Submission No 54

INQUIRY INTO WASTE AVOIDANCE AND RESOURCE RECOVERY AMENDMENT (PLASTICS REDUCTION) BILL 2021

Organisation: CSIRO

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Ms Cate Faehrmann MLC
Committee Chair
Portfolio Committee No. 7 – Planning and Environment
Parliament House, Macquarie Street, Sydney NSW 2000, Australia
PortfolioCommittee7@parliament.nsw.gov.au

Dear Ms Faehrmann

RE: Bill to reduce plastics waste in NSW

CSIRO welcomes the opportunity to provide input to the Planning and Environment Portfolio Committee No 7 Inquiry into the Waste Avoidance and Resource Recovery Amendment (Plastics Reduction) Bill 2021 available at https://www.parliament.nsw.gov.au/bills/Pages/bill-details.aspx?pk=3721.

Science and research can inform decision making and policy development in waste avoidance, resource recovery and waste management domains. The comments provided in our submission are based on science and our extensive expertise and long-standing experience in plastic waste research.

Through CSIRO's Ending Plastic Waste mission we are focussing large scale effort towards addressing the issue of plastic waste. The mission aims to dramatically reduce the loss of waste plastic to the environment and increase the recovery of plastic as a resource with impact focussed scientific and collaborative initiatives. We aim to drive Australia's systemic change in plastic pathways through data science, materials and manufacturing, recycling processes and whole of life, circular solutions to reduce plastic pollution entering the environment.

This submission follows many years of engagement between CSIRO and all levels of government and industry across the plastic waste and recycling sector, and a range of research projects to support industry practice and strategic planning in the waste sector.

We have wide-ranging capability and experience in understanding the plastic waste ecosystem and would welcome the opportunity to provide further information if that would be of benefit to the Committee. The contact in this instance is Ms Caroline Seagrove, NSW State Relationship Manager, on or email

Yours sincerely

Dr Andreas Schiller
Director, CSIRO Oceans & Atmosphere

CSIRO Submission 21/756: Inquiry into the Waste Avoidance and Resource Recovery Amendment (Plastics Reduction) Bill 2021

CSIRO has world-leading expertise and experience in material flow, waste and recycling research, including the application of research to inform policy development and implementation as well as industry practice. We are a global leader in the domains of marine debris and ocean pollution research (Hardesty et al. 2015), green chemistry (Hutt et al. 2016) and environmental effects (Williams et al. 2016). Please see **Appendix 1** for a sample list of relevant publications in these areas.

We would like to provide comment on two areas for consideration by the Committee in developing legislation in this area. Our research and global experience indicate that harmonisation across jurisdictions and the ability to provide for measurement and monitoring are two of the critical elements to ensure the outcomes desired in reducing plastic usage.

Harmonisation

Recent CSIRO research produced a national roadmap (Schandl et al. 2021, see **Appendix 2**) for the circular economy of plastics, glass, paper, and tyres. The roadmap identified a number of major challenges impeding Australia's transition from a linear economy, where the pattern is to 'take-make-waste', to a circular economy that focuses on designing out waste and pollution, keeping materials and products in use, and regenerating natural systems.

A major challenge identified in the roadmap research was the lack of consistency in governance across state and territory jurisdictions with respect to waste prevention and management, recycling, and remanufacturing using secondary materials. Phasing out problematic materials (such as single-use plastic) was an example of inconsistency in regulations. Inconsistencies created confusion for consumers and hindered industry and local government responses to mitigating the impacts of waste materials and to realising opportunities that would promote a circular economy.

The roadmap research included 83 interviews with industry and government stakeholders from the waste and resource recovery sector, as well as an extensive literature review. The roadmap research developed a suite of strategies to address these challenges which can be grouped into six integrated circular economy strategies, as shown in Figure 1 below. One stream of strategies centred on creating consistent governance to enable Australia to reach its national targets as outlined in the National Waste Policy Action Plan (2019). This strategy includes national harmonisation of messaging, labelling, regulations, and education, for example.

Figure 1. Integrated circular economy strategies. Inner circle strategies relate to material flows and outer circle strategies relate to enabling practices. (Source: Schandl et al. 2021)

Measurement and Monitoring

The UN Environment Programme report, Single-Use Plastics – A roadmap for sustainability (2018), recognises the importance of measuring and monitoring the effectiveness of regulatory changes. It cites an example of where consumption of plastic bags increased after introduction of a levy. A comparative example in Australia's Northern Territory showed that five years after a ban on plastic bags < 35 microns, people continued to treat the bags as single use disposable items (UNEP 2018). The ability to evaluate the success of legislation which has been introduced to reduce the environmental impacts of single use plastics will rely on collection of data through programs of work for monitoring and waste flow tracking.

Summary

The examples provided of harmonisation and measurement and monitoring demonstrate that effecting change in the use of single-use plastics can benefit from science and research, delivered at the requisite scale, to tackle the complex governance across state and territory jurisdictions, as well as the sometimes counterintuitive behaviours relating to the use of single-use plastics.

CSIRO has wide-ranging, at-scale capability and experience in understanding the plastic waste ecosystem and would welcome the opportunity to provide further information if that would be of benefit to the Committee. The contact in this instance is Ms Caroline Seagrove, NSW State Relationship Manager, on or email

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Appendix 1

Plastics debris research

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Australia's National
Science Agency

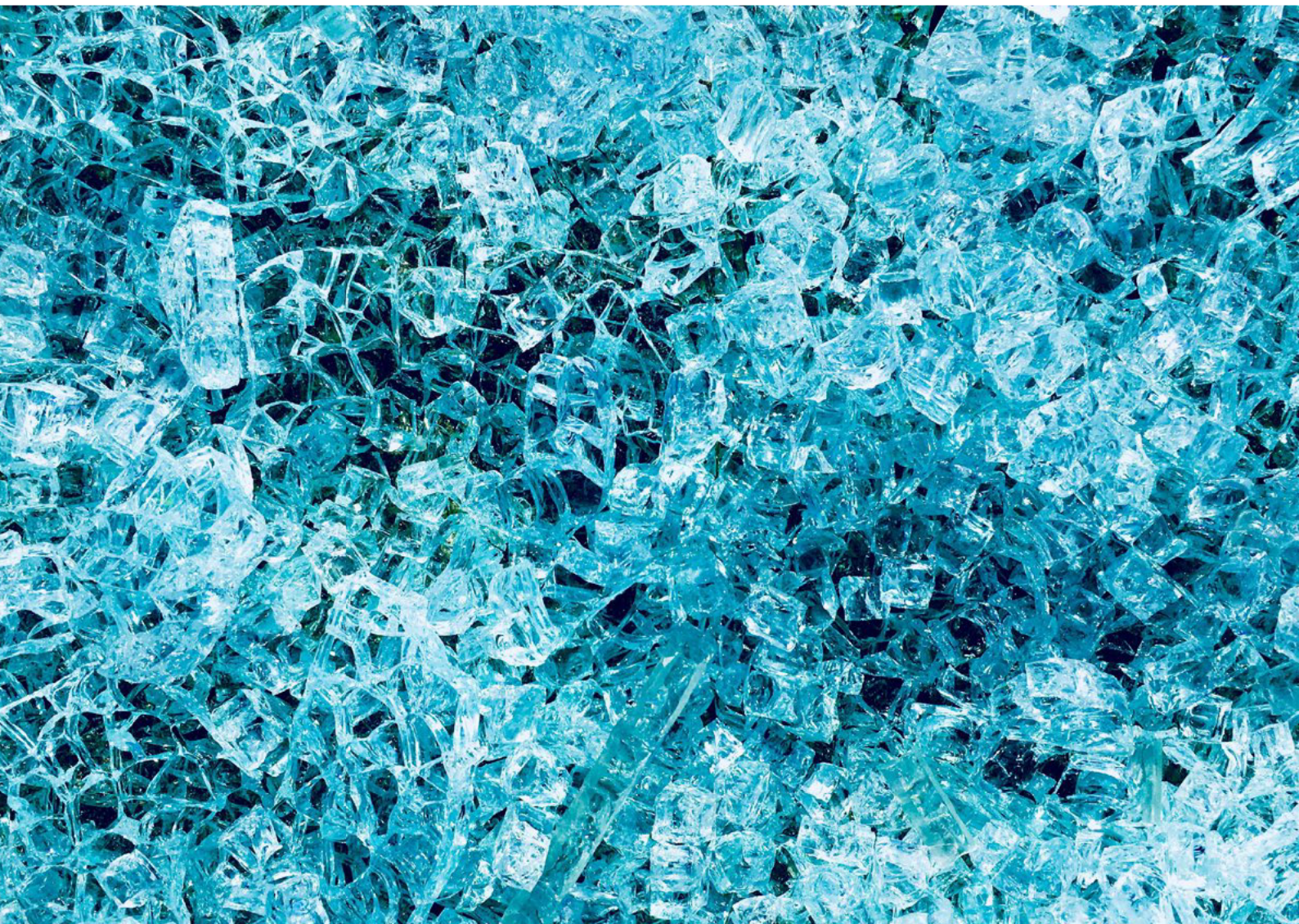
Appendix 2

NATIONAL

Circular economy roadmap for plastics, glass, paper and tyres

Pathways for unlocking future growth opportunities for Australia

SUMMARY | JANUARY 2021



Acknowledgments

The circular economy roadmap has been developed with input from 83 business and government participants. We thank the Federal Department of Industry, Science, Energy and Resources and the Federal Department of Agriculture, Water and the Environment for their support. We also thank Josh Dowse for advising the storyline and Sonja Chandler for editorial services.

Citation and CiP (Main Report)

Schandl H, King S, Walton A, Kaksonen AH, Tapsuwan S and Baynes TM (2020) National circular economy roadmap for plastics, glass, paper and tyres. CSIRO, Australia.

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Important disclaimer

This report is current as of August 2020. CSIRO continues to actively undertake research into the circular economy both internationally and for Australia.

Unlocking Australia's circular economy

Australia is beginning to imagine an economy in which today's goods are tomorrow's resources.

In three related initiatives, the Australian government has set a national target to reduce waste to landfill by 80% by 2030, agreed to ban the export of waste plastics, paper, glass and tyres, and committed to develop a strategy that radically increases Australia's capacity to generate and market high value recycled commodities.

The Australian government also seeks to do two seemingly independent things simultaneously: reduce the environmental impacts and economic costs of waste and enhance regional prosperity and employment. Recognising that an innovative and systems-based approach is needed, the Commonwealth Department of Industry, Science, Energy and Resources has asked CSIRO to consider what solutions are available. CSIRO consulted with 83 industry, research and government representatives to determine those solutions.

This report suggests that Australia has what it needs to launch a circular economy strategy that will both address fundamental environmental issues and foster economic development and employment.

It sets out:

- **Australia needs an integrated and innovative circular economy strategy.** Promising existing work has not yet met that need, so that waste exports and material extraction both continue to rise, and Australia lags further behind other countries in a growth market.
- **A circular economy strategy** that integrates material flows and enabling institutions in six elements
- **Strategies across the four major waste resource streams** of paper, glass, tyres and plastics that will overcome challenges identified by stakeholders
- **Clear roles for participants in the circular economy**, spanning the public, household, government, private and non-profit sectors
- **The actions needed to build on this report and implement an Australian circular economy strategy**

CSIRO presents this strategy as a practical and achievable approach for Australia to transition to a resource-efficient path.

Australia needs an integrated circular economy strategy

An integrated circular economy strategy is needed to meet our intrinsically linked environmental, economic and social needs.

Australia needs to deal with both its immediate waste management issues as well as the long-term sustainability of its natural resources. These are issues it shares with other nations, both individually and collectively. Our traditional 'take-make-dispose' consumption pattern is hitting two walls: ever-more-expensive primary materials, and ever-more-unacceptable ways of dealing with waste. More recently, the global pandemic has disrupted global supply chains which challenges Australia to be self-sufficient with sovereign manufacturing capability. As landfills are compromising our environment and Australia has a limited recycling industry, Australia has been exporting its waste: 4.4 million tonnes in 2019, mainly to Asian nations, including 1.4 million tonnes of plastic, paper, glass and tyres. Partial bans on the export of this waste are now limiting that option as Australian government leadership commits to domestically processing our waste.

To achieve this Australia needs to transition to a circular economy in which today's goods are tomorrow's resources. This will reduce the pressure to extract or import virgin materials, in ever more sensitive areas, and reduce the impact of landfills on our aquifers, oceans and greenhouse gas emissions. Innovation in waste recycling and product design creates opportunities for economic and science collaboration with our regional neighbours, export opportunities for technologies and jobs in regional Australia.

We recognise the need for action

In the last three years, there have been several inquiries and projects to address waste management and recycling, culminating in the National Waste Policy 2018 and accompanying Action Plan 2019. At the Council of Australian Governments (COAG) meeting on 9 August 2019, the Federal Government and State Governments have developed a timetable to ban the export of waste plastic, paper, glass and tyres, and develop a strategy to build Australia's capacity to generate high value recycled commodities domestically and associated demand. Leaders agreed the strategy should draw on the best science, research and commercial experience, including CSIRO.

Significant challenges to a circular economy will need to be overcome

Five interlocking challenges are stifling progress toward a circular economy:

- **Loss of source material through sub-optimal product design, consumption, and collection**, so that valuable resources are lost to landfill, dumped, stockpiled or disposed on site. Commingled kerbside collection means that potentially recyclable material is contaminated by glass fines, electronic waste, nappies, textiles and organic waste. The use of composite or problematic material in product design and packaging exacerbates the problem, as does product design for obsolescence rather than for repair, reuse, disassembling and recycling.
- **Lack of reprocessing capacity** limits the potential for manufacture from recycled material**.** Australia needs to grow the sorting and recycling infrastructure needed to retain that source material. Potential investors face high capital and operating costs and small profit margins, and the economies of scale needed are beyond reach.
- **Lack of end markets for secondary materials**. Corporate and government procurement can often stick to the products they know: often cheaper imports made from virgin resources or subsidised recyclates. Similarly, there seems little appetite for investment to test and commercialise niche innovations in secondary material manufacturing.
- **Lack of consistency across jurisdictions** in consumer education, industry standards, and waste governance. All product stewardship and sustainable design schemes are voluntary, and the good intentions of some consumers and businesses are overwhelmed by inconsistent policies and disposal fees and a regulation bypass for imported goods.
- **Lack of system-wide capability to support a circular economy** slows down the transition towards increased value recovery**.** Australia needs accurate material flow, life-cycle and industry asset data to support nationwide waste governance and innovation through the product stream. Such data are incomplete for the four material streams of plastic, glass, paper, and tyres.

Together, these challenges represent a relative lack of understanding about the principles of the circular economy and how to foster it, especially in SMEs. These challenges can only be overcome with a concerted effort to build a national culture that values the re-use of secondary materials.

The six elements of the circular economy

While there is a clear circular flow for materials through three broad stages in the circular economy (represented by the inner circle), Australia must also address three primary enablers to achieve a circular economy (represented by the outer circle).

1. Retain material through use and collection

Materials that are kept in circulation are valuable twice over: they reduce the need for virgin materials and reduce waste going to landfill. The less processing they need in the cycle, the more valuable they are. The product cycle has to allow for easy disassembly, collection and sorting infrastructure – to retain as much high-quality secondary materials as possible.

2. Upscale and innovate recycling technologies

To capitalise on quality feedstock, Australia needs to radically improve its recycling capability. Innovation must be pursued through government-research-industry collaboration. Improved planning is needed for reverse logistics and state-of-the-art recycling technology integrated with industry and commerce. Depending on transport economics, regions can house either major waste and recycling hubs, or smaller-scale community-based solutions.

3. Innovate and collaborate in design and manufacture

In some existing product streams, especially glass, recycled material can be readily substituted for virgin material. Many more could draw on recycled material, if the product design or the supply chain policies encouraged it. However, the biggest opportunity is for the circular economy to be a principle of Australia's growing investment in innovation, with government, science and industry incorporating secondary materials in product design and business models.

4. Develop markets for secondary materials and the products that use them

High quality secondary material is of little value if there is no market for it and additional effort is needed to develop that market. Three initiatives are needed, at a minimum: Product standards must allow the use of secondary materials wherever possible. Government agencies and sustainable corporations can seize the opportunity and implement procurement practices to 'buy recycled', particularly in construction. Financial incentives can encourage the use of recycled products.

5. Streamline nationally consistent governance

Reducing waste is a valuable public good, and so the circular economy must be supported by favourable regulation. Australia needs nationally consistent standards for material use and collection, to allow recycling hubs to reach economies of scale. We need uniform rules and mechanisms to reduce the cost and increase the levels of compliance.

6. Secure a national zero-waste culture

None of these things will be possible without a national culture that thinks 're-use' before 'throw out' and acts accordingly. Every channel should be used to support that vision, to change mindsets and guide behaviours both at home and at work. That extends from clear and consistent product labelling and recycling instructions, up through industry and local initiatives, and ultimately to national campaigns, metrics and targets. With this vision supporting an effective strategy, more investment, collaboration, innovation and skill-building will follow.

Strategies to build enablers and overcome challenges

ELEMENT	STRATEGIES
1. **Retain material through use and collection**	**Improved collection** Effective consumer education; dedicated collection systems (clean and cross-contamination materials); banning of landfilling, dumping, stockpiling and on-site disposal, and reverse logistics **Improved sorting** Upgrading MRFs; aligned contractual arrangements, improved data collection
2. **Upscale and innovate recycling technologies**	**Increase capacity for plastics, paper, and tyres** Strategic investment aligned to infrastructure and innovation plans; streamlined approval processes **Foster regional recycling** Local recyclate; hubs with reverse logistics; precincts committed to circular economy; micro-factories, composting and waste-to-energy
3. **Innovate and collaborate in design and manufacture**	**Circular product design** Eco-design of products; packaging in one material stream, retreadable and durable tyres **Tie the circular economy to innovation** Leverage national and industry innovation programs; incorporate circularity principles; pursue novel solutions for niche problems
4. **Develop markets for secondary materials and their products**	**Drive procurement policies** Government and corporate procurement, including forward commitments, financial incentives **Innovate business models** Replace at risk virgin materials; research novel products; collaborate on economics
5. **Streamline nationally consistent governance**	**Harmonise governance** Harmonise waste policies, regulations, levies and quality standards for imports, waste collection and recycling fees, standards for products with recycled content, single use plastics, construction materials and other applications **Streamline compliance** Implement consistent auditing and accreditation and remove burden of duplicated or ineffective compliance
6. **Build a national zero-waste culture**	**Change the national culture** Consistent public campaigns, labelling and instructions for households, commerce and government; national metrics, data and targets; International participation **Support industry participation** Grandfather existing contracts; promote material stewardship; promote participation in the circular economy supply chain; build resilience to system shocks

Staged priorities across the four material streams

Plastics priorities

2022

- Government procurement;
- sorting technology;
- infrastructure investment;
- and standards development and industry pledges to increase market demand.

2025

- Regional and niche demonstration projects improved data across supply chain, consistent labelling and consumer education.

2030

- Standardise council waste contracts, 80% plastics recovery rate, commercial scale feedstock recycling.

Glass priorities

2022

- Uncontaminated, sorted glass at collection;
- streamline standards and compliance burden.

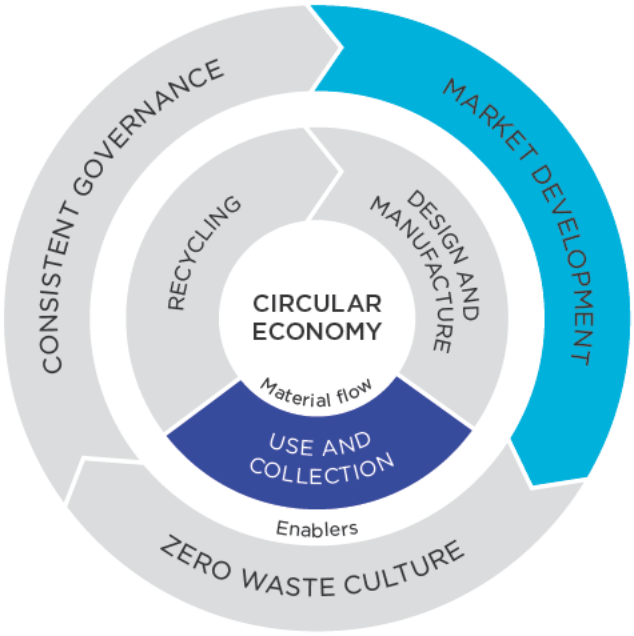
2025

- Innovation in recycled products and processing;
- entry of SME and regional operators.

2030

- 80% glass recovery;
- virgin material drops under 20% of input;
- recycling an essential service.

Paper priorities



2022

- Uncontaminated paper at kerbside collection;
- harmonised standards;
- new domestic demand for recovered paper products.

2025

- Regional facilities for recycling fibre;
- 100% packaging to re-use, recycle or compost;
- national targets and data tracking.

2030

- 80% recovery rate;
- regional Australia the centre of paper ecology;
- Australian solutions for low-quality paper recycling adopted globally.

Tyre priorities

2022

- Mandatory tyre stewardship, quality standards and increased levies for imports;
- harmonised transparent recycling fees to fund recycling infrastructure.

2025

- Tyre disposal bans;
- harmonised national governance;
- and specifications for recyclates;
- procurement policies and financial incentives for recycled material use.

2030

- 100% recovery;
- new market platforms for industrial ecology, reverse logistics, innovation parks and non-tyre infrastructure.

Plastics priorities

Australia consumes 3.4 MT of plastics and recycles just 12% of end-of life plastics. Just over 60% of what is recovered is exported, earning $43M in 2018, but that export will be banned from 2021 (mixed plastics) and 2022 (unprocessed single type plastics). To process what was previously exported, Australia must increase its recycling capacity by around 150%. There is no single 'silver bullet' for this transition to a circular economy in plastics, as there are many types of plastics, and the challenges are numerous and often interconnected.

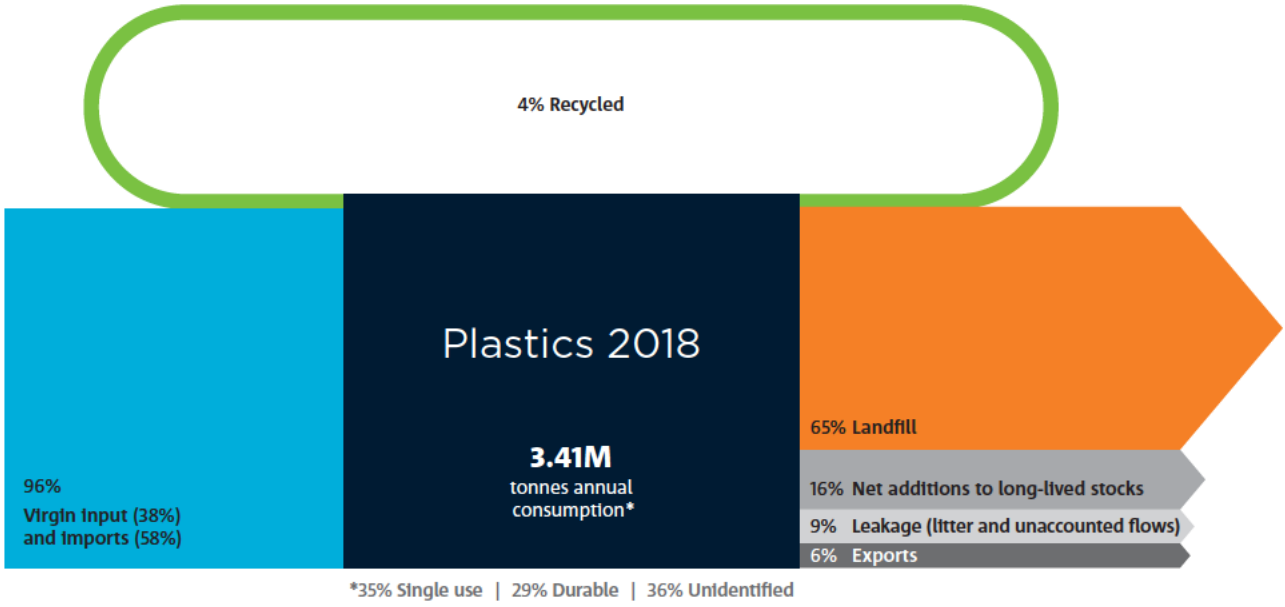
However, the biggest single need is to create more markets for recycled plastics, which will underpin confidence for investors to build recycling infrastructure.

Increased market demand will flow from better information across the supply chain and quality standards to provide confidence that material is fit for purpose. Plastics challenges are best overcome by collaborative projects between manufacturers and recyclers to bring together the supply chain. A good example is the collaboration between Cleanaway Waste Management (resource supply), PACT Group (packaging capability) and Asahi Beverage Group (market need), supported by the NSW Government to recycle PET at a new facility in Albury/Wodonga.

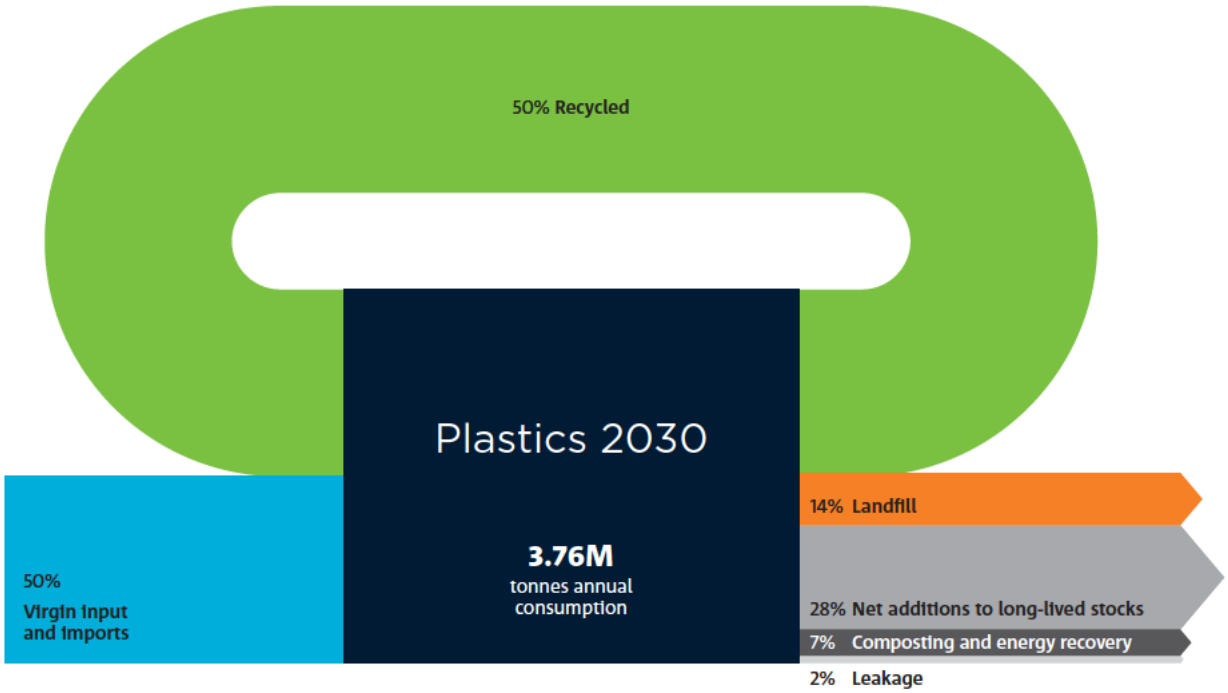
Based on the analysis of 4 technology examples, investments of $99 million in a MRF Facility, LDPE processing, rPET processing and feedstock recycling (catalytic reactors to produce synthetic oils) would abate 140kt of plastics and generate 94 jobs (not including LDPE processing or construction).

The priorities to increase domestic processing and develop a circular economy for plastics in Australia are:

- **Design and collection:** Design packaging to be 100% recyclable. Optical sorting technology to reduce contamination levels and sort plastics into types.
- **Infrastructure:** Connect waste processing and manufacturing sectors to replace virgin resources with recycled resources, develop new infrastructure for processing plastics (washing, flaking and pelletising) and niche business models for plastics not collected via MRFs
- **Market development and innovation:** Increase government procurement of recycled plastic products; develop standards for recycled plastics to support infrastructure investment and confidence in virgin resource substitution; identify and remove barriers to adoption in major infrastructure; monitor and track increased market demand; national program for plastics research.
- **Circular economy vision:** Increase product stewardship; campaigns to reduce plastics pollution, increased adoption of the Australasian Recycling Label and education on household recycling
- **Governance:** Grants, loans and streamlined approvals to stimulate recycling infrastructure investment phase out or ban problematic, unnecessary single-use plastic packaging; connect to international initiatives



*35% Single use | 29% Durable | 36% Unidentified



Glass priorities

By 2030, Australia aims to double its domestic recycling of glass to reach two-thirds of all end-of-life glass and recover 80% of glass across the supply chain.

To do that, Australia must focus on recovering clean, sorted glass at source, as well as finding applications for low-quality waste glass.

Clean, separated waste glass (or "cullet") is a 100% recyclable material, valued at about $70/tonne for packaging glass (bottles and jars) and even more for flat glass. It is totally substitutable for virgin material, and requires less energy, additives and processing in glass manufacture.

However, over a quarter of Australia's end-of-life glass went to landfill in 2018, with a further 20% stockpiled for undetermined future use. At the same time, two-thirds of glass manufacturing inputs were sourced from virgin material or imports.

The problem is that mixed, compacted waste glass is difficult and costly to sort and clean post-collection. It can have a low or even negative value (i.e. pay for it to be removed).

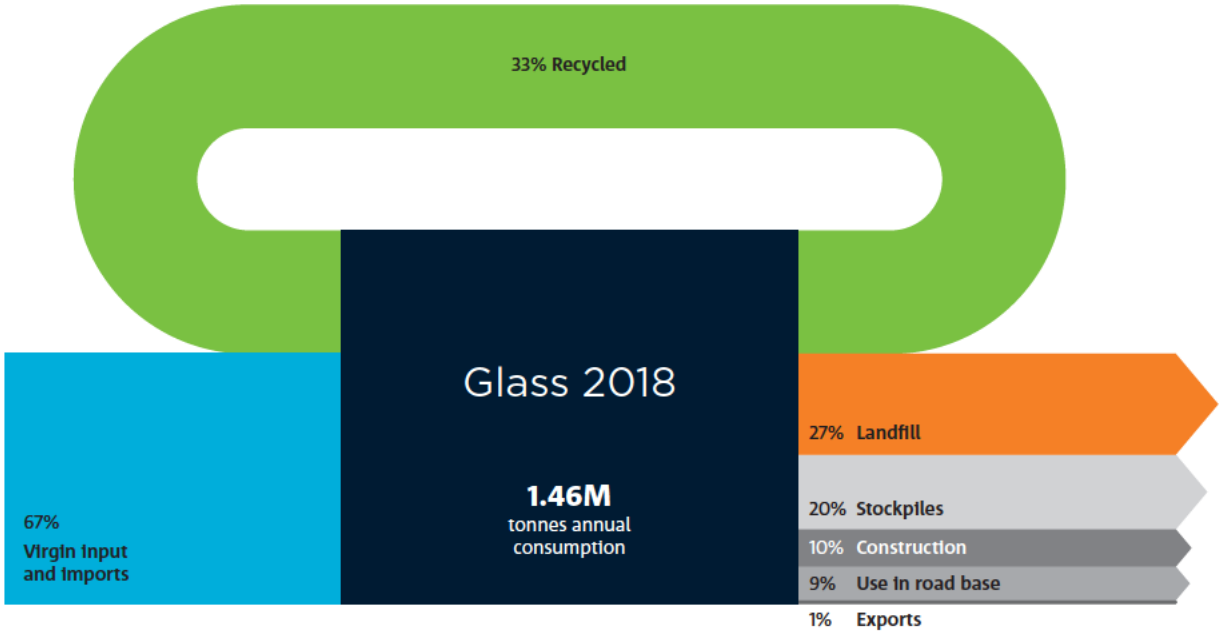
The best solution is to separate waste glass from other materials at the collection point. Clean, separated feedstock opens opportunities for smaller recyclers, micro-factories and recycled glass applications at regional scale.

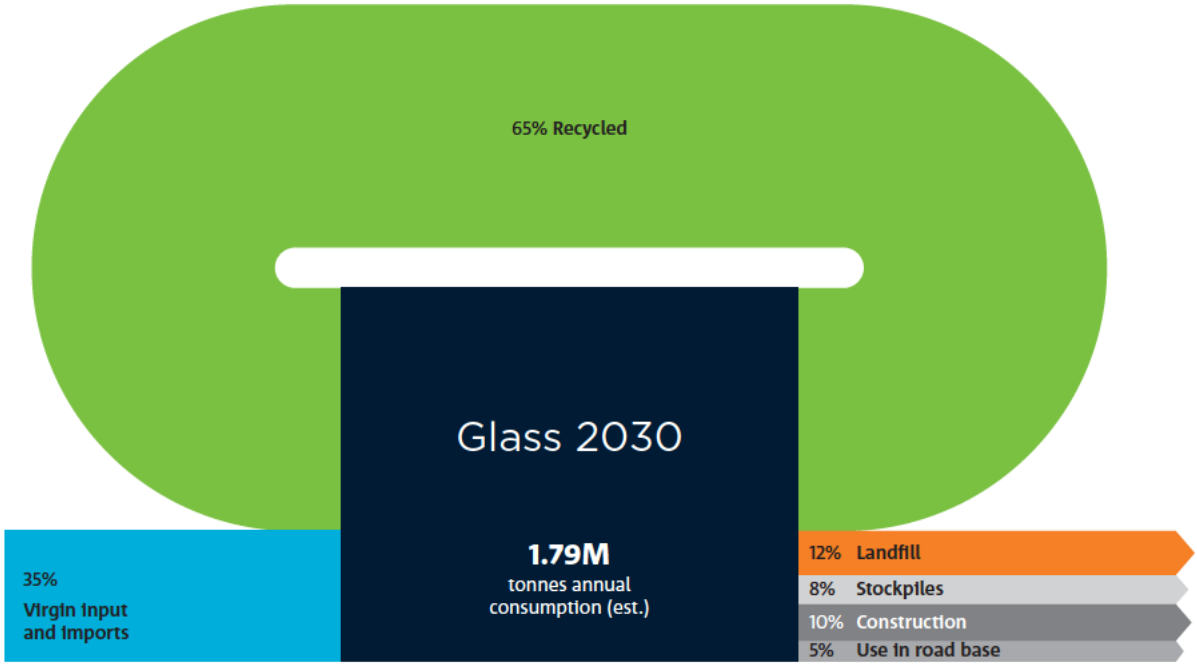
There are also opportunities for capturing the highest value forms of glass – flat and architectural glass. As well, Australia has more than 12 million glass solar panels installed, many of which will reach end-of-life over the next 10 years.

While clean, sorted cullet has a ready market, currently about 30-40% of collected glass is not appropriate for glass packaging manufacture. It requires an alternative market, for example as glass sand in road base and asphalt. An investment of $20M could generate 150 jobs and process up to 200 kt per year, valued at $2.4M per year.

The specific actions needed to improve the quality of waste glass at the collection point are:

- **Zero waste culture:** Comprehensive behaviour change initiatives with niche technologies and if needed financial incentives to clean and sort used bottles and jars at home and work.
- **Use and collection:** Provide collection bins for separated glass (for example, Yarra City Council is trialling separation at source with 1,300 households). Reverse logistics to reduce transport costs. Where separation at collection is not feasible, some investment in optical and digital sorting capabilities can raise recovery rates
- **Consistent governance:** Track high-value glass flows from beginning to end, especially for flat glass. Update waste regulation to allow glass to be stored in quantities that meet the demand of infrastructure projects.


33% Recycled
Glass 2018
1.46M
tonnes annual
consumption
67%
Virgin input
and imports
27% Landfill
20% Stockpiles
10% Construction
9% Use in road base
1% Exports


65% Recycled
Glass 2030
1.79M
tonnes annual
consumption (est.)
35%
Virgin input
and imports
12% Landfill
8% Stockpiles
10% Construction
5% Use in road base

Paper priorities

Australia already recycles 2.16 million tonnes or 39% of the 5.6 Mt of used paper and cardboard that we generate each year. So there is a circular paper economy to build on, and paper can be recycled up to seven times if it stays in a clean feedstock loop. However, too much of the paper and cardboard we send for recycling is contaminated, adding to the 2.24 Mt that goes directly to landfill.

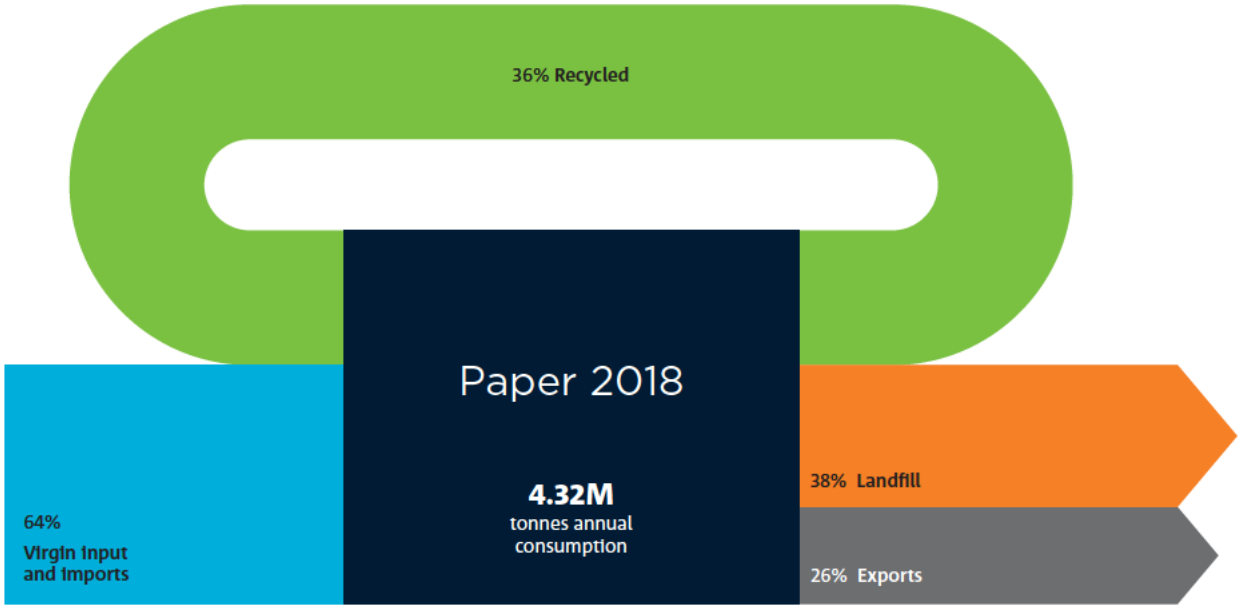
Given Australia already has a developed paper recycling industry, it should focus on reducing single-use paper and addressing the leakage from lower value fibre.

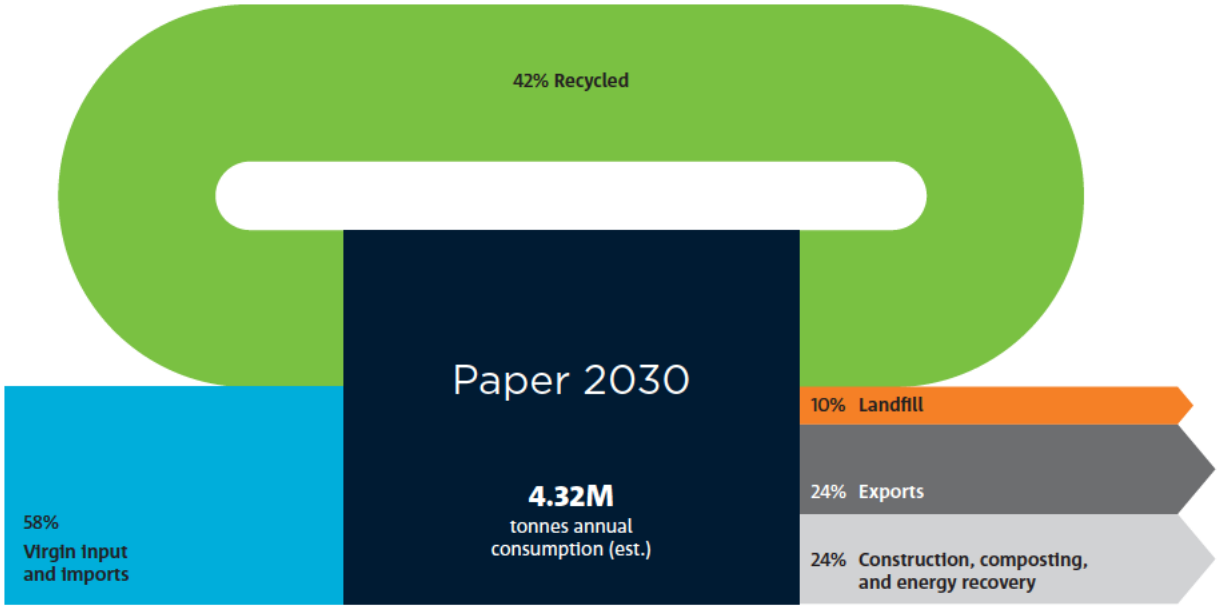
This would include replacing single-use paper products with reusable materials, sorting used paper products more effectively, and using lower-value end-of-life paper in construction, composting and for energy recovery.

Australia should also continue to earn income from exporting about 800 kt of bulk clean cardboard. As we already meet almost all of our domestic needs for recycled board, it makes sense to export it to where it can be processed and re-used.

To support these shifts, Australia needs targeted action in five elements of the circular economy:

- **Design and manufacture:** Embed circular economy thinking, particularly in SMEs – designing products for circularity, substituting disposable paper products with reusable products, simplifying packaging to single source materials, and removing hazardous inks and polymer coatings.
- **Use and collection:** Less contamination of paper in domestic curbside collection, particularly from glass and organics, and less paper use in large public and private sector institutions. This would deliver uncontaminated feedstock for high-value recycling.
- **Recycling:** Explore capital investment to recycle uncontaminated feedstock into corrugated-packaging, box board or recycled office paper.
- **Market development:** Using procurement guidelines and certification processes for existing secondary materials and developing more options in construction, energy and compost for low quality mixed paper. For example, a regional waste-to-energy facility could abate 280 kt of paper fibre per year.
- **Consistent governance:** Giving potential users clearer data on the availability of secondary material, through industry standards, life cycle assessments and infrastructure mapping. Setting national targets embedded in state-based plans with progress metrics.


36% Recycled
Paper 2018
4.32M
tonnes annual
consumption
64%
Virgin input
and imports
38% Landfill
26% Exports


42% Recycled
Paper 2030
4.32M
tonnes annual
consumption (est.)
58%
Virgin input
and imports
10% Landfill
24% Exports
24% Construction, composting,
and energy recovery

Tyre priorities

Currently, Australia recycles or re-uses domestically just 14% of its used tyre stock. Another 55% is exported for a modest income, and 31% is sent to landfill or just stockpiled, dumped or buried on-site in the mining and farming sectors. These other actions have an unacceptable environmental impact.

Australia has a clear opportunity to increase the capture of tyres for value recovery and to invest to build domestic recycling capacity.

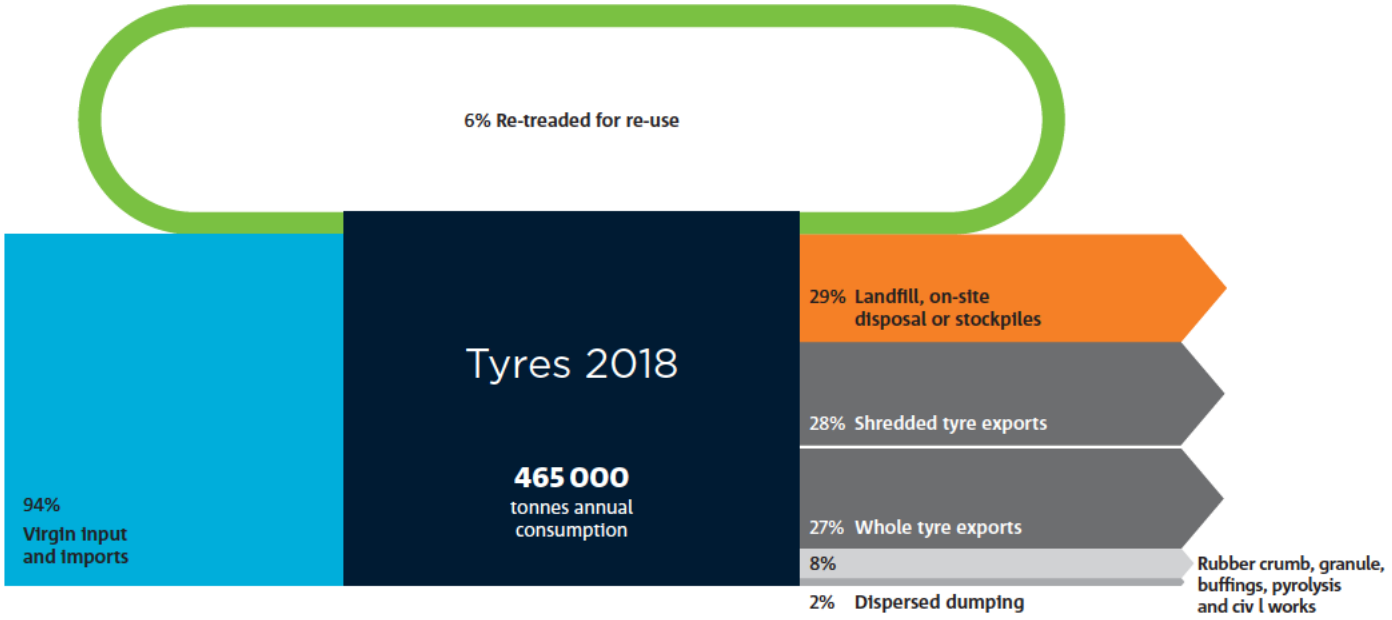
As an indication of the investment needed, the cost to annually process 1 ton of used tyres is estimated to be $133 for civil construction, $160 for shredding, $480 for crumbing and $1,660 for pyrolysis. For comparison, disposal of tyres to landfills in jurisdictions where it was still allowed costed $600-1,900/t.

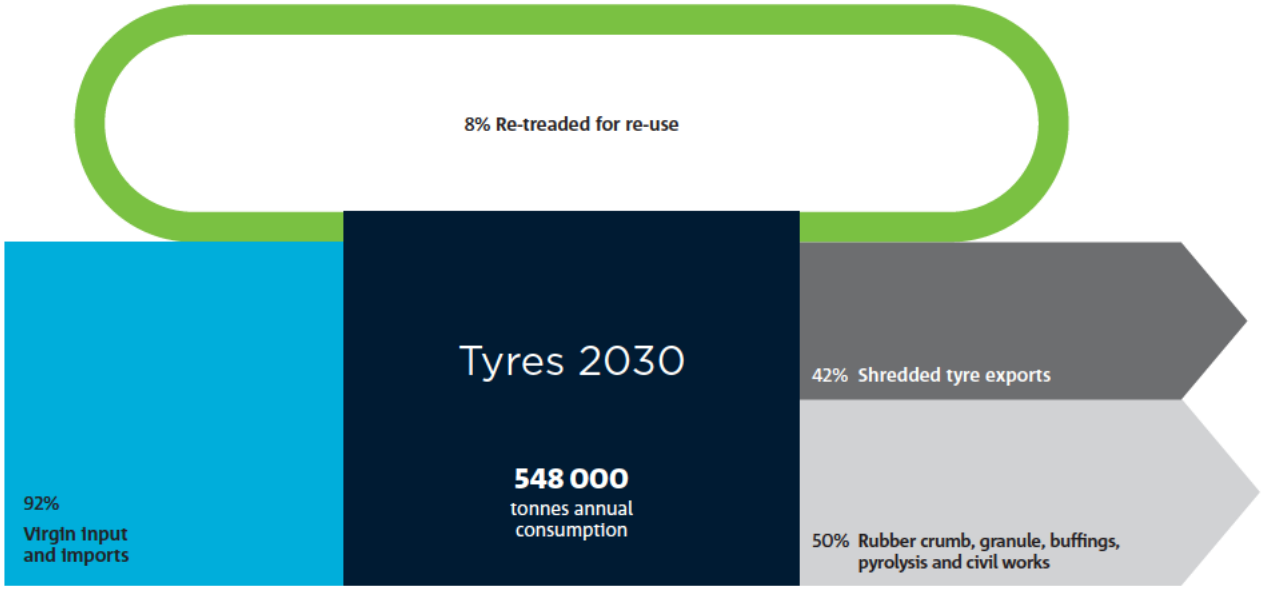
In terms of employment, civil engineering with used tyres could employ 6-7 people/kt, shredding 0.4 people/kt, crumbing 1.2 people/kt, pyrolysis 1-2 people/kt and retreading 10.4 people/kt.

This opportunity would turn the mounting cost of tyre disposal into recurring employment and income from a valuable secondary material and fulfill the latent national desire for a more circular economy.

The actions to secure this opportunity include:

- **Consistent governance:** A mandatory national tyre stewardship scheme. This would be funded by an increased levy on all imported tyres, and a transparent, consistent and higher recycling fee for all new tyres with a higher proportion of that fee going to recyclers. It would be enforced by strict bans on landfilling, dumping, stockpiling and on-site disposal and mandatory auditing and accreditation of operators and online tracking of all tyre transports; minimum quality standard for all imported tyres to ensure durability and recyclability.
- **Infrastructure:** Investment in infrastructure that facilitates collection, reverse-logistics and recycling of used tyres and that helps to avoid or reduce tyre use.
- **Market development:** Procurement policies and financial incentives for retreaded tyres, tyre-derived products and fuels, and new market models, such as tyre leasing.
- **Innovation:** Support for research, innovation, performance evaluation, demonstration, upscaling and commercialisation of new innovations that support the circular economy of tyres.
- **Education and culture shift:** Multi-tiered education to support circular economy of tyres and a zero-waste culture shift.


6% Re-treaded for re-use
Tyres 2018
465 000
tonnes annual consumption
94%
Virgin input and imports
29% Landfill, on-site disposal or stockpiles
28% Shredded tyre exports
27% Whole tyre exports
8%
Rubber crumb, granule, buffings, pyrolysis and civ l works
2% Dispersed dumping


8% Re-treaded for re-use
Tyres 2030
548 000
tonnes annual consumption
92%
Virgin input and imports
42% Shredded tyre exports
50% Rubber crumb, granule, buffings, pyrolysis and civil works

Clear roles for all participants

All participants in the circular economy have a shared responsibility to make it efficient and effective.

Government

Government agencies at all three levels can influence a more sustainable circular economy by:

- setting the leadership agenda with harmonised policy, targets, benchmarking and regulation of which the National Waste Policy Action Plan is a good example
- funding priority areas with grants, subsidies or taxation incentives and loans for infrastructure
- leading community education initiatives, and
- setting standards in its own procurement to support the circular economy.

Industry

In the circular economy, industry participants include sectors that consumer large quantities of tyres, plastic, paper and glass,specialist waste management and manufacturing sectors, as well as infrastructure, product, service and investment companies who either use or can sponsor recycled products. While private firms will make their own investment decisions, industry organisations can support them and the circular economy by:

- coordinating input into policy, research and supply chain priorities
- initiating or brokering collaborative pilots and research initiatives, and
- liasing with government on local, state or national policies and initiatives.

Community

The primary community actors are the households and small businesses, who collectively generate most of Australia's recyclable waste. Their roles are paramount in:

- the primary cleaning and sorting of recyclable paper, plastics and glass
- Return of used tyres for value recovery
- consumption decisions that favour products of recyclable material and packaging, and
- supporting government actions towards a more sustainable circular economy.

Secondary community actors include non profit organisations that can both advocate on behalf of households for equitable and efficient regulation towards the circular economy, and support households in adopting the recycling behaviours on which the circular economy depends.

Research

Agencies such as universities and the CSIRO have both research and facilitation roles, undertaken either independently or at the request of any other participants, to:

- identify barriers through the value chain
- identify possible solutions, whether original or existing in Australia or overseas
- test those solutions with industry participants
- engage with and inform government policy, and
- track progress against targets.

Building the roadmap is just the start

CSIRO has set out this roadmap after in-depth interviews with 83 stakeholders including companies, universities and government agencies, a review of the national and international literature, and testing the viability of options in the Australian economic and regulatory context.

It sets out specific industry initiatives to retain and maintain the quality of primary materials, improve collection and sorting systems, and build the national capacity to reprocess all four waste materials.

These actions for the material flow must be supported by a harmonisation of national governance, sharper development of new markets and business models, and most of all a shift towards a 'zero waste' culture.

The next steps needed to advance this vision may be to:

- convene through the National Cabinet a mechanism to harmonise the governance of material flows, as part of its pursuit of a national circular economy strategy
- facilitate a national summit to refine this roadmap into a clear and agreed national strategy, and to secure responsibilities for it
- establish metrics and baseline data to track the loss of materials
- inject the principle of the circular economy into Australia's innovation funding, initiatives and objectives
- fund demonstration projects of closed loop industry, particularly in the regions
- link with one or more other countries with similar or complementary material economies, to inspire ideas and commitment for those leading the national effort.

The priorities set out in this roadmap form the basis for a circular economy strategy that will address fundamental environmental issues, and foster regional employment.

CSIRO looks forward to working with industry and government stakeholders on these solutions.

As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.

CSIRO. Unlocking a better future for everyone.

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