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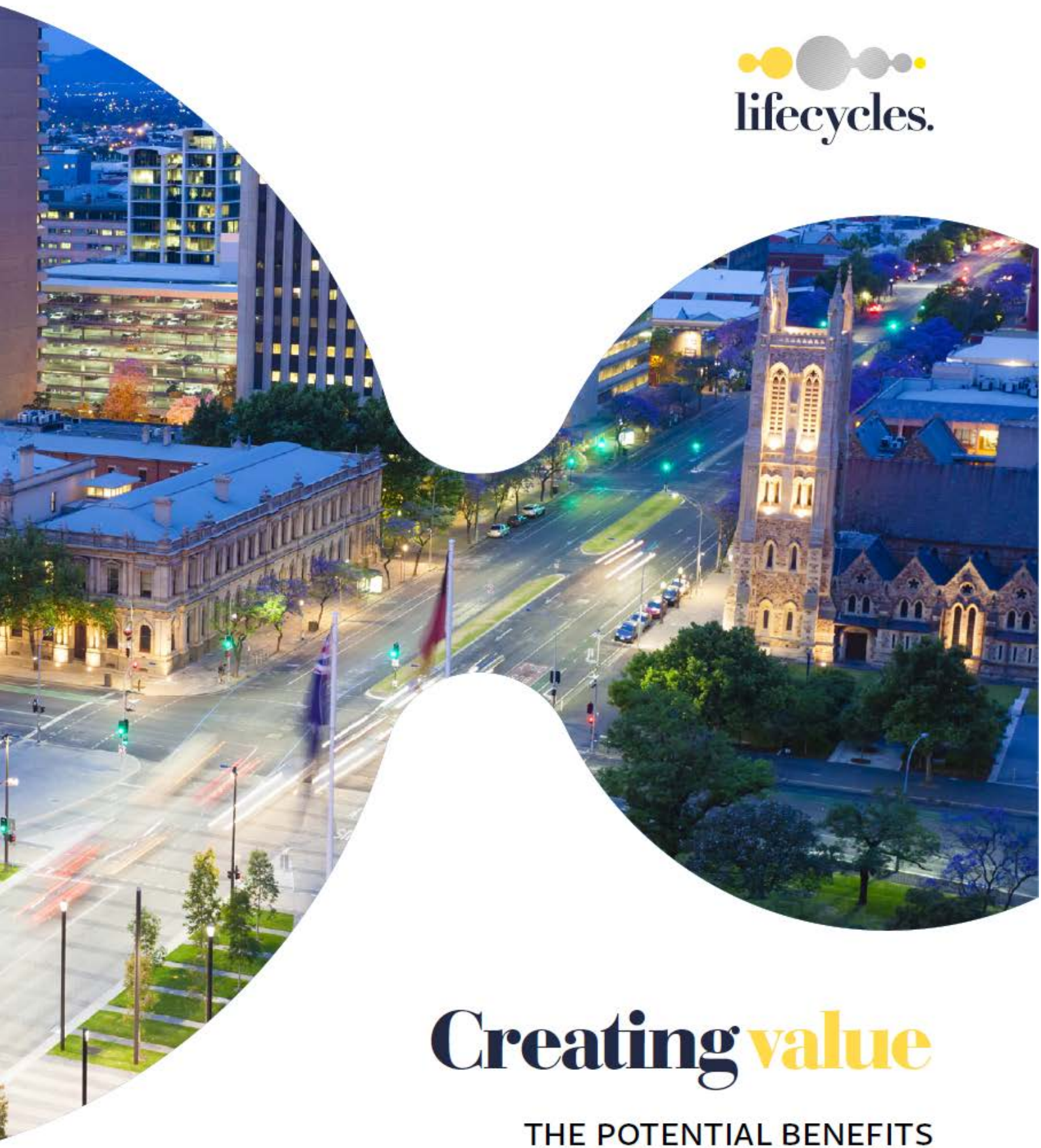

Creating value

THE POTENTIAL BENEFITS OF A CIRCULAR ECONOMY IN SOUTH AUSTRALIA

"International studies have repeatedly demonstrated the positive economic, societal, and environmental effects a transition to a circular economy can have. We welcome that this report explores the exciting opportunities that moving to a new, regenerative economic model can bring to South Australia, and we hope it helps accelerate such a transition there."

Stephanie Hubold, Government & Cities Programme Lead, Ellen MacArthur Foundation

“Whilst recent studies have shown that a circular economy can create jobs and reduce carbon emissions in Europe, this report demonstrates that this is also true in the Australian context. We look forward to seeing South Australia taking this challenge into implementation.”

Anders Wijkman, Stockholm Environment Institute, Co-president of the Club of Rome

“Results are very solid and encouraging for South Australia. I had not seen before such a clear articulation between circular economy and the creation of green jobs. I sincerely hope the results are broadly disseminated to decision makers in other regions as we can all learn from the findings drawn.”

Sonia Valdivia, Programme Manager, Sustainable Recycling Industries and Life Cycle Management, World Resources Forum

“South Australia has taken a big strategic step towards a circular economy. Now it’s time to roll up sleeves and get it done.”

Kari Herlevi, Senior Lead, Circular Economy, Sitra Finnish Innovation Fund

“Generating growth, creating job opportunities with a variety of occupation and skill types while reducing the environmental impact of economic activity are challenges all regions and countries face. For South Australia, this report highlights the potential for substantial job creation and benefits to the environment from expansion in circular economy”

Peter Mitchell, Head of Economics, WRAP

“This is a detailed and engaging report which must now be used to build momentum in Australia for a transition towards the circular economy. It projects lower greenhouse gas emissions and higher jobs and presents a compelling case for change.”

Damien Giurco, Professor of Resource Futures, Institute for Sustainable Futures, University of Technology Sydney

“This exciting study makes clear that the circular economy can be the foundation of a job rich economic model that works within environmental limits. Perhaps more important is that the type of jobs that the circular economy requires create the conditions for high quality, long lasting, skilled employment – exactly the sort of jobs that have been lost over the past 20 years.”

Dustin Benton, Acting Deputy Director, Green Alliance

Report prepared by Lifecycles, EconSearch, Colby Industries and the University of Queensland, for Green Industries SA.
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Released May 2017.

Report commissioned by Green Industries SA (www.greenindustries.sa.gov.au).

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Particular thanks to the international expert committee for their insight: Stephanie Hubold, Ella Jamsin and Lukasz, Ellen MacArthur Foundation, Dustin Benton, Green Alliance, Peter Mitchell, WRAP, Anders Wijkman and Kristian Skånberg, Stockholm Environment Institute, Callum Blackburn and Michael Lenaghan, Zero Waste Scotland, Veerle Labeeuw, OVAM Public Waste Agency of Flanders, Kari Herlevi, Sitra Finnish Innovation Fund, Markus Bjerre, Danish Business Authority, Damien Giurco, University of Technology Sydney, and Sonia Valdivia, World Resources Forum.

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summary

a circular economy…

…is where economic growth is decoupled from consumption of finite resources.
A circular economy is restorative by design, keeping products, components and materials at their highest utility and value.

This study is a first attempt at understanding what a more circular economy could mean for South Australia and evaluating the opportunities it might create.

Using broad assumptions about a more circular economy we conservatively estimate that it could create an additional 25,700 full time equivalent jobs by 2030 compared to a business as usual scenario.

A circular economy could also reduce South Australia's greenhouse gas emissions by 27%, or 7.7 million tonnes of $CO_{2\text{-eq}}$, compared with business as usual in 2030. This could help South Australia make a significant contribution towards reducing future climate change.

How? By keeping products, components and materials at their highest utility and value for the optimal duration. In practice, this means:

- designing – or importing – 'smart' products that last longer and can be reused many times;
- sharing things more and making repair the norm;
- recycling materials effectively and converting some waste materials into biofuels, and;
- displacing fossil fuels and derived products with bio-based materials.

Entrepreneurs and innovation in reverse logistics, services, digital technologies will be needed to facilitate these changes.

This study demonstrates that by moving towards a more circular economy, South Australia could decouple its economic growth and development from the consumption of finite resources. This means continuing to enjoy high standards of living while preserving our environment for future generations.

Whilst we have drawn upon global best practice to make the results as reliable as possible, imagining and modelling a whole new economy is a complex task. Analysis of circular economy benefits is an emerging practice and all assumptions used in the modelling should be further investigated prior to implementation.

This report is a first step to understanding potential opportunities. It provides insights into how South Australia could create jobs and reduce carbon emissions in an innovative and sustainable way. We hope it supports South Australian policy makers, industry and community stakeholders to come together and make it happen.

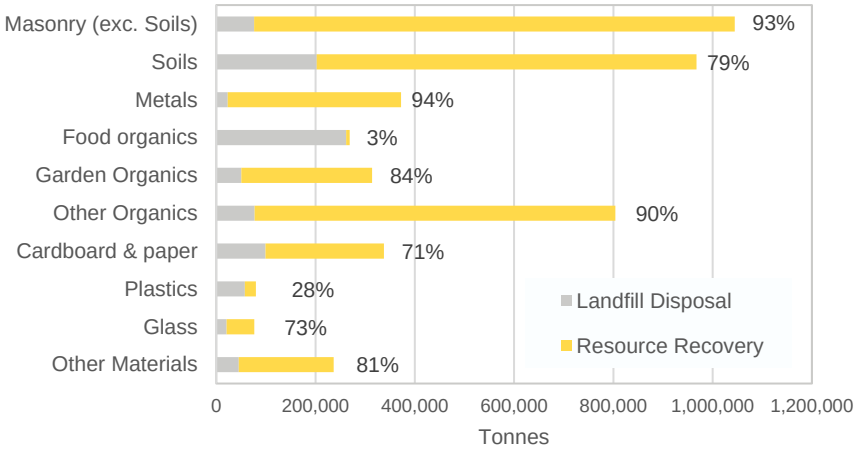
context

This report has been prepared for Green Industries SA. It analyses the potential employment and economic opportunities for South Australia of a more circular economy.

It reflects the achievements of South Australia in providing leadership in managing waste and improving resource recovery since the 1970s, and a desire to go beyond waste management to address materials as a wider, systemic challenge and opportunity.

Through years of proactive policy and on the ground initiatives led by Zero Waste SA (now Green Industries SA), South Australia is performing strongly regarding recycling. In 2010, the UN acclaimed South Australia's waste and resource management as global best practice [1]. In 2013-2014, 80% of all waste streams were diverted from landfill, as shown by the breakdown by material category in Figure 1 [2].

Figure 1 – Recycling amounts and rates by material category in SA, 2013-2014.



"Adelaide and South Australia's waste and resources management system is in some respects global best practice. South Australia has demonstrated a high level of political commitment and willingness to 'stick its neck out' and implement some policies and legislation upon which other administrations take a more conservative position."

Solid Waste Management in the World's Cities 2010, UN HABITAT

Looking beyond waste, greenhouse gas emissions have been decreased to below 1990 levels whilst the State's economy has grown by more than 60% [3][4]. Nearly 40% of the State's energy is generated from renewable wind and solar energy, which is the highest rate of any State and Territory in Australia [4].

This has produced some important economic spin-offs for South Australia:

- The State's waste management sector is a significant sector of the economy, with an annual turnover of around $1 billion, contributing directly and indirectly more than $500 million to Gross State Product (≈0.6% of GSP), and employing around 4,800 people across a wide spectrum of jobs. [5]
- The renewable energy sector has attracted over $6.5 billion in investment. [6]

Recently, South Australia has taken important and ambitious steps towards delivering a more sustainable future for the State and its people:

- The State Waste Strategy 2015-2020 now targets material and resource efficiency in addition to diverting waste from landfill for recycling.
- A new State Government agency, Green Industries SA, has been established to oversee implementation of this Waste Strategy.
- A new Climate Change Strategy for South Australia has been developed to move the State towards a Low Carbon Economy, including achieving net zero emissions by 2050.

These initiatives are all signposts directing South Australia down a path towards a more circular economy. Formalising a future circular economy model for the State would help to build upon current policy initiatives and activities designed to reduce waste, improve material and energy efficiency, and decrease greenhouse gas emissions. Furthermore, the potential benefits of a circular economy align closely with other State goals and priorities such as the stimulation of employment and resilient local economies, and the development of a low-carbon economy.

It is important to note that the South Australian context is very different to Europe, where measures to transition towards a more circular economy are gaining considerable traction. South Australia has a much smaller population (1.7 million) and is far more geographically dispersed. Even though it has a well-developed manufacturing sector, the economy has a greater reliance on agriculture, forestry and mining activities, many of which are export oriented. South Australia's consumer market is highly dependent on imported goods. The policy response to implementing a circular economy will need to take these factors into account, whilst being collaborative with other Australian States and Territories, as well as our key export and import markets.

Container Deposit Legislation: a South Australian success story

In 1975 the South Australian Government introduced container deposit legislation that imposed a deposit on a range of beverage containers. The deposit is included in the retail price and refunded when the container is returned to a collection point.

What started as a response to a litter now results in return rates for beverage containers around 80%. The container deposit legislation generates jobs at the 126 approved depots, and provides financial benefits to hundreds of community groups, sporting clubs and charities that collect empty containers for refund. By rewarding South Australians with a direct financial incentive for recycling these materials, it visibly demonstrates that recycling has a value that they can share in, encouraging them to participate in other recycling initiatives.

"Pooraka Bottle & Can Recycling Depot has been a family owned and run business for over 25 years. and have a 25-strong workforce of casual and full-time employees. Many of my staff have been working here for many years. We receive more than 20 million cans and bottles every year"
Carri Hollis, Owner, Pooraka Bottle and Can Recycling

what is a circular economy?

A circular economy is restorative by design, keeping products, components and materials at their highest utility and value for the optimal duration.

It seeks to decouple economic growth and development from the consumption of finite resources. This enables a high standard of living and quality of life, whilst conserving finite resources and protecting the environment for future generations.

It builds upon the “reduce, reuse, recycle” waste hierarchy that has been the remit for Zero Waste SA (now Green Industries SA) for a decade. A circular economy promotes the notion of waste as a resource further, to a systems approach considering how biological and technical materials move throughout the economy. Parts of this approach are described in the following paragraphs, and summarised in Figure 2.

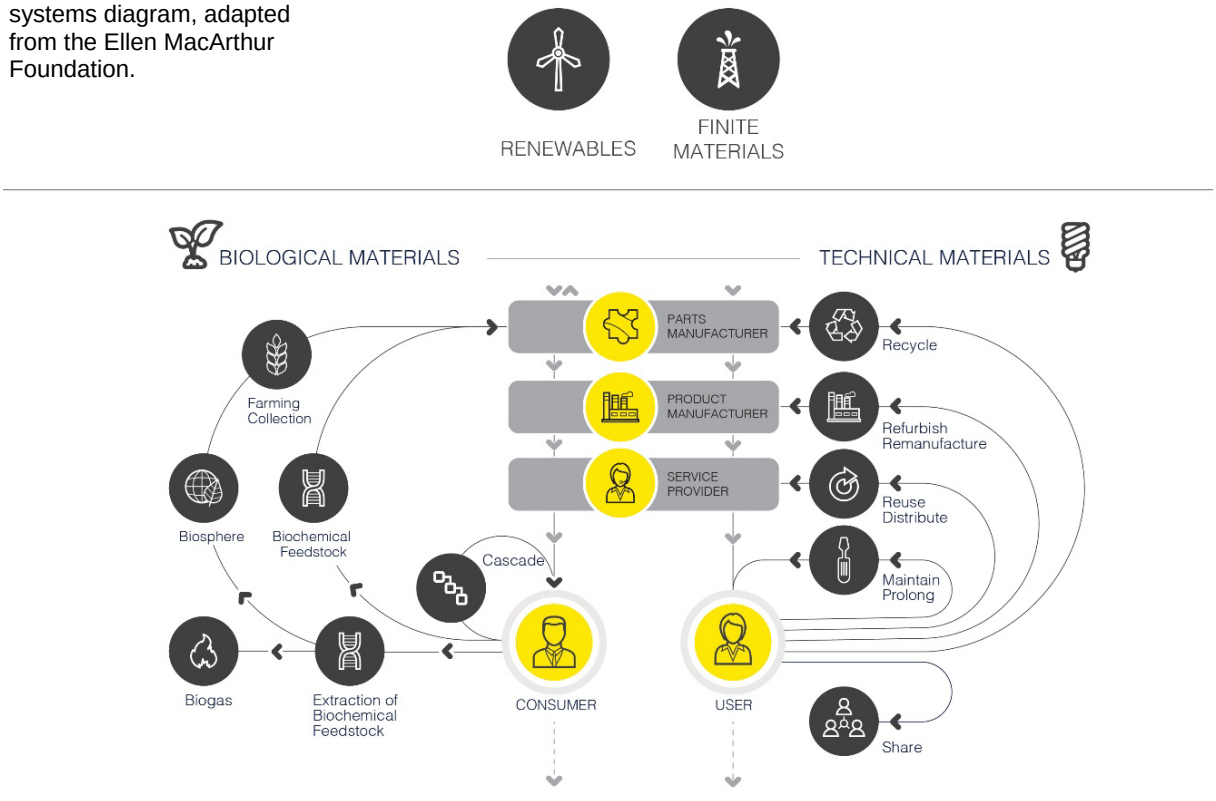


Figure 2 – Circular economy systems diagram, adapted from the Ellen MacArthur Foundation.

To facilitate the cycling of materials, biological materials (e.g. organic) and technical materials (e.g. metals, paper, plastics, etc.) are kept separate to prevent cross contamination. Organic ‘waste’ can then be returned to agricultural production, and plastics, metals and other man-made materials can be reused, refurbished or recycled effectively.

For technical materials, products are kept in the system as long as possible through repair and reuse, which preserves both the highly engineered character of a product, its useful function and the embodied energy used to make it. Sharing is also used to increase product utilisation. Components are refurbished and remanufactured, creating more locally based economic activity, and finally materials are returned to the economy through efficient recycling processes.

Circular systems also maximise use of biological materials, extracting valuable biochemical feedstocks and cascading them into different, increasingly low-grade applications. For instance, going from tree to furnace forgoes the value that could be harnessed via staged decomposition through successive uses as timber and timber products before decay and eventual incineration [7].

Good process and product design means that less materials and energy are used to manufacture the goods and provide services in the first place. Goods are also designed to last longer and to be easily repaired, upgraded or used differently in future cycles.

A truly circular economy is driven by renewable flows, rather than finite stocks. It depends on wherever possible renewable energy sources, including wind, solar and bioenergy, rather than, say, coal and other fossil fuels, and materials from renewable sources.

Transitioning towards a more circular economy, as this report demonstrates, could be an important driver for both job creation and reducing greenhouse gas emissions. Activities such as services, reverse logistics and remanufacturing tend to be more localised and create long term jobs. Reducing the (raw) material consumption of the South Australian economy would reduce both greenhouse gas emissions generated in SA, as well as those embedded in imported materials. This could help contribute towards achieving not only state and national targets, but being responsible for our carbon footprint as part of a global supply chain.

7

Growth potential: circular economy business models

Some leading companies are already seizing the business opportunities presented by getting the maximum value from products and materials. At the heart of these circular business models, resources are kept in use for as long as possible by design. Below are some examples.

Sharing (or collaborative consumption)	Rental or sharing of products between members of the public or businesses (peer-to-peer sharing of privately owned products or public sharing of a pool of products). This keeps product loop speed low and maximises the utilisation of products. The collaborative – or sharing – economy can help reduce structural waste, such as cars simply being parked 90% of the time or 60% of office spaces not being used [8].
Hire and Leasing	Hire or leasing of products as an alternative to purchasing can also keep products running longer, especially through maintenance, repair, and design for durability.
Products Service Systems (or servitisation, functional or performance economy)	Providing a service based on delivering the performance outputs of a product where the manufacturer retains ownership, has greater control over the production of a product, and therefore has more interest in producing a product that lasts. No large businesses buy their printers anymore- they all pay for their printing as part of a product service system. Global companies like Canon and Xerox now focus on servicing their customers, keeping their equipment running as long as possible and refurbishing, reusing and recycling all components to keep their running costs low, rather than just selling a printer and waiting for it to break down for the next sale. This model is now proven in the world of photocopiers, and developing strongly in computing (HP and IBM both have strong programs for their large business clients). Companies like Interface and Desso also offer similar services with carpet tiles.
Incentivised Return	Offering a financial or other incentive for the return of 'used' products. Products can be refurbished and re-sold.
Asset Management	Maximising product lifetime and minimising new purchase through tracking an organisation's assets, planning what can be re-used, repaired or redeployed at a different site.

These business models are often facilitated by transformational technologies such as big data analytics, social media, trace and return systems, 3D printing and modular design technologies.

Why go there, aren't we improving without the circular economy?

In the 20th century, the linear "take-make-dispose" economic system has generated impressive growth and allowed much of the world to access goods and services that have improved our lives. This has, however, come at the cost of depleting natural resources and environmental damage.

As a consequence, much work has been done since the 1970s to increase the efficiency of the current system. This is starting to generate some decoupling between economic growth, natural resource consumption and environmental impacts, mainly in developed countries. Whilst this is encouraging, recent analysis shows that almost all countries that reduce greenhouse gas emissions while growing GDP also reduce the industrial sector share of their economies [9]. This translates to a 'leaking' of both carbon emissions and employment to other countries.

Linear economic systems remain dependent on abundant resources feeding them, and the negative impacts arising from the waste these systems create have historically been borne by the environment and society as a whole (externalised). With resource shortages becoming more prevalent on one side, and major impacts such as climate change on the other, the negative impacts are being felt far more now than for previous generations.

In South Australia's case, whilst our exceptional recycling rate is a success story, and puts South Australia in a good position to ensure these resources circulate more, it by no means makes the current economic model circular. Figure 3 shows that although 80% of the material volume is captured and returned to the system, this represents only 4% of the raw material value.

Products that are reused or manufactured retain much more of the value created during manufacturing, than if they were only recycled. A powerful example of this is the iPhone. A reused iPhone retains around 48% of its original value, whereas its value as recyclate is just 0.24% of its original value [10].

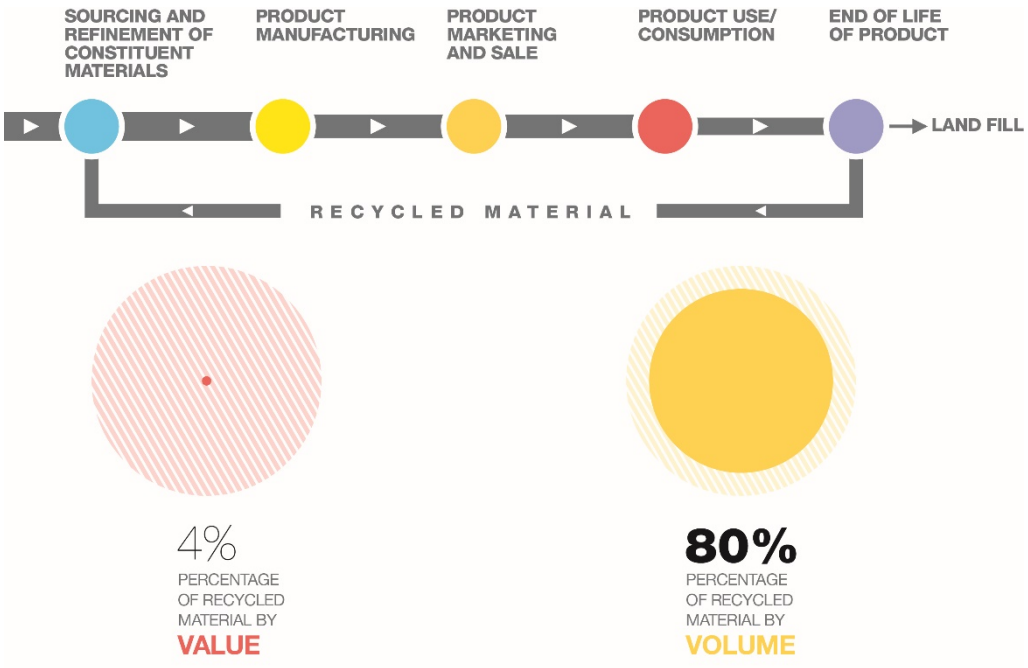


Figure 3 – Loss of value in recycled materials.
Using the European material value retention ratio of 5%, established by the Ellen MacArthur Foundation [8]. The material retention ratio is, defined as the estimated material and energy output of the waste management and recycling sector, divided by the output of the raw material sector (adjusted for net primary resource imports and 30% embedded resource value in net imported products).

9

International movement towards a circular economy

In 2012, the Ellen MacArthur Foundation released their watershed report entitled “Towards the Circular Economy vol. 1” [7]. In it, they invited readers to imagine an economy in which today’s goods are tomorrow’s resources, forming a virtuous cycle that fosters prosperity in a world of finite resources. Most importantly, they evaluated the “size of the prize”: an annual net material cost savings opportunity for the European Union of US$380 to 630 billion, depending on the ambition of the transition.

Fast forward to 2014, as the Ellen MacArthur Foundation gathers momentum in its CE100 movement – which brings together forward thinking companies, cities and governments to create critical mass for a transition – and the World Economic Forum participates in a global study putting the size of the prize at over US$1Trillion [11].

EU Circular Economy Package Launch, December 2015
Source edie.net

Closer to home, an action agenda released at the World Resources Forum Asia Pacific held June 2015 in Sydney estimated the value of a circular economy to Australia could be AU$26 billion per year by 2025 [12].

Many countries are now considering or actively integrating and adopting circular economy principles to guide future economic and environmental policies and practices, especially in Asia and Europe. On the corporate side, major global businesses such as Google, Unilever, Nike, Cisco and Renault are investing heavily in the circular economy, with the capacity to influence supply chains worldwide.

Some estimate that the remanufacturing and recycling industries presently account for about one million jobs in Europe and the United States [13]. A 2015 study by WRAP suggested that around 3.4 million people already work in circular economy jobs such as repair, waste and recycling and rental and leasing sectors across the European Union [10].

Circular economy in action at the policy level

Policy makers around the world are incorporating measures to support the circular economy in various environmental, economic and innovation policy measures:

- Japan’s Basic Act on Establishing a Sound Material-Cycle Society came into operation in January 2001.
- China released a national strategy for achieving a circular economy in 2013, including targets to increase energy and water productivity, and to almost double the output of the recycling industry.
- The European Union released its circular economy package in December 2015, including broad measures for changing the full product lifecycle including an eco-design working plan, actions to reduce food waste, development of quality standards for secondary raw materials and a strategy on plastics.
- Scotland released their first circular economy Strategy ‘Making Things Last’ in 2016 and the circular economy is a core aspect of ‘Manufacturing the Future’ Scotland’s Manufacturing Action Plan (2016).
- Denmark, Scotland, Taiwan, Northern France, Wallonia (Belgium), Catalonia (Spain), London (UK), Haarlemmermeer (Netherlands) and Phoenix (USA) are all working together in the Ellen MacArthur Foundation’s CE100 governments and cities programme to accelerate the transition towards a circular economy.
- The Flanders’ Materials Programme was founded in 2011 to transform Belgium’s Flanders region into a sustainable future-proof economy where material-cycles are being closed. This public-private initiative run by OVAM, the public waste & materials agency, won the award for circular economy governments, cities & regions at the 2016 World Economic Forum Annual Meeting in Davos.

modelling approach

methodology

The study was performed using a purpose-designed environmentally extended input-output model of the South Australian economy. The model depicts the interdependencies between 78 different sectors, showing how output from one industrial sector may become an input to another.

Assumptions, modelling techniques and results were reviewed by an international panel of circular economy experts. Details of the environmental input-output modelling process and all modelling assumptions are provided in the accompanying Methods Report.

This report uses a macro-economic approach to provide quantified information about possible impacts on employment, carbon emissions and energy use for the state of South Australia if it adopted certain practices to become a more circular economy. The following scenarios were examined:

BUSINESS AS USUAL
Based on existing trends and implementation of current policy on renewable energy (State Strategic Plan).

EFFICIENT AND RENEWABLE ENERGY
South Australia implements its ambitious Climate Change Strategy 2015-2050.

MATERIAL EFFICIENCY
Products, components and materials are kept at their highest utility/value at all times.

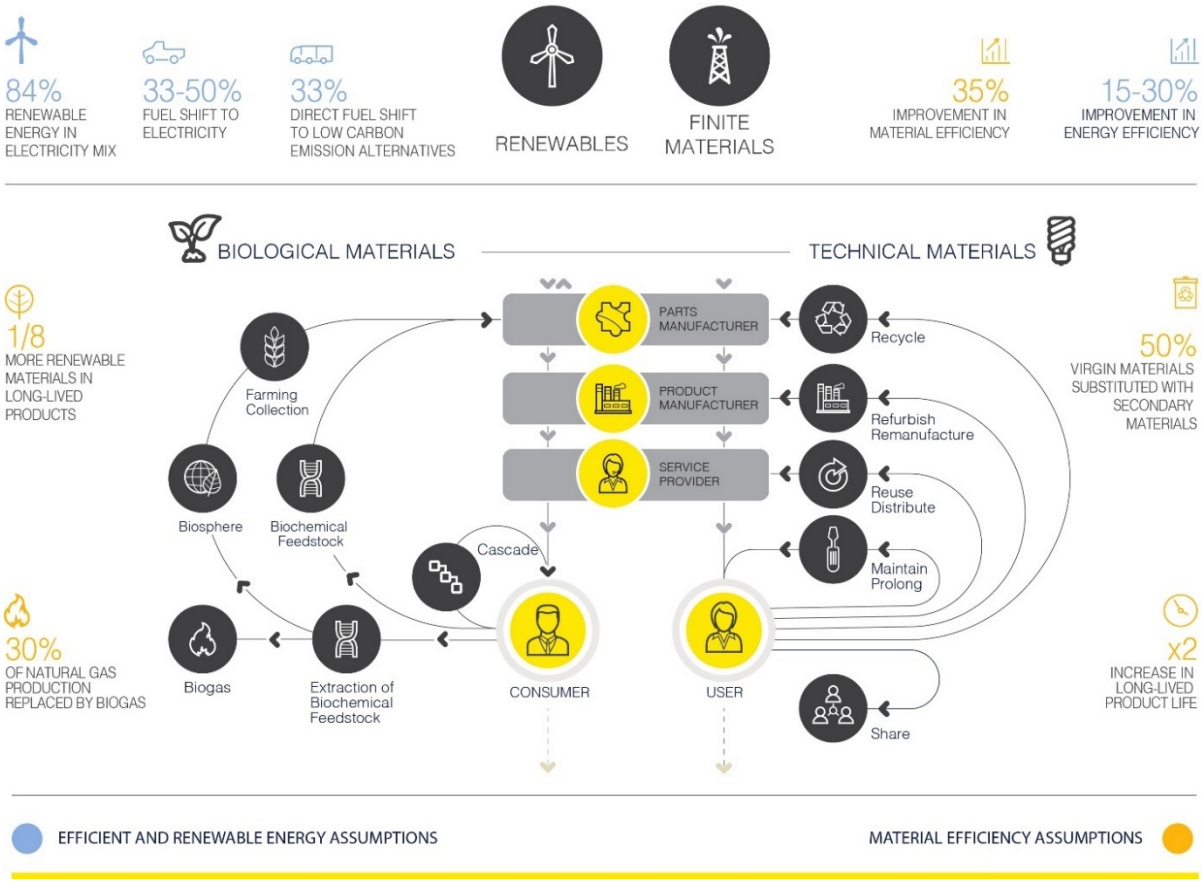
CIRCULAR ECONOMY
The strategies from material efficiency and efficient and renewable energy scenarios are combined to achieve a circular economy.

The business as usual scenario of the South Australian economy was established for 2030 based on existing baseline trends. All other scenarios are compared against this as the base case:

- The efficient and renewable energy scenario is based on the ‘towards net zero emissions’ energy efficiency, low carbon electricity, electrification and fuel switching approaches set out in the SA Government’s ambitious Climate Change Strategy 2015-2050 [3].
- The material efficiency scenario uses three key assumptions around material efficiency, use of secondary materials and longer product lifetimes, inspired by a 2015 report to the Club of Rome [14]. To further investigate the role of biological materials in a more circular economy, the project team also included assumptions around renewable materials in long lived products and biogas.
- The circular economy scenario combines the material and energy measures, reflecting that a truly circular economy addresses the careful use of finite stocks of both energy and materials.

In our modelling, we kept the overall size of the economy (measured in terms of gross state product) constant between all scenarios to observe the structural changes to the SA economy that could be expected and to assess the potential benefits in these terms. This conservative approach is consistent with modelling in the recent report to the Club of Rome [14]. All assumptions are mapped against the circular economy systems diagram in Figure 4.

Figure 4 – Modelling assumptions.



modelling results

The results of our modelling demonstrate the potential value of implementing both energy and material focused policy measures in South Australia.

Table 1 presents the summary results for employment, greenhouse gas emissions and energy use for the different modelling scenarios. These results will be discussed further in the following sections.

Table 1 – Results summary*.

	2014-2015	BUSINESS AS USUAL 2030	EFFICIENT AND RENEWABLE ENERGY	MATERIAL EFFICIENCY	CIRCULAR ECONOMY
JOBS (Full Time Equivalent)	**701,600**	**818,100**	**822,800**	**839,200**	**843,800**
		+116,500 (16.6%) compared to 2014-15	+4,700 (0.6%) compared to BAU	+21,000 (2.6%) compared to BAU	+25,700 (3.1%) compared to BAU
CONSUMPTION GHG EMISSIONS (Million Tonnes of $CO_{2\text{-eq}}$)	**29.7**	**28.4**	**22.5**	**26.7**	**20.7**
		-1.3 (-4.0%) compared to 2014-15	-6.0 (-21.0%) compared to BAU	-1.8 (-6.1%) compared to BAU	-7.7 (-27.2%) compared to BAU
TERRITORIAL ENERGY USE (Peta Joules)	**330**	**428**	**352**	**418**	**342**
		+97 (29.4%) compared to 2014-15	-76 (-17.7%) compared to BAU	-10 (-2.3%) compared to BAU	-86 (-20.1%) compared to BAU

[a] *Sums may not equal totals due to rounding*

All scenarios create jobs, reduce greenhouse gas emissions and reduce energy use.

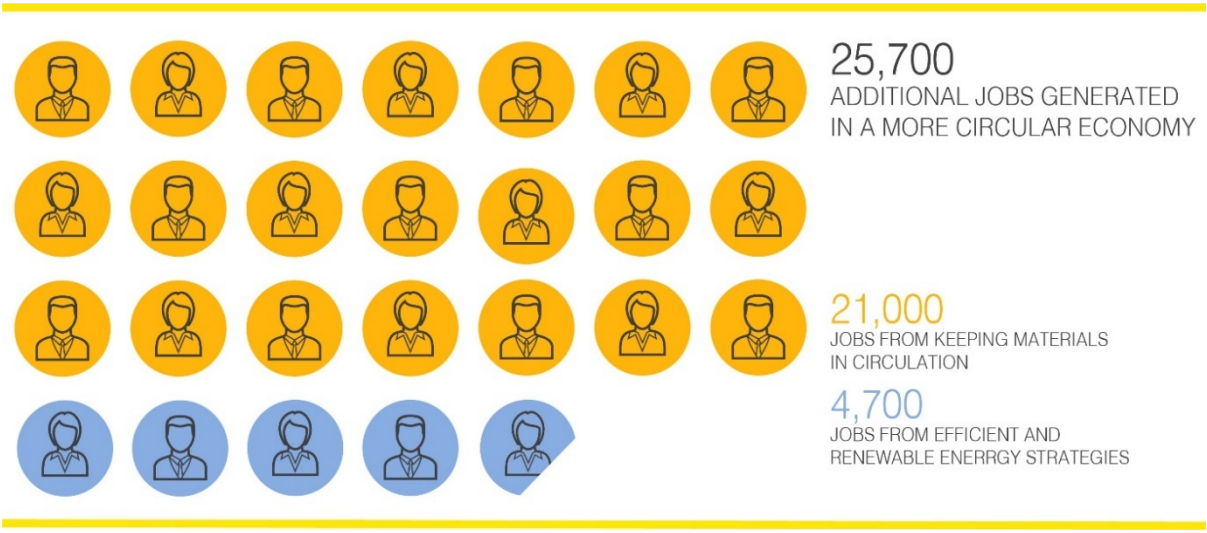
13

Employment

According to our modelling, a more circular economy could increase the number of full time equivalent jobs in South Australia in 2030 by 25,700 compared with business as usual for the same sized economy[1]. Whilst both the efficient and renewable energy scenario and the material efficiency scenario increased the number of jobs compared with business as usual, material efficiency measures were responsible for over 80% of jobs generated (Table 1, Figure 5).

The key messages are that implementing materials strategies could create many more jobs than a purely energy focussed response to climate change mitigation, but most importantly that both strategies are vectors for job creation.

Figure 5 – Jobs created in a more circular economy.



Most of the jobs created in the circular economy scenario come from service sectors, reflecting the need for design and technology professionals to achieve the transition, but also jobs to repair and maintain goods so that they stay in circulation for longer. In some sectors, such as construction, there is some displacement of jobs from creating new products and materials (in this case buildings and other structures) to maintenance and building refurbishment. Figure 6 shows the number of jobs created under the circular economy scenario in key service sectors relative to business-as-usual. It also shows the size of the sector, in terms of fulltime equivalent jobs, under the business-as-usual scenario. For example, the professional, scientific and technical services sector increases by approximately 15,000 jobs from 73,000 (under business-as-usual) to approximately 88,000 jobs under the circular economy[2].

[1] Measured in terms of gross state product.
[2] Detailed sector results are available on request from Green Industries SA.

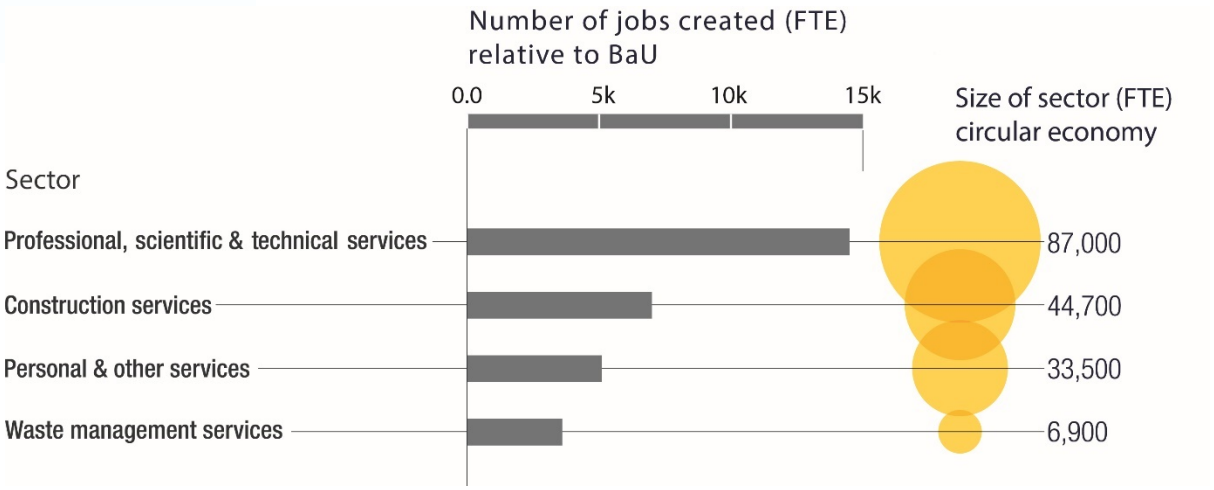


Figure 6 – Number of jobs created and size of sector, circular economy 2030.

Greenhouse gas emissions

The results of the modelling indicate that a more circular economy would reduce South Australia's greenhouse gas emissions. The business as usual scenario projects the State's greenhouse gas emissions at approximately 28 million tonnes $CO_{2\text{-eq}}$ in 2030 (consumption basis). A more circular economy showed a decrease in these emissions by 27%, or 7.7 million tonnes of $CO_{2\text{-eq}}$ by 2030. This represents taking more than 1.5 million large 4WD vehicles off the road[3].

Whilst most of these reductions are achieved through efficient and renewable energy measures, almost a quarter of the improvements could be achieved by using materials differently. These figures include the "embodied" emissions contained in the goods and services imported into South Australia, ensuring that we reduce our emissions without passing them onto other Australian states or overseas.

If these projections were realised, it would also make a significant contribution towards South Australia's target to reduce territorial greenhouse gas emissions[4] by at least 60% of 1990 levels by 2050 [15], as shown in Figure 7.

[3] Based on figures from the Australian Greenhouse Calculator, a large 4WD vehicle emits 4.6 tonnes of $CO_{2\text{-e}}$ per year (assuming typical vehicle use)

[4] GHG emissions are reported primarily as consumption based emissions in this report, which include the full supply chain impacts for goods and services consumed in SA, to assess the sustainability of consumption patterns. Territorial emissions were also modelled, which are used in Figure 7 as SA's GHG emission targets use this methodology. More discussion on the difference between consumption and territorial emissions, and the effect on results are presented in the separate methods report.

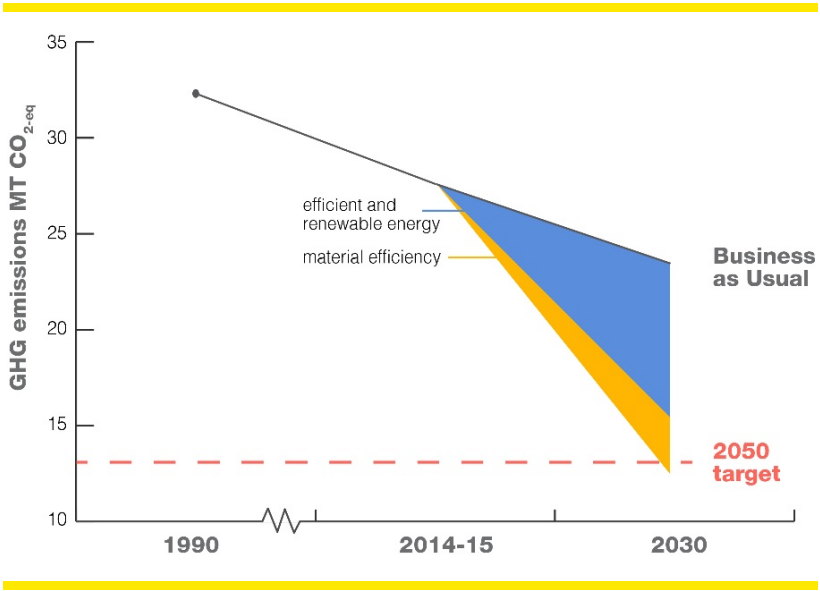


Figure 7 –Contribution of a more circular economy to GHG emission targets (territorial emissions).

Energy use

Energy use was also considered, as a key environmental and economic issue facing South Australia. The modelling indicated that despite greenhouse gas emissions decreasing in 2030 business as usual projections (compared to 2014/15), territorial energy use increases by 30%, showing the importance of existing policy initiatives to move towards non-fossil energy sources.

The modelling results indicated that a more circular economy could cut the energy use in South Australia (territorial energy use) by 86 petajoules (PJ) compared to business as usual in 2030, or just over a 20% reduction. This improvement would not be enough to compensate for the overall increase from current demand, but would still reduce energy use by the equivalent of two power stations' the size of Torrens Island power station[5].

Whilst implementing material efficiency measures contributed positively to reducing energy use, its effect was marginal at only a 2% improvement. The energy related measures provided the majority of the effect.

[5] Torrens Island is South Australia's largest power station with a capacity of 1.28 GW

discussion

Beyond the modelling, it is interesting to look at the kinds of jobs that might be created by a more circular economy, and examples of businesses that are taking this approach today.

Many types of circular economy jobs exist already, especially in economies like South Australia with well-developed recycling and waste management sectors and are investing in renewable energy.

Whilst many of these jobs are in traditional “waste” areas of waste collection, recovery and recycling, a UK study found reuse (repair, sales of second-hand goods) and sharing (rental and leasing) activities to comprise more than half of current circular economy jobs [16].

A UK study [17] delving into the types of new jobs that will be created by a circular economy, explored the differing education, skills, and training requirements for new circular economy occupations:

Table 2 – Potential skill needs for different circular economy activity [16].

Activity	Low skilled	Skilled	Professional
Closed loop recycling Using waste to make new products without changing the inherent properties of the material being recycled e.g. bottle to bottle recycling	4	4	1
Open loop recycling Using recovered materials to create lower value products, e.g. turning glass containers into aggregate	4	2	1
Servitisation Leasing or moving from providing products to services, deferring consumption of new assets	3	3	3
Remanufacturing Returning a product to at least its original performance with a warranty that is equivalent or better than that of the newly manufactured product	2	5	2
Reuse Using an item again after it has been used	4	2	1
Biorefining Extracts small quantities of valuable materials from biowaste (such as proteins or specialty chemicals) or converting waste into energy	1	4	4

This suggests that skilled or mid-wage employment in administrative and secretarial, trade and plant operating areas could benefit the most from a more circular economy, followed by lower skilled occupations in sales and customer service, laboring and transport. Importantly, the circular economy could contribute to higher-skilled jobs for entrepreneurs, managers, engineers, scientists and other professionals. Research and development-focused and innovative professionals will be needed to expand and create new businesses needed to support circular economy activities and industries.

For the energy aspect of a circular economy, the Australian Bureau of Statistics recently found that direct employment created by renewable energy activities for Australia in 2014 already accounts for 14,020 jobs [18]. The Climate Council recently examined the kinds of new jobs that could be created if Australia transitions towards 50% renewable energy [19].

It's happening in SA

Innovative entrepreneurs are already creating business models around the circular economy right here in South Australia. Whilst these few case studies are just the tip of the iceberg, they do show some of the ingredients already in place that could help South Australia successfully transition to the more circular economy envisaged in this report.

sundrop

www.sundropfarms.com

The Sundrop System uses a combination of proven technologies to grow high-value crops using seawater and sunlight. The system allows Sundrop to produce more from less; growing profits while breaking farming's worsening dependency on freshwater, farmland and fossil fuels. The 20 hectares of greenhouses at Port Augusta will produce 15,000 tonnes of prime truss tomatoes worth tens of millions of dollars a year. The hydroponic operation is located on degraded land not usually considered suitable for agriculture, and is powered by more than 23,000 mirrors focusing the sun's energy at the top of a 115m tower. This thermal energy heats the greenhouses, creates electricity, and powers the desalination plant used to create fresh water for the enterprise. The system saves around 16,000 tonnes $CO_{2\text{-eq}}$, 450,000 m^3 of fresh water and has created more than 150 jobs in a new high tech industry.

peats SOIL & GARDEN SUPPLIES

http://peatssoil.com.au

Peats Soils & Garden Supplies uses waste organic material to produce high quality compost products. They developed their own proprietary process to manufacture Blend 437, a finely-screened humus – the most stable and long-lasting form of organic matter. It has been field demonstrated to improve crop yield and quality for viticulture, broad-acre and horticulture. Blend 437 has been further re-manufactured into PEATS TAILORMADE™ Prill, a more advanced product in flowable form to allow easy application by farmers through air-seeder equipment during crop sowing. Peats is also upgrading one of their depots to extract additional value from waste organic material, through anaerobic digestion to generate bioenergy to supply electricity to plant used at the depot, and manufacturing biodiesel to replace fossil fuel use in machinery and trucks.

SHARE N SAVE

www.sharensave.com.au

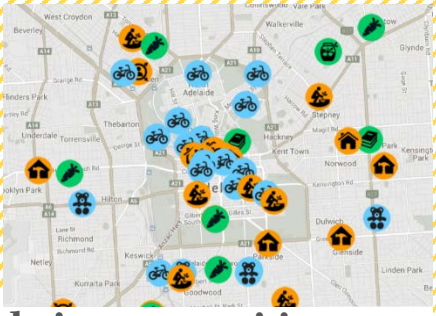
The collaborative – or sharing – economy can facilitate peer to peer reuse of items that are no longer wanted by their owners. Created by Zero Waste SA in 2013, Share N Save is an open source, online interactive map that shows where sharing activities take place across Adelaide. Over 200 groups, activities and events are listed, and categorised according to whether they are about sharing and swapping, doing things together or borrowing, including food swaps, community gardens, toy and tool lending

“Sundrop Farms is proud to be part of the efforts to transform South Australia’s economy and to provide jobs and highest quality fresh produce using a truly circular and triple bottom line approach.”

Philipp Saumweber, Chairman and CEO, Sundrop Farms

“The circular economy has already started to transform and generate new jobs across our organics recycling business in South Australia. This report is timely in demonstrating the exciting new opportunities for our industry, to be part of this economic transition towards a more sustainable future.”

Peter Wadewitz, Managing Director, Peats Soils & Garden Supplies



“Citizens must lead the transformation of their communities, but government can play a vital enabling role. The Share N Save initiative is a prime example of the role government can play in empowering citizens to help each other.”

Neal Gorenflo, Founder, Shareable.net

International best practice

The following companies are successfully pursuing circular business models in Europe, but could they work here in South Australia?

Reuse/Remanufacturing Furniture

Nnof supplies products and services geared toward reusing and upgrading existing office furniture in Belgium. Customers' own office furniture serves as the raw material for Nnof projects, that range from straight reuse to the complete transformation of existing objects. Drawer units can be made into lockers, desk tops are sawn and reused to make sitting blocks, and so on. Nnof offers both catalogue products and tailored designs. Reusing these materials comes with a significant financial gain and customers are provided with certificates attesting to their reduced ecological footprint.

Why it could work in South Australia

This model isn't dependent on having a major local furniture manufacturer. The founders of Nnof were office removalists who were shocked by the volume of otherwise good office furniture going to low value resales. They teamed up with local carpenters and designers – all of which we have here in South Australia. This is such a great example as the company was profitable extremely quickly as their model makes economic sense, and resonates with the environmental policies of their bigger clients such as banks and government agencies.

Remanufacturing Electrical Goods

Norsk Ombruk is a dynamic and ambitious remanufacturing company that extends the life of household electrical goods in Norway. They partner with leading brands and retailers to source suitable products and sell the refurbished and remanufactured goods back to consumers. Their leading edge tracking and management system guides the process, and stringent testing and finishing ensures that they provide quality products. In 2015 they remanufactured over 8000 electrical products.

Why it could work in South Australia

South Australia already has well-established electronic waste collection systems and resource recovery industries (E-Cycle, Advanced Recycling Technologies, and Aspitech), making it well placed to divert suitable household electrical goods for repair and remanufacturing. These activities will become more commercially attractive as new electrical goods designs embed capabilities to replace/upgrade components, and as raw material costs increase. The success of recycling collection schemes (such as mobile muster and the National Television and Computer Recycling Scheme) and development of retailers refurbishing household goods on a small scale suggest that the market could be ready.

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Product Service Systems – Washing Machines

Dutch start up Bundles has partnered with Miele to offer top quality washing machines to consumers with a pay per wash model, using Internet of Things technology. After launching in 2014, Bundles now operates 400 appliances, revolutionising the way people do their washing.

Why it could work in South Australia

South Australia is dependent on imports for most of its electrical goods, so scope to redesign whole product ranges locally is limited. This model relies on clever technology developed by Bundles to track use of the machine to bill clients and detect problems with the machine for servicing. Local technology companies could partner with existing local service providers and international manufacturers – such as Miele – who produce high quality goods that are designed to last. Ideally South Australian financial institutions could also partner to provide leasing services, like DLL does in the Netherlands.

"A circular economy is the only way forward. Getting there requires focus on creating consumer value and this can only be done if parties from different 'worlds' find ways to share and collaborate"

Marcel Peters, CEO, Bundles

conclusions

This study has demonstrated that by beginning to implement a circular economy, South Australia could potentially decouple its economic growth and development from the consumption of finite resources. It shows that, even with a conservative modelling approach, potential benefits – in terms of jobs, greenhouse gas emissions and energy use – are substantial, and therefore worth understanding more and pursuing actively.

It provides a potential vision for how South Australia could create jobs and reduce carbon emissions in an innovative and sustainable way.

Environmentally extended input output modelling was selected to look at the big picture in a consistent way across all sectors. It provides insight into the structural changes that may result when the economy is rewired so that products, components and materials circulate effectively powered by more renewable resources.

This “broad brush” method has its limitations, and there are many aspects that should be investigated further:

- Sector specific studies would help create a more nuanced and realistic picture of how a transition towards a more circular economy could be achieved and its implications. The methodology provided by the Ellen MacArthur Foundation [20] could be used to select priority sectors for South Australia and quantify impacts with a bottom up approach, analyzing one activity at a time, whilst engaging industry and wider stakeholders.
- Further physical flows modelling would help to understand the potential of certain materials to circulate through different economic sectors. For example, the assumption that 50% virgin materials are substituted with secondary materials needs to be examined regarding the potential availability of secondary materials in the market place. More reuse and recycling capacity will be necessary in South Australia and interstate to support such a development.
- Examining how the circular economy may affect water use is particularly relevant given the importance of water resources in South Australia.
- Whilst the RISE model that is used for this study is price sensitive, it is still essentially a linear approach (see methodology report). Using computable general equilibrium (CGE) modelling would provide further insight as to the market dynamics and an understanding of how the circular economy may impact economic growth in South Australia.

As outlined in the Methods Report, we have intentionally selected stretch targets when imagining how materials may flow in a more circular economy in South Australia. Each assumption has inherent uncertainties, and requires further feasibility assessment prior to implementation.

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