implementation of strategies aimed at:

- Providing education and training programs for their local communities.
- Sourcing environmentally sustainable products for their local communities. This will mean a shift in procurement policy to assess all costs associated with the lifecycle of products, not just the initial outlay.
- Collaborating with other councils to achieve economies of scale for recycling and re-use programs.

Will complement the advocacy opportunities outlined above.

6.5 Regional Innovation and Collaboration Hubs

There is a major opportunity to develop and implement regional innovation and collaboration hubs aimed at:

- Investment attraction and business development with a focus on the circular economy, start-ups and the expansion of existing enterprises.
- Mentoring, collaboration (including the establishment and ongoing support for business networks) and entrepreneurship incorporating engagement with regional leaders and champions.
- Linkages to key information sources and relevant training and education resources including facilitation of regional forums on identified topics of interest.

The hub would ideally be located in an existing, underutilised building, in keeping with circular economy principles. Realisation of other non-sectoral opportunities could be driven from within the hub. The key benefit of fostering this concept will be to encourage innovative businesses and start-ups to remain in the region, rather than losing them and the economic and social development opportunities they generate to the major cities.

What next...

- Identify suitable locations for shared space in multi-use buildings.
- Undertake research to determine demand, potential user preferences and propensity to pay.
- Develop the hub concept based on the research findings.
- Prepare a business case including an assessment of the capital required and the project viability.
- Assuming financial viability, secure funding for the project and develop and implement the shared space hub.

Key stakeholders

- RDAMR
- GISA
- Future Industries eXchange for Entrepreneurship (FIXE)
- ThincLab Loxton.

7 Next steps

RDAMR and GISA are working together to support further development of the opportunities presented in this report. As the circular economy may be a new concept to many businesses, GISA will be undertaking key activities to raise the business community's awareness of the opportunities it can provide, and to highlight the economic and environmental benefits of adopting new business models. In addition, RDAMR will seek opportunities to facilitate collaboration between businesses, particularly those from different sectors, and councils and to signpost to sources of support and funding.

GISA offers several programs and funding opportunities that can help accelerate Circular Economy opportunities in the Murraylands and Riverland region including its Business Sustainability Program and Circular Economy Market Development Grants.

This report suggests a number of recommended next steps to be implemented to support the development of the circular economy across the Murraylands and Riverland region. It is expected that these recommendations would be delivered using a collaborative approach involving the stakeholders detailed in the action plans provided in Section 5.

7.1 Stakeholder collaboration

The diversity of landscapes, land uses and communities across a region naturally includes many businesses and associated stakeholders. Therefore, it is important to ensure businesses are provided with the support needed to develop circular economy opportunities and that the stakeholders work together to provide a comprehensive and joined-up support to their business members. In particular, it is suggested that industry stakeholders and those organisations involved in economic development collaborate to provide a coordinated service and to enhance support for existing circular businesses.

7.2 Sectoral and cross-sectoral knowledge sharing

Businesses usually associate themselves with a sector. This study identified four priority sectors – food and drink value chain, utilities, manufacturing, and construction and the built environment. It is strongly recommended that a sectoral approach is adopted in engaging with businesses. Sectors often have well-defined communication and engagement channels through trusted stakeholders, which are well placed to promote the benefits of a circular economy and showcase circular business models.

There is also valuable knowledge and experience to share through partnerships across sectors. Modern supply chains are increasingly complex and relationships across sectoral lines also need to be fostered in order to articulate and realise the benefits that circular business models can offer, which may be shared across supply chain partners.

7.3 Setting regional conditions for a circular economy

Regions should integrate their commitment to a circular economy into relevant strategic documents, setting out local priorities, planned measures and forms of support available. This sends a clear signal to local and regional stakeholders, enabling them to plan their activities in the long term. These strategies need to embed circular economy principles and provide a framework for coordinated action.

7.4 Establishing some circular economy indicators

The progress made through policy instruments and interventions can be measured by introducing specific indicators that focus on the circular economy. These indicators could include, for example, tracking the number of regional businesses that are engaged in the circular economy through actions within their businesses. Likewise tracking levels of engagement and adoption of CE principles within local government authorities could be considered. Another type of indicator that could be considered is tracking waste material flows at the regional level[69] periodically to monitor resource use and loss.

7.5 Regional circular economy procurement

Procurement is a key enabler to drive the circular economy. This is because it can influence how materials and products are sourced, so minimising waste and maximising resource efficiency throughout the supply chain.

Local and regional authorities can stimulate the take-up of circular economy approaches and solutions through leading by example. As consumers, local and regional authorities can include circular economy considerations in their purchasing decisions by using green public procurement criteria and mechanisms such as pre-commercial procurement. In practice, this means a shift towards evaluating all costs and benefits related to the entire lifecycle of a product or service, including criteria related to sustainable sourcing of raw materials as well as product maintenance, repair, reuse and management at end of life.

Endnotes

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Additional photo credits:

Ockert Le Roux - pg 14, 27, 28
Destination Riverland - pg 23, 28, 30

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