

Tipping the balance

The business case for
a circular economy
for Australia's
off-the-road tyres,
conveyors,
and tracks



**Summary and
Action Plan**

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This report was informed by so many organisations and people, both here in Australia and globally, that were so generous in sharing their knowledge, experience, and insights. We are grateful to each of you and look forward to continuing to tip the balance towards improved resource recovery of off-the-road tyres, conveyors and tracks in Australia.

Thank you to the OTR Project Committee that oversaw the project, providing feedback and guidance from their perspectives of the OTR related products, OTR sectors, resource recovery value chain and stewardship, social justice and governance best practice.

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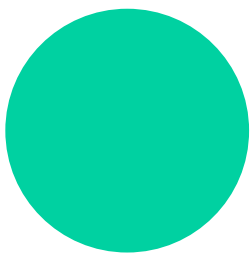


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Summary and Action Plan



A word from Lina Goodman,

CEO Tyre Stewardship Australia



Times have changed, we need to change with them

Over the past 200 years, Australia has built successful mining and agricultural sectors that are the envy of the world. We can be justifiably proud of the economic contribution these sectors have made to this nation, while acknowledging that, with this success, comes an expectation of increased environmental and social responsibility and action.

A critical component of these sectors that is often overlooked is off-road tyres, tracks and conveyor belts (OTR rubber products). Without these items, mining, agriculture and other sectors such as construction, manufacturing and aviation in Australia would literally grind to a halt. But when these items reach the end of their useful life, what do we do with them? Most we simply bury, stockpile onsite or send to landfill.

A lost opportunity

Historically, miners and farmers have had little option, because limited onshore infrastructure was available to recover OTR rubber products from the remote locations where they are used. What's more, regulations that apply to other areas of waste management and landfill are silent when it comes to onsite disposal of OTR rubber products, so there is neither an incentive nor a requirement to recover and recycle them.

This combination has allowed experts in resource extraction to simply waste resources, and possibly degrade landscapes. Then there is the question of reconciling how industries treat Australian land with core values held by First Nations peoples, many of whom will have a future responsibility for Country after it is handed back when mining operations cease.

Times have changed, and what we did in the past is no longer good enough in a world that has woken up to the environmental dangers and enormous social harms of industrial pollution. Globally, there has been a shift in the appreciation of the impact of our actions on future generations, making the practice of onsite burial, stockpiling, and landfilling of OTR rubber products increasingly unacceptable.

Showing leadership

The Australian mining and agricultural sectors have always been at the forefront of innovation. We're now looking at a huge opportunity to step up and become the world leaders in recovering and recycling OTR rubber products. Many countries are already moving into this market, and if we sit on our hands now we will be left behind.

Many stakeholders need to become part of the conversation about how we're going to address this. Not just the miners and the farmers, but tyre importers, recyclers, governments, indigenous people and local communities and other users of OTR rubber products, such as the manufacturing, construction, and aviation sectors.

Pulling together

If recyclers are to create a viable market from the valuable products that can be made from OTR rubber products, we need the heft and reach of everyone involved to help us create a circular economy. Tyre Stewardship Australia can't do it alone, nor can individual companies or governments – we all need to work together to overcome the barriers.

This will be hard, we're under no illusions about that. The vast distances involved, the logistics of moving huge and heavy tyres and many other obstacles will have to be overcome.

Catchments - a way forward

One of this report's key findings is the identification of catchment areas across Australia with high concentrations of OTR rubber products. This is a national issue and we don't want to leave anyone behind, but starting with these catchments will enable us to concentrate our efforts in areas where we can have the biggest impact, create reliable economic opportunities for investors and indigenous people and local communities, and enable companies to demonstrate their willingness to change.

This approach will shore-up future successes across Australia, as we learn and build on our real-world knowledge from the similarities and uniqueness of each catchment.

How to do it?

A first step is to reconsider the current voluntary Tyre Product Stewardship Scheme (the Scheme). Under the existing guidelines and voluntary funding arrangements, the Scheme does not have the authorisation to support the whole supply chain for OTR rubber products in a manner that Australia requires.

A second step is to engage all the parties involved in supplying, using and recycling OTR rubber products, and the various other stakeholders who are affected by or have a say in the way these products are used.

In the absence of a Scheme designed for greater recovery across the Australia, TSA will continue to play an advocacy role and find ways to collaborate with cooperative partners to deliver change desperately needed to improve very low recovery of OTR rubber products.

Change does not happen overnight, but now is the time to act, because we know enough to step forward confidently. The world has moved on and we need to move with it. We can't bury our heads in the sand about onsite dumping of OTR products anymore.

I look forward to working with you all over the coming years to build a world-leading circular economy for OTR rubber products.



Lina Goodman
CEO, Tyre Stewardship Australia

Report Summary

About this summary

This document summarises the findings in *Tipping the Balance* and provides TSA's position on improving OTR rubber product recovery in Australia.

Tipping the Balance is the culmination of significant research, data collection, stakeholder engagement, and consultation.

The report identifies the:



Challenges and opportunities of increasing recovery and recycling of OTR rubber products.



Benefits of improving recovery and striving for a circular economy.



Proposed approach to expanding the Scheme to include all OTR rubber products.

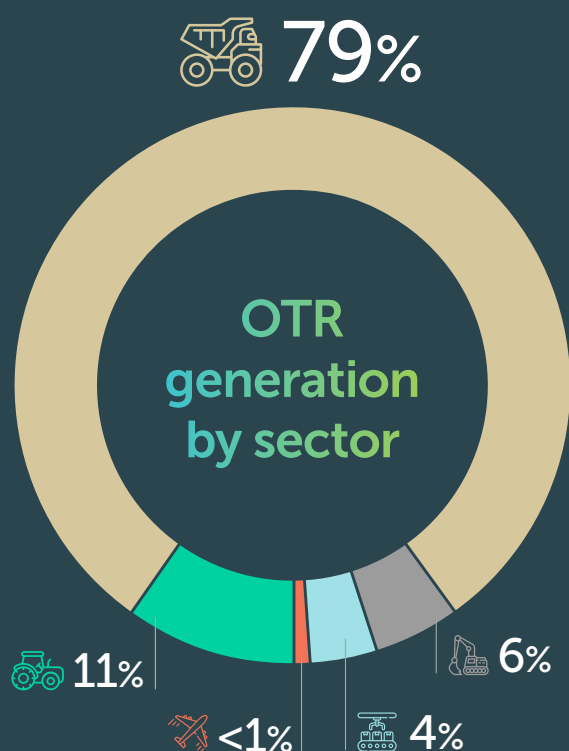


Roles and responsibilities of stakeholders across the OTR rubber product supply chain in driving change.



Roadmap to achieving a circular economy for Australia's OTR rubber products.

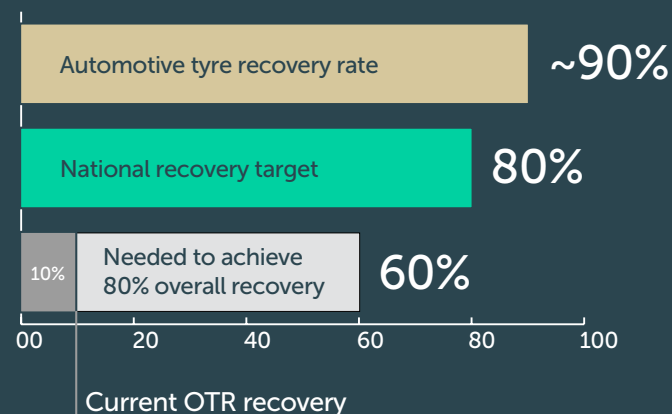
Most end-of-life OTR tyres are generated by mining, with agriculture a distant but significant second.



Fewer than **10%** of OTR tyres are recovered, with this falling to <2% of mining and agriculture tyres.

Across Australia **130,000 tonnes** of off-the-road tyres reach their end of life each year.

Add to this up to another **115,000 tonnes** of rubber tracks and conveyors, that's up to **245,000 tonnes** of OTR rubber products we're throwing away every year



We recover about **90% of automotive tyres**, but to reach **80% overall recovery** we need to improve **OTR recovery from 10% to 60%.**

TSA's Brief

Since 2014, Tyre Stewardship Australia (TSA) has run the Tyre Product Stewardship Scheme (the Scheme) supporting recovery and recycling of passenger car, bus and truck tyres (automotive) and off-the-road (OTR) tyres.

In 2020, the Federal Government awarded grants under the National Product Stewardship Investment Fund to:

- increase and expand industry-led stewardship schemes
- increase availability of product recycling schemes
- reduce waste to landfill and increase recycling rates
- contribute to the national target of 80% resource recovery by 2030 under the *National Waste Policy Action Plan*.

The grant to TSA

TSA was awarded a grant to improve tyre recovery in the mining sector. The project's scope was to increase the participation of users of OTR rubber products in the Scheme, and expand the Scheme to include all OTR rubber products like tyres, rubber tracks, and conveyor belts.

This was to be achieved by developing and implementing a business case and exploring technology to collect data about the consumption, disposal, collection and recycling of OTR rubber products.

To satisfy the grant, TSA would examine how:

- to bring the whole supply chain of OTR rubber products into the Scheme
- to improve the recovery rate of used OTR rubber products and develop new markets to encourage collection, recycling and investment
- to identify and assess options for used OTR rubber product users in remote locations
- to engage with all stakeholders to understand the issues from all angles
- other parts of the world have approached the issue, including relationships with indigenous groups.

Before we start, some important definitions

What are OTR rubber products?

OTR rubber products refers to tyres, tracks, and conveyor belts used on off-the-road equipment such as construction and mining equipment, agricultural tractors, industrial equipment, aircraft, and defence equipment.

OTR tyres come in a range of rim sizes, from a forklift tyre with a rim of less than 20cm that you could pick up in one hand, to mining dump truck tyres with a rim size of nearly two metres (63 inch) that weigh up to five tonnes.

OTR tyres are not automotive tyres (i.e. car, bus, truck, 4-wheel drive, or motorbike tyres), which are used mostly for on-road applications. In this report we refer to these types of tyres as 'automotive' tyres.

See *Section 2 of the Tipping the Balance: Research Report* for a detailed description of these products and their uses, their composition, consumption, and generation in tonnes by category and state, with further detailed by catchment area in *Section 8 and 9*.

End-of-life, used, or waste OTR rubber products

This report refers to end-of-life, used, or waste OTR rubber products. These are all the same thing: an OTR rubber product that is worn and due for replacement. It could be refurbished, re-treaded, or re-processed to make use of the embodied materials.

Consumption versus generation

Unless stated otherwise, figures refer to end-of life OTR tyres generated by each sector, rather than the amount of new tyres purchased by those sectors. The difference between OTR tyre consumption and OTR tyre waste generation is wear and degradation over the tyre's operating life.

Catchments

This report refers to eleven catchment areas, meaning regions where there are high consumption rates of OTR rubber products, such as the Pilbara in WA, the Bowen Basin in QLD and the Hunter Valley in NSW.

Catchments are a key concept in this report, as one of the main ways to reduce transport and logistics costs by locating recovery solutions in key waste generation locations. Catchments are outlined in detail in *Section 8* of the *Tipping the Balance: Research Report*.

The OTR recovery challenge

The issue and the opportunity

Why is TSA focussing on OTR rubber products, and tyres in particular? Because of the approximately 130,000 tonnes of used OTR tyres generated each year, at present only around 10% are recovered - the rest are mostly buried or stockpiled onsite or sent to landfill.

This falls short of both the current recovery rates of around 90% for automotive tyres and the government's target of 80% across all waste streams by 2030.

We also estimate that up to an additional 55,000 tonnes of used rubber conveyor belts are disposed onsite at mining sites and up to 30,000 tonnes of used rubber tracks are buried onsite or disposed to licensed landfills.



Of the approximately 130,000 tonnes of used OTR tyres generated each year, at present only around 10% are recovered



Who's generating used OTR rubber products?

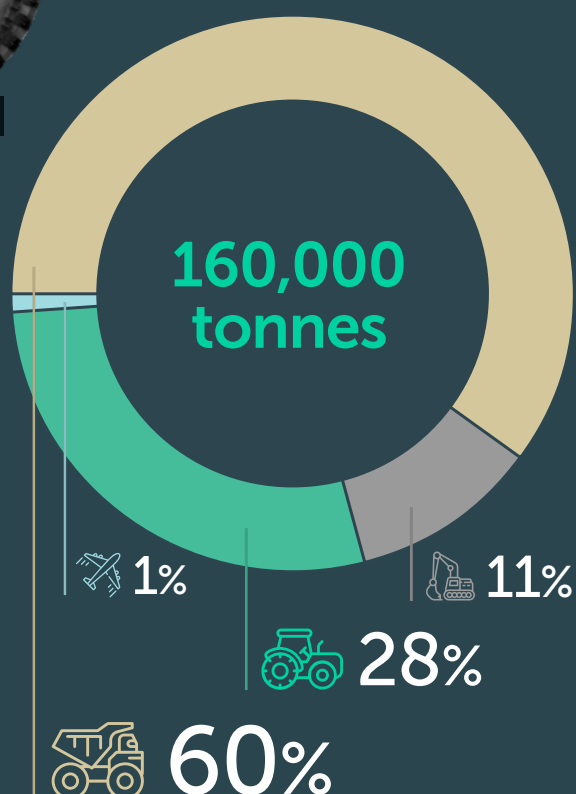
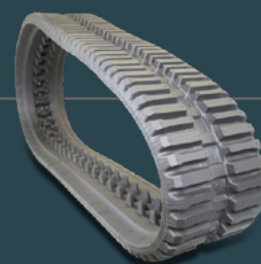
Tyres

On average, Australia consumes 160,000 tonnes of OTR tyres from a wide range of applications in mining, agriculture, construction, industry and aviation. From this it generates around 130,000 tonnes of used OTR tyres each year, accounting for degradation and wear of tyres.

Average consumption of OTR tyres by Sector in Australia

	Sector	Tonnes of OTR tyres	Proportion
	Agriculture and forestry	18,000	11%
	Mining	128,200	80%
	Construction (and demolition)	8,500	5%
	Industrial (manufacturing and trade)	5,600	3%
	Aviation	600	<1%
	Total	160,900	

Estimated weight (tonnes) of OTR tyres consumed in Australia, 2021-22



Sector	2021 used OTR generation (tonnes)	Contribution to used OTR generation (%)	2021 used OTR recovered (%)
 Agriculture and forestry	15,140	11%	<1%
 Mining	107,940 t	79%	<1%
 Construction (and demolition)	7,800	6%	~80%
 Industrial (manufacturing and trade)	5,190	4%	~80%
 Aviation	600 t	<1%	~80%
Total	136,670	100 %	~10%

Tracks and Conveyors

Add to this up to 85,000 tonnes of used conveyors and up to 30,000 tonnes of rubber tracks:

	Lower estimate	Upper estimate
Used conveyors	60,000	85,000
Used rubber tracks - construction	18,750	22,500
Used rubber tracks - agriculture	6,250	7,500
Total	85,000	115,000

Total

This gives us a range of between 215,000 and 245,000 tonnes of used OTR rubber products per year.

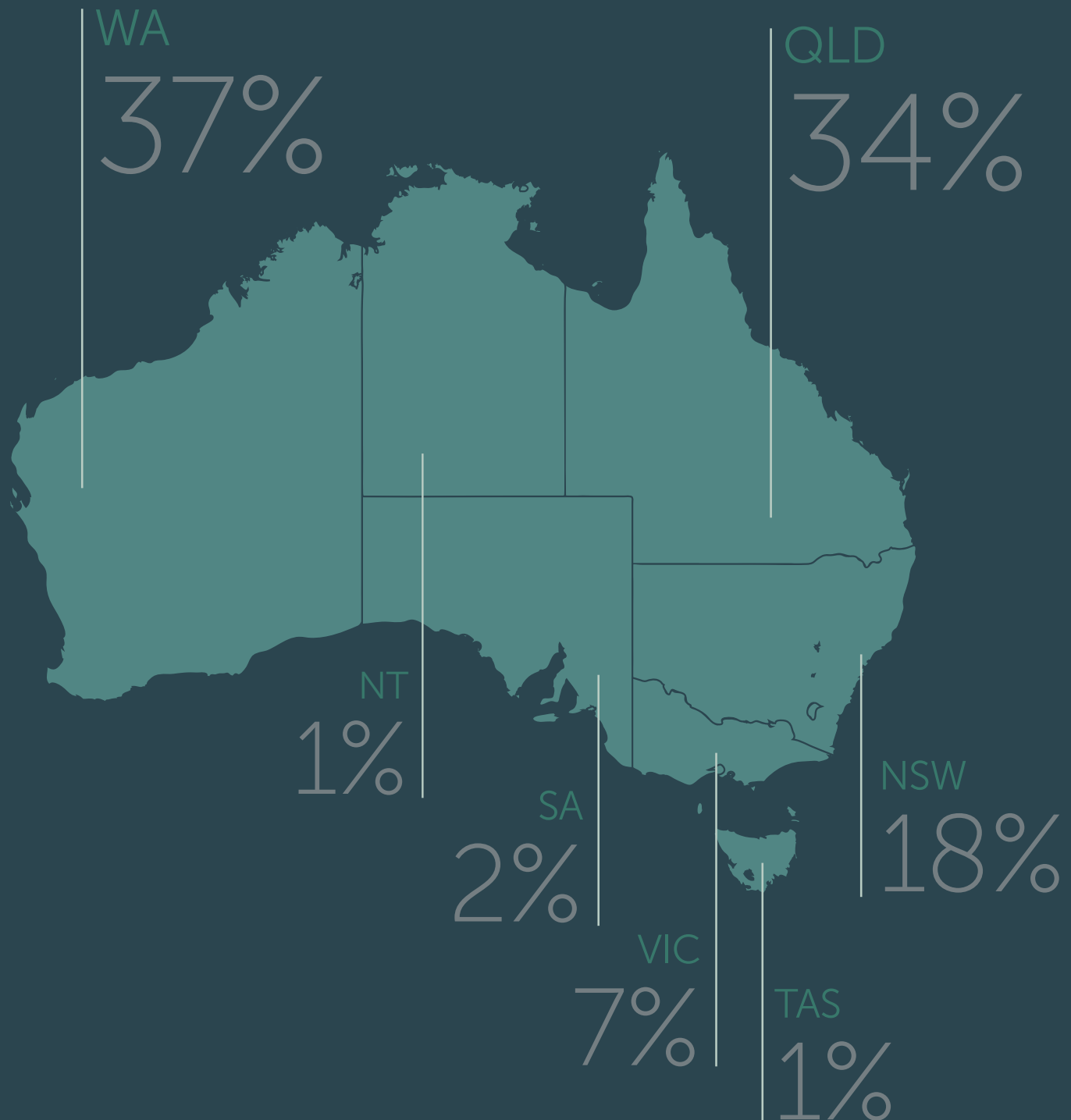
See *Section 2 of the Tipping the Balance: Research Report* for a detailed analysis of the amounts, uses, and distributions of OTR rubber products.

And where are they generating them?

While used automotive tyre generation is concentrated in urban areas where they can be recovered relatively easily, the opposite is true of most OTR rubber products. Mining and agriculture in particular generate large amounts of used OTR rubber products in some of the most remote parts of the country:

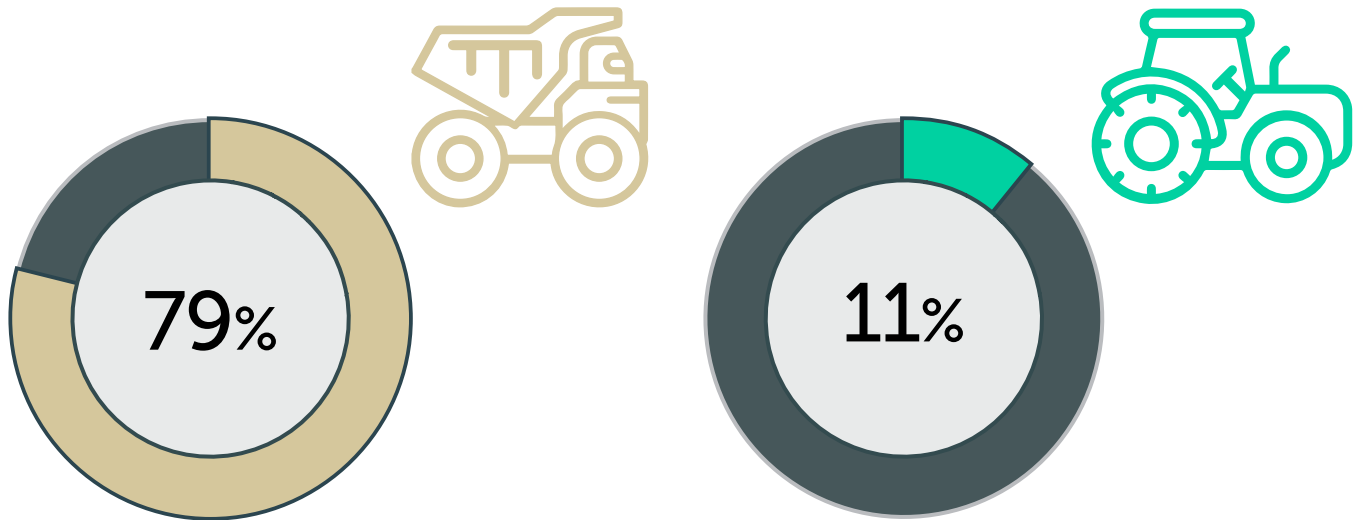
OTR tyres view by state

Western Australia is the largest generator, at about 50,000 tonnes per year (37%), with Queensland coming second at about 46,000 tonnes (34%) followed by New South Wales which generated about 25,000 tonnes in 2021-22.



OTR tyres view by sector

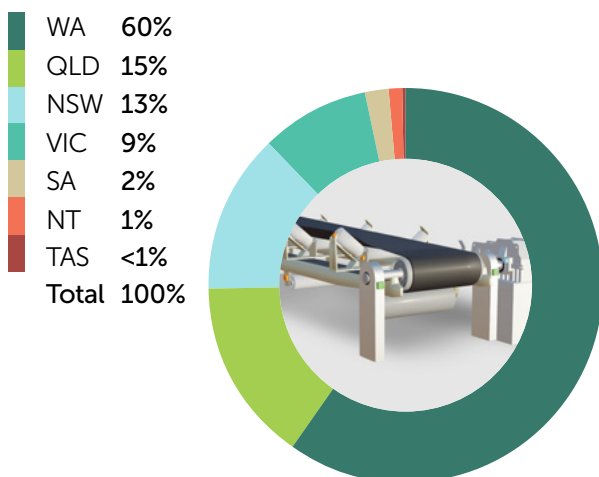
Mining takes the prize at 107,940 tonnes per year (79%), with agriculture next at about 15,140 tonnes (11%) in 2021-22.



The industrial (manufacturing and trade), construction (and demolition) and aviation sectors are important contributors, but we need to consider the amounts generated and current recovery rates. In 2021, these three sectors were estimated to have generated only around 14,000 tonnes of tyres, most of which were recovered.

Conveyor belts

Western Australia dominates used conveyor belt generation across almost all belt types, followed by Queensland, then New South Wales and Victoria, reflecting the scale of the resource sectors in these states.



Rubber tracks

Victoria generates the highest tonnage of used tracks, followed by New South Wales, Queensland, then Western Australia, reflecting the scale of the construction and agricultural activity across these states.

Jurisdiction	Proportion (%)
Victoria	37%
New South Wales	30%
Queensland	19%
Western Australia	12%
South Australia	2%
Tasmania	<1%
Northern Territory	<1%
Total	100%

Can Australia recover these used OTR rubber products?

There are several recovery options for used OTR rubber product that have not been implemented in Australia.

Used OTR tyres and conveyors can be refurbished or re-treaded to extend their life. The aviation sector for example, re-treads its aircraft tyres multiple times before they are recycled. This higher-order approach extends the useful life of OTR rubber products and should be considered before recycling.

After that there are several reprocessing options, including shredding, granulation and grinding. Reprocessing outputs can be used to make new tyres, artificial turf, bunker fuel, paints and adhesives, road binders in asphalt and many other products. Section 4 explains these technologies, products and emerging recycling processes in detail.

Since the Tyre Product Stewardship Scheme started in 2013 with a mandate to increase automotive tyre recovery, recovery rates have grown to 70%.

This success has shown that it is possible to rapidly increase recovery when incentives are in place and stakeholder objectives are aligned.

Granted, automotive tyres are significantly easier to recover than OTR rubber products, but this statistic demonstrates that major change can occur when there is will and drive within the sector, and harmony in the approach of stakeholders.



Since the Tyre Product Stewardship Scheme started in 2013 with a mandate to increase automotive tyre recovery, recovery rates have grown to 70%



Have any countries done better?

Globally there are examples of successful OTR tyre stewardship schemes that have operated for 20 years. Australia's current estimated recovery rate for OTR tyres of around 10% is well below that of comparable jurisdictions:

Location	Recovery Rate	Approach
Denmark	100% OTR recovery	Tax scheme, moderate fee, granulation and pyrolysis subsidies only, EPA-approved
Ontario, Canada	87% large OTR recovery	Legislated recovery rate, low fee, producers must meet recovery rates (60% large tyres, 85% other)
France	78% medium-large OTR tyre recovery	POM target, moderate fees, producers must collect and process tonnages from previous year
Australia	~10% OTR recovery	Voluntary scheme, low fee, no mandatory recovery, burial permitted

It can be difficult to make an 'apples to apples' comparison with any single jurisdiction, but other countries are proving that used OTR tyre handling, logistics, processing, and supply into established end markets is both technically feasible and economically viable, once the right scheme, economics, and policy settings are in place.

 Denmark

100%

 Canada (Ontario)

87%

 France

78%

 Australia

<15%

What's preventing recovery of OTR rubber products?

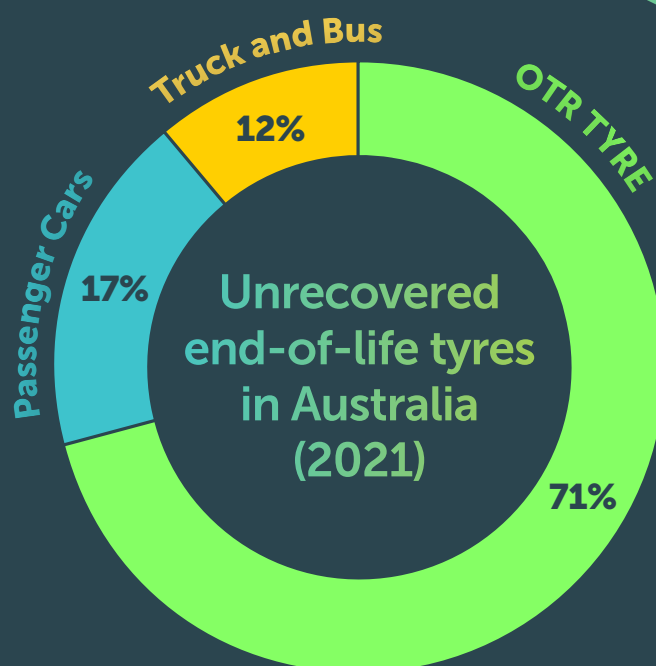
Unlike the automotive tyre market, there is limited established recycling infrastructure for used OTR rubber products. These products are also used in remote locations spread right across Australia, far from established processing facilities or regional hubs, making them harder to recover and harder to invest in proven locations.

With few recycling services available, long distances to transport them, and no requirement to do it, the current solution is often just to bury or stockpile these products onsite, which not only wastes the materials but has the potential for long-term negative impacts on the environment, community and land rights.



The result is that only around 10,000 tonnes of used OTR tyres are recovered each year.

End-of-life OTR tyres account for almost three-quarters of all unrecovered tyres annually in Australia.



Barriers

Each sector and region in Australia has its own unique characteristics, which are covered in detail in Section 10 of the *Tipping the Balance: Research Report*, but the reasons for low OTR recovery rates are generally due to these common barriers:

Barrier	Description
Low cost of onsite disposal	Disposing on mining sites is practically free, due to exemptions from inert waste landfilling requirements that apply to every other sector. Disposal of inert waste (including OTR rubber products) must comply with major landfilling regulations, including the payment of waste levies.
High tyre recovery costs	OTR rubber products, especially big tyres, cost a lot to recover because they need special equipment and operations to transport and process them, across vast distances over rough country, between where the OTR rubber products are used and the locations of end markets.
Low regulatory pressure	Current regulations allow landfill disposal on mining sites, a very different regulatory standard than applied to other industries. There is limited enforcement to prevent dumping on farmland.
Lack of nearby recovery service providers	While mining sector onsite disposal is allowed there is little or no material available for recovery businesses to process, so no incentive to invest in processing facilities nearby.
Unfamiliarity and uncertainty	Reluctance to commit to or invest in other recovery methods without certainty about their legitimacy and long-term stability.
Limited public scrutiny	The general public has almost no visibility of practices in mining and agriculture operations, reducing pressure to align practices with community standards.
Low priority	Perceptions that environmental performance and land custodianship are not essential to core business.
Internal barriers and procedural overheads	For larger firms, decisions necessarily involve many departments, slowing the process.
Dispersed waste feedstock	Limited availability of waste feedstock in some locations, the distances involved and specialised equipment needed in some cases creates a high cost per tonne.
Uncertain base of customers and tyre generation	A small number of companies may generate a high quantity of OTR rubber products, which creates a commercial risk to service providers relying on a small number of contracts. Supply can also be affected by factors like weather and changing operating levels of mines.
Uncertainty in demand for recovered products	Recycling of automotive tyres meets current demand for tyre-derived material. Introducing large amounts of OTR rubber products may flood the market and affect prices.
Limited opportunity to test and refine offerings to OTR tyre generators	With few incentives on offer, recovery providers have not pursued this market segment, so there has been little business development, market engagement, and feasibility testing.

See Sections 5.1 and 5.2 of the *Tipping the Balance: Research Report* for details.

Factors encouraging OTR recovery



Clarity around recovery outcomes

Some OTR waste generators are keen to implement recovery, providing an opportunity for recovery service providers.



Larger amounts able to be locked in over a medium-term period

Recovery services will have access to large and reliable amounts of OTR rubber products from the start, taking advantage of stockpiles created over years to create certainty of supply.



First mover advantages

The first operator with a commercially mature service and track record will be able to take a large market share.



Alignment with circular economy and regional development priorities

Globally, governments are adopting circular economy measures. Used tyres are on the Australian Government products stewardship priority list.

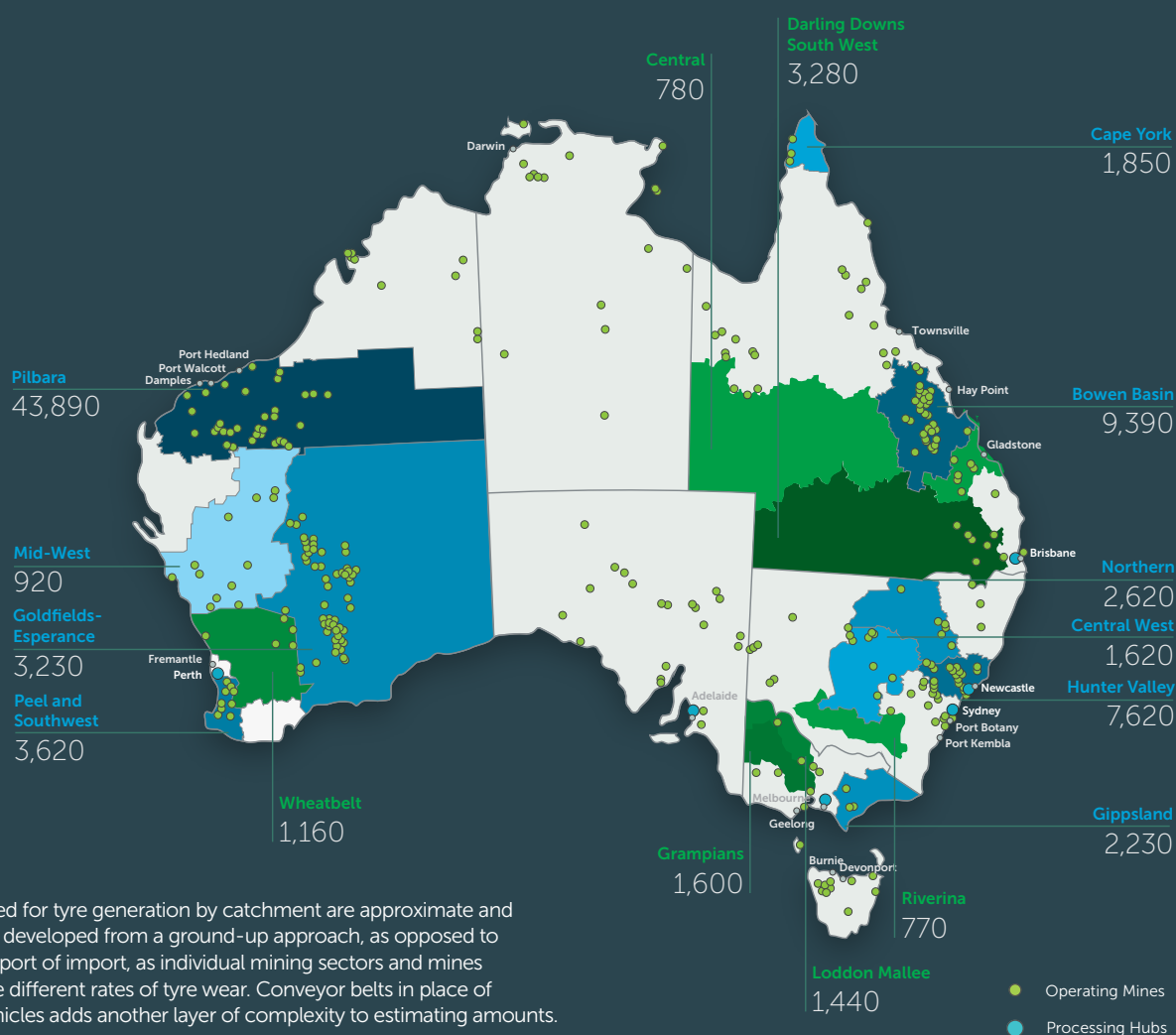
Taking a catchment view

Viewed from a long way up, recovering OTR rubber products can seem like a large and intractable problem. Looking more closely though, ways to break it up into more bite-size pieces emerge. Key to this is the concept of catchments.

TSA's research has identified that eleven catchment areas around the country account for around 90,000 tonnes (65%) of the OTR tyres consumed annually. Catchments with high levels of mining operations tend to have higher concentrations of OTR tyres, while in agricultural catchments they are more widely dispersed.

This table shows the tonnes-per-year of OTR tyres generated in each catchment by the sectors with the lowest recovery rates, mining and agriculture:

	Mining	Agriculture	Total OTR tyres (% of Priority Catchments)
Pilbara (WA)	43,890	-	43,890 (49%)
Hunter & Northern (NSW)	10,240	360	10,600 (12%)
Bowen Basin (Qld)	9,390	780	10,170 (11%)
Riverina, Murray & Central West (NSW)	1,620	1,500	3,120 (4%)
Peel, Southwest & Lower Wheatbelt (WA)	3,620	1,180	4,800 (5%)
Mid-West & upper Wheatbelt (WA)	920	960	1,880 (2%)
Western Victoria (Vic)	50	3,040	3,090 (3%)
Goldfields-Esperance (WA)	3,230	380	3,610 (4%)
North & Yorke Peninsula (SA)	900	400	1,300 (1%)
Darling Downs & Surat Basin (Qld)	750	3,280	4,030 (5%)
Gippsland (Vic)	2,230	80	2,310 (3%)
			88,800



Why change current methods?

Current methods of 'onsite management', which in many cases is a euphemism for simply burying the problem, are not sustainable long-term. These methods create risks to Australia, its industries and its communities.

The risks of doing nothing

Market risk

Failing to recover these materials is a huge lost opportunity to create a sustainable market for a valuable commodity. While these practices continue there is no incentive to change this practice and no prospect of a market for them, as the costs of recovery and recycling can't compete with zero-cost disposal.

The success of automotive tyre recycling has proven that a profitable market exists for these materials. Not recovering OTR rubber products creates a competition risk for this market against overseas competitors with access to large amounts of cheaper materials.

Effective OTR material recovery exists or has begun in France, Denmark, Italy, Canada, and Chile, all of which have established or are implementing regulated schemes for OTR rubber products. A natural consequence is investment in recycling facilities and the creation of jobs. See *Tipping the Balance Research Report - Appendix 3 – Global Review of OTR Tyre Management* for details.

In its tradition of innovation and ingenuity, Australia has an opportunity right now to take the lead in OTR recovery and seize the enormous market available to it. The alternative is to stay idle and fall quickly behind, handing this economic opportunity to other countries by leaving it buried.

Corporate and compliance risk

In recent years, the NSW, QLD and WA State Governments have been reviewing their position on permitting the onsite disposal of OTR products at mine sites. They have indicated that they would move to amend licences if recovery options were available to be implemented in Australia.

Key mining areas of QLD and NSW are located within landfill levy zones. If used OTR rubber products were landfilled offsite, the fees would be significant. Tyres are also often required to be shredded before landfilling at offsite licensed landfills, adding another significant cost.

The mining sector risks a sudden increase in costs if they were to lose their current permission to bury these products onsite, which can be mitigated by working to develop recovery pathways now.

As the costs for disposing automotive tyres (and other wastes) at offsite licensed landfill increases, there is an increased financial driver to dispose these wastes at mining sites (that are only allowed to bury OTR rubber products generated onsite). Again, we can reduce this risk by removing waste disposal areas from mining sites.

There are significant fines and penalties for illegal dumping of used OTR rubber products, which could have a significant effect, particularly on the agriculture sector.

Environmental risk

From an environmental perspective, leaving these materials in the ground or in stockpiles on site can have long-term impacts. The effects of these materials degrading over time are hard to define, but historical examples both here and around the world of erosion, and water and soil contamination, show that few good things come from gross pollution of land.

Licensed landfills have long adopted a principle of precaution to protect the surrounding environment, requiring liners, leachate collection and treatment, site rehabilitation, and aftercare. These requirements are not in place at mining site disposal areas, which creates



an inconsistent social, environmental and economic framework in Australia.

In Australia, for nearly 50 years solid wastes have been required to be taken to offsite licensed landfills, with two notable exceptions: coal ash from power stations, and OTR rubber products on mining sites. These are *the only remaining examples* of regulators providing exemption from landfill disposal rules that apply to everyone else in Australia, and allowing this practice to continue puts Australia behind other countries.

Social risk

The onsite management approach creates social and economic impacts for the indigenous peoples and local communities (IPLC) that host or live near OTR tyre disposal sites. These impacts are created by the enduring (and sometimes unanticipated) reality of tyre waste that can affect the health, livelihoods, and social/cultural wellbeing of affected people.

The impacts undermine and erode IPLC social license, creating real costs for operators and the prospect of trailing liabilities that may be born largely by nearby IPLC. Social injustice and inequity can be an enduring legacy – created by OTR tyre generators and disproportionately born by IPLC.

Responsibility risk

The onsite management approach has a high risk of simply transferring the liability for these materials to other landowners and future generations. It is not a user-pays model, but a short-term model in which the costs of environmental management are not factored into the cost of production and are literally buried for future generations to deal with.

Mining and agricultural activities are often located in areas of significance to local communities and First Nations peoples across Australia, so this is particularly an issue from their perspective, as it is their homes, backyards and ancestral lands being filled with waste that will be slowly degrading for centuries to come.

In the Australian spirit of the 'fair go', users of OTR rubber products need to take responsibility for their waste and factor in the costs of clean-up into the costs of doing business.

Reputation risk

Australian citizens expect a minimum duty of care, and if a stockpile of thousands of tonnes of giant tyres were

sitting next to a major city there would be an outcry. Disposing of OTR rubber products rather than recycling them is completely out of step with community expectations, and its invisibility is a major factor enabling it to continue.

In 2021, Perth-based corporate services body State of Play asked mining executives 'why is mining perceived negatively by society.' The top three answers out of ten were:

- Environmental impact (by a significant margin)
- Misunderstood mining benefits
- Community impacts.

Similarly, a 2022 survey taken by KPMG found the first-ranked risk to be 'environmental risks, including new regulations', and flagged 'community relations and social licence to operate' as third-ranked.

Clearly, mining companies are aware of the reputational risks inherent in their operations, but they are not the only party subject to reputational risk.

When governments debate regulations, public detriment is a significant consideration and if we continue to kick this can down the road it will simply snowball into a bigger and more intractable political problem.

Allowing gross industrial pollution of land to continue, simply because it's in remote areas and therefore 'out of sight and out of mind', represents a reputational risk not just to the companies consuming these materials, but to governments at all levels and to Australia as a whole.

Strategic risk

OTR rubber products are utterly vital to Australian businesses and interests, but apart from a local industry supplying some of the country's conveyor belt requirements, they are almost completely imported. This reliance on international supply chains puts Australia in a vulnerable position. The global pandemic and Russia's invasion of Ukraine have proven just how fragile these supply chains can be.

From the strategic perspective of self-reliance, Australia should refurbish and re-use these materials wherever possible, and recover valuable rubber which is currently being wasted. An established onshore recovery, refurbishing and recycling industry will help maintain supply of these critical resources, and could provide the source materials for onshore manufacturing industries.

The benefits of change

Public benefits

Economic

There are many public economic benefits from improving OTR rubber product recovery.

These public economic benefits include:

- growing and diversifying the Australian economy, by expanding onshore economic activity to capture the valuable resources contained in OTR tyres
- regional development, through investment, employment and labour force development
- innovation and productivity, because addressing the OTR gap will require new methods, technologies and business models
- recovering the value of the materials use - if we recovered 120,000 of the 130,000 tonnes of used OTR tyres generated each year, this could translate into 42,000 tonnes of steel and 78,000 tonnes of crumb rubber, or \$11 million in recovered steel and \$62 million in crumb rubber
- creating jobs in the recycling industry - using Access Economics' modelling on job creation in the recycling industry, recovering 215,000 tonnes of OTR rubber products could create 365 direct and indirect jobs.
- stimulate investment - for every \$1million that TSA has provided to support market development activities, private businesses have invested \$4.5million.

Environmental

The Earth is a closed system, so re-using and recycling materials is straightforward common sense. In 2023 this logic is beyond debate and is the basis of the need for a circular economy.

Recovering used OTR rubber products will:

- recapture high-quality materials that would otherwise be lost
- reduce reliance on new materials and the consequent environmental damage in rubber-growing countries
- improve the treatment of environments and landscapes
- reduce exposure to harms such as fire, habitat loss, contamination and potential breeding grounds for vermin
- set an example and lift the accepted standard for managing end-of-life products.
- reduce greenhouse gas emissions from new tyre creation and rubber deforestation.





Social benefits

Avoided social impacts and costs creates social benefits and improves social license to operate. Economic benefits translate directly into social benefits. These benefits include:

- more productive and improved livelihoods of IPLC that host or live near OTR tyre disposal sites (and perhaps participate in recycling ventures).
- attendant positive social outcomes born of increased economic opportunities and the improved livelihoods.
- improved health and mortality outcomes created by reduced exposure to environmental impacts.
- improved reputational outcomes for OTR tyre generators.

Agriculture

Many farmers re-use end-of-life tyres for a range of purposes on their farms, and value them as a commodity, but substantial amounts of used tyres piling up are both a liability and an opportunity.

Recovering these OTR tyres is simply better business practice and asset management, with benefits including:

- better land care
- pest management and disease control
- fire safety
- general onsite risk management.

Farmland may be leased, passed on from generation to generation, or bought and sold, and these benefits provide a better level of care for a long-lasting=capital asset.

Mining

For the mining sector, the benefits include:

- the opportunity to respond to Environment, Social and Governance (ESG) expectations, Global Reporting Initiative (GRI) obligations, UN Sustainable Development Goals and other social responsibility factors
- improved onsite safety as the stockpiling and landfilling of used OTR rubber products can create hazards onsite and increases the amount of handling over time (compared to a product replacement and removal from site model).
- better budget management by accruing disposal costs when the tyres are being used, rather than risking high costs to dispose of them properly later
- removing used rubber product stockpiles, with their associated costs of fire and vermin management and eventual disposal
- appreciation from the public for acknowledging that in-pit burial is at odds with community values, especially as most car and truck owners pay to recover their end-of-life tyres
- the potential to evolve practices, sector standards and workplace culture, to adopt circular economy principles and accept greater accountability for practices across their supply chains
- acceptance that in-pit burial can't continue indefinitely, and that getting in now to adapt to future regulations and mining licence requirements will help ensure operational continuity
- avoiding the perception of underperforming in their due diligence, exposing them to rising perceptions of negligent corporate practice
- showing leadership and reducing costs through onsite consumption of re-processed OTR rubber products.
- tyre creation and rubber deforestation.

What could recovery look like?

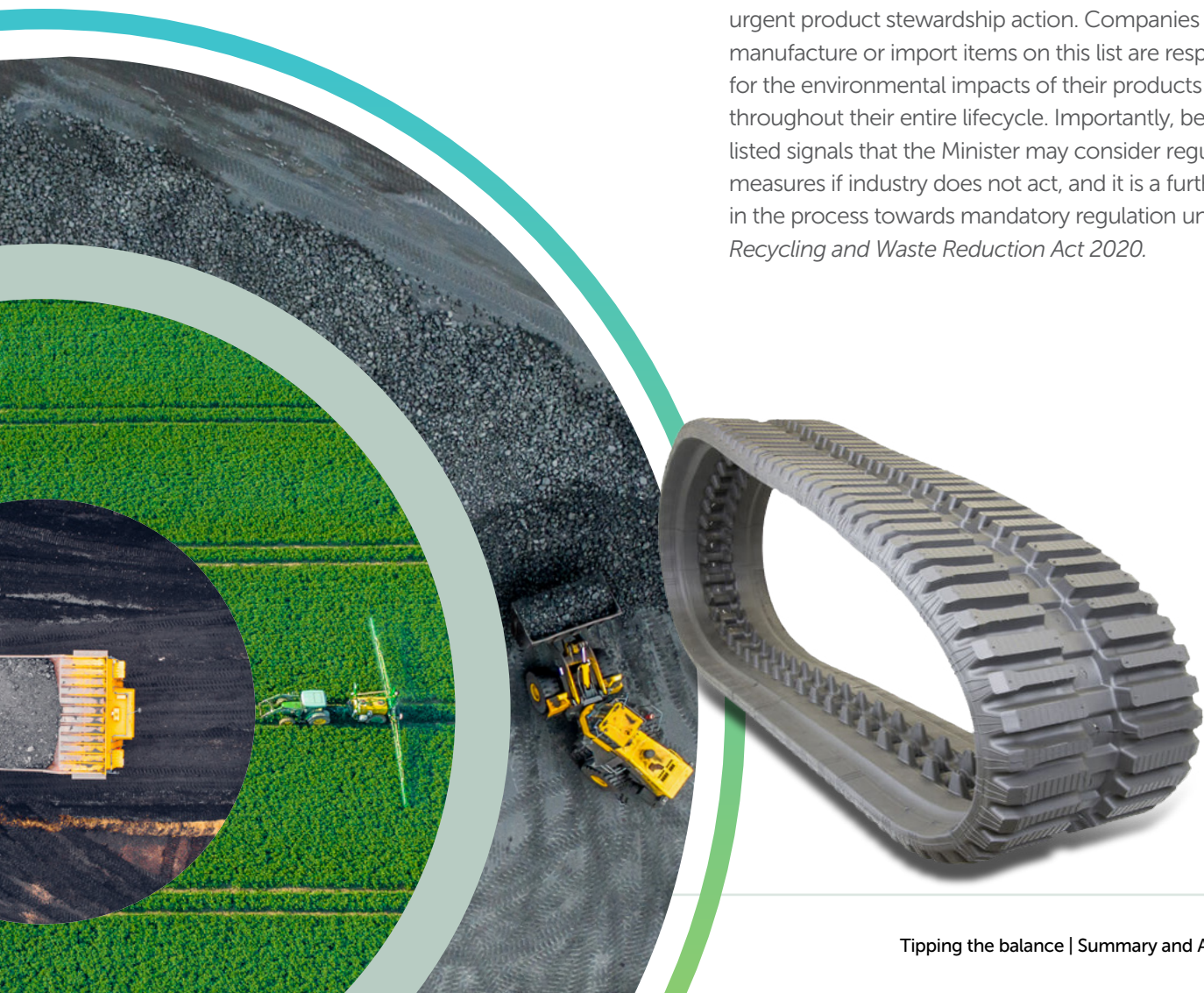
The design of the Tyre Product Stewardship Scheme (the Scheme) in Australia is under review because its current design has seen recovery stall after previous successes. TSA's objective is to find ways to improve recovery of all tyre imports and rubber OTR products.

Independent review and priority listing

In August 2022, an independent review of the Scheme was completed. It found that the program has delivered public benefits at a small cost to the economy, but that the current voluntary structure of the Scheme limits its ability to achieve more.

The independent review suggested that under a regulated structure the Scheme could expand its activities and pursue strategic opportunities and innovation for stakeholders in the circular tyre economy.

On 8 November 2022, the Federal Minister for the Environment and Water announced the inclusion of end-of-life tyres on the annual Minister's Priority Product List (the List) as a product that needs urgent product stewardship action. Companies that manufacture or import items on this list are responsible for the environmental impacts of their products throughout their entire lifecycle. Importantly, being listed signals that the Minister may consider regulatory measures if industry does not act, and it is a further step in the process towards mandatory regulation under the *Recycling and Waste Reduction Act 2020*.



A revised Scheme

We aim to broaden the Scheme to include the complete rubber product supply chain – from automotive and OTR tyres to conveyor belts and rubber tracks – in line with a circular economy approach.

Beyond broadening, we visualise a Scheme—potentially underpinned by government regulation—designed to support the whole supply chain, increase recovery rates, create downstream incentives and encourage markets to develop.

This may involve:

- introducing an advance disposal fee that is fair and equitable across all rubber product types
- creating an incentive program
- improving re-use and recycling rates in high-generation catchments
- supporting a viable recovery pathway for OTR rubber products
- demonstrations to expand markets for recovered materials
- supporting investment to maximise recovery and minimise stockpiling
- conducting research into better management of OTR rubber products to extend their useful life
- supporting OTR rubber product users (such as mining and agriculture companies) to better account for the impacts of their consumption and management at end-of-life
- helping users and their supply chains pioneer new business practices and commercial arrangements that favour repair and reuse
- engaging with indigenous peoples and local communities.

We appreciate that this is a significant change on current practices, and has many implications for all the parties involved.

Revised Scheme needs

While each catchment has its own requirements, any changes to regulations will need to address the following for *all* catchments:

- **Drivers** – what are the drivers, interests and tensions that need to be resolved, to define the costs and benefits of recovering OTR rubber products?
- **Impact of regulations** – how can we co-ordinate regulatory arrangements for mining companies without undue disruption or unnecessary costs?
- **Incentives** – what inducements can we offer for agriculture businesses and farms to get involved beyond a reasonable degree of on-farm usage?
- **Logistics** – what pragmatic mechanisms can we use to reduce transport, handling and logistical overheads long distances from dispersed points of origin?
- **Investment** – how can we encourage investment in the tyre recovery sector and ensure their solutions reflect standards, duties of care and ESG principles?
- **Behavioural change** – how can we change behaviours to the needs of OTR tyre generators while getting the support of regional, community and sectoral support organisations?

Any revision or expansion of the Scheme will have to take these factors into account from the national to the local level. All the stakeholders involved have their own roles in achieving this.





How recovery might work

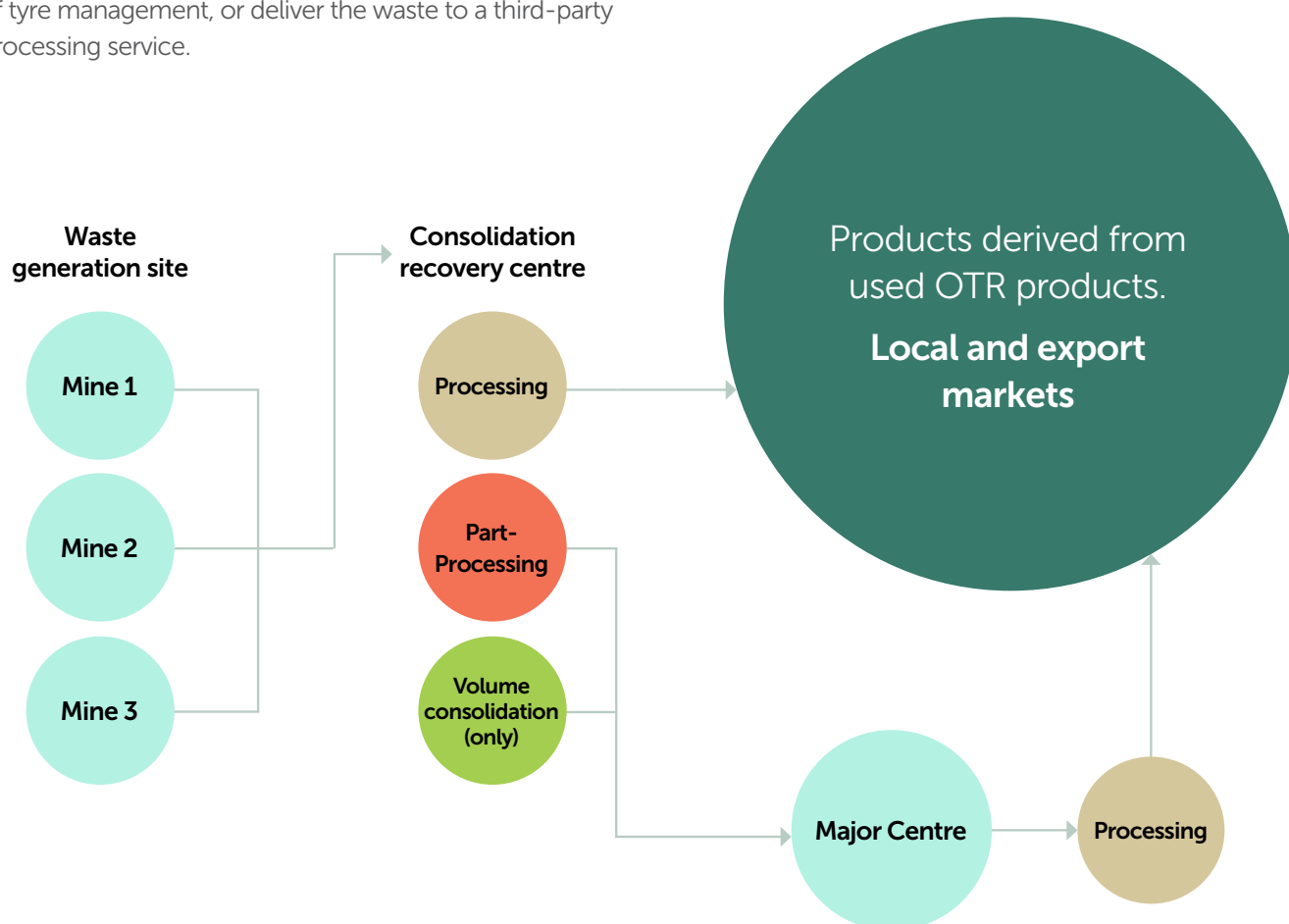
The two main recovery solutions that we have identified can be termed 'reverse logistics' and 'Consolidation at a recovery centre'. An important part of solving the high transport and processing costs of OTR recovery involves applying a reverse logistics approach.

Reverse logistics

Reverse logistics is the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal. Our ideal approach to reverse logistics involves the tyre seller collecting their previously sold tyres when they deliver new tyres, using the same logistics network for both delivery and recovery. They would then take their old tyres back to their own processing facilities for re-tread or material recovery within their own circular economy of tyre management, or deliver the waste to a third-party processing service.

Consolidation at a recovery centre

Consolidation at a recovery centre within a catchment involves multiple waste generation sites consolidating their waste tyres, conveyors, or tracks into one centralised location convenient for all sites. This consolidation point would either process the waste directly into a product, or sort and process it for delivery to another processing facility. Processing at the consolidation point or another facility would turn it into a product which might be used locally or exported.



What it might cost

Collection costs vary depending on the distance travelled. This is an estimate of those costs depending on distance:

Mine site	Lower		Upper		Comments
	\$/unit	\$/tonne	\$/unit	\$/tonne	
Regional	\$1000	\$333	\$1800	\$600	Collection costs vary by distance travelled. 'Regional' collections typically allow for up to 500kms from processor.
Remote	\$1400	\$467	\$2300	\$767	Collection costs vary by distance travelled. 'Remote' collections typically allow for up to 1,000kms from processor.

This table shows the cost of processing tyres also depends on the way that they are processed:

Process	Lower	Upper	Comments
	\$/tonne	\$/tonne	
Recycling (Crumbed rubber- onshore)	\$600	\$800	Assumes an additional \$200/tonne to process large mining tyres for de-beading and extra size reduction costs. Crumbing costs are typically \$400-\$600 per tonne.
Recovery via pyrolysis (oil, syngas, act, carbon - onshore)	\$300	\$500	Costs are for whole mining tyres processing.
Energy recovery (tyre derived fuel - exported)	\$285	\$300	Assumes an additional \$200/tonne to process large mining tyres for de-beading and extra size reduction costs. Typical costs for TDF exports are around \$85 to \$100.

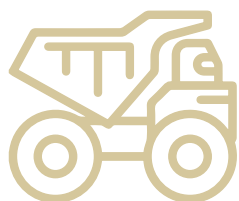
Relative value

In the most expensive case—mining companies in remote areas—it would cost from \$1,285 to \$3,100 to collect and process a three-tonne used mining tyre. Given that on average a new tyre costs \$45,000, these costs represent a fraction (7% at most) of the cost of a new tyre.

Clearly, a reverse logistics approach would need to be tailored to catchments or regions depending on their concentration of OTR rubber products.

Choosing the most suitable options

One size won't fit all, and each sector and region will need tailored approaches, but there are some general measures they will need to take to ensure success.



In mining catchments

To improve recovery in mining catchments, stakeholders will need to:

- agree on a local solution, so any working capital dedicated to recovery is used as efficiently as possible
- agree on the best place to locate the recovery infrastructure to optimise the balance of supply chain components
- find suitable ways to reduce transport costs as far as possible
- develop a strategy to sell end products that will give companies confidence that material is being recovered to standards meeting ESG obligations and stakeholder expectations
- provide long-term support to help create a circular economy for their OTR rubber products.



In agricultural catchments

To improve recovery in agricultural catchments, all stakeholders need to create:

- strong and effective incentives for farmers to play their role in having agricultural OTR rubber products recovered
- a cost-efficient and convenient network of collection points
- distributed mobile or stationary infrastructure to lessen transport costs from consolidation points to recovery facilities
- in-depth engagement and behaviour change programs to help agricultural communities change practices, and to understand what to do when new systems come in place.

Roles and responsibilities

It's often said that an ideal compromise is when all parties are equally unhappy with the result. When it comes to implementing an expanded nationwide stewardship scheme we need to move beyond this definition.

For an expanded stewardship scheme to work, we will need to tailor the solutions to the needs of different regions to maximise the benefits to all parties involved. TSA can't do this alone, but we can help all stakeholders work together to find the best solution.

The Stakeholders

Tyre industry	• Tyre manufacturers and importers • Tyre retailers and transporters
Recycling industry	• Tyre recyclers • Buyers of recycled materials
Mining Sector	• Mining companies • Mining sector peak bodies • Mining sector regulators and licence issuers
Agricultural Sector	• Farmers and agribusiness • Farming peak bodies • Farming produce supply chains
Other sector representatives	• Aviation • Manufacturing & trade • Construction
Governments	• Federal, State and local governments • Environmental Protection Authorities • Public funding agencies
Indigenous People and Local Communities	• Traditional owners • Local communities • NGOs

Type importers

Some tyre importers currently volunteer to pay a levy and report on the amount of tyres they sell. This levy and reporting enables TSA to meet the Scheme's objectives, and ideally all tyre importers would be a part of the Scheme.

Tyre importers are uniquely positioned to help the transition by:

- reporting supply chain impacts to major customers so that they can make informed decisions and use their purchasing power to influence those impacts
- working with large customers on business models and product specifications to extend useful life, increase recovery, and reduce the materials intensity of using OTR rubber products
- influencing their retail and logistics partners to play a greater role in assisting recovery
- investing in or partnering with one or more parts of the tyre recovery supply chain over the medium-to-longer term to help make a 'tyres into tyres' recovery model viable for the Australian economy.



For an expanded stewardship scheme to work, we will need to tailor the solutions to the needs of different regions to maximise the benefits to all parties involved. TSA can't do this alone, but we can help all stakeholders work together to find the best solution.



Tyre retailers and afters-sales service providers

There is scope for OTR tyre retail and after-sales services to include:

- long-distance haulage to remote points of use (mining tenements and farms)
- inspection for repair, re-tread, or disposal
- repair and re-tread services
- replacing tyres
- transporting used tyres off-site for recovery after new tyres are provided, a reverse logistics solution.

Many of these services are not currently offered for OTR rubber products or only offered on a limited basis, so there is an opportunity in the market waiting to be fulfilled.

Recyclers

If we expect recyclers to invest in expanding their operations to include OTR rubber products, they will need to be confident that there will be both:

- a reliable gate fee and supply of the source materials, and
- a proven demand for the products derived from reprocessing.

If we can demonstrate that these conditions can be created over the next few years, recyclers will take the opportunity to expand their operations accordingly.



Governments

The role of governments at all levels will be harmonising the regulations across Australia to support the operation of a redesigned scheme encompassing OTR rubber products. This could include aligning the environmental and waste management regulations across Australia to develop a consistent approach. This will involve extensive consultation with all stakeholders.

A consideration of regulation that encourages and supports OTR rubber product recyclers and processors to gainfully invest, knowing that the consumers will have a responsibility imposed on them to better manage OTR products once they reach end-of-life.

Major users of OTR rubber products

Companies using OTR rubber products will understandably be cautious about any regulatory change that potentially increases their costs or requires a change to their operations.

It's critical that they be extensively consulted about any proposed changes and have the opportunity to work with the other stakeholders to find a mutually agreeable result.

Between them, the mining and agricultural sectors generate approximately 90% of OTR tyres and, currently, almost no recovery is occurring. Even if 100% recovery of automotive tyres were achieved, it is unlikely that the 80% overall tyre recovery target could be achieved without a significant increase in OTR tyre recovery. To meet a national 80% recovery target, 60% (~60,000 - 80,000 tonnes) recovery of OTR tyres by 2030 would be required.

The first step will be to acknowledge reality: current disposal practices are no longer socially acceptable, they are becoming increasingly high-risk, and there is an opportunity to use these products and materials in a more productive way.

After that it comes down to finding ways to do it that are cost-effective. Solving complex logistical and operational issues like this is the bread and butter of these organisations, and the expansion of the Scheme represents an opportunity for them to demonstrate leadership to find the most effective solutions.



Indigenous people and local communities

Women, men, and youth live within the IPLC that are adjacent to or near catchment OTR tyre disposal sites. These citizens and their communities deserve to be spared negative environmental and social impacts, and they also deserve to benefit from any efforts to recycle OTR tyres. Benefits can be created by avoided costs and through actual participation in removal and recycling ventures. The practices for effective and fair engagement are known and do-able.

The rich cultures, histories, and social and economic assets that these women, men, and communities can bring to the equation will help shape and improve any OTR tyre recovery and recycling efforts. Their input and consent to improved approaches within the catchments will yield improved social license to operate and also seed their own opportunities to benefit and prosper.

Their leaders – representing both women and men – can provide important input on future decisions and help shape outcomes that benefit both individuals and communities.



TSA's role

TSA's core roles in an expanded Scheme would be to:

- track OTR rubber product flows
- run trials
- stimulate and strengthen the resilience of OTR rubber product recovery supply chains
- conduct and coordinate research in support of the Scheme's aims
- communicate, promote and advocate
- drive the national agenda towards a circular economy for OTR rubber products, beyond success in individual catchments.

Other measures could include:

- co-ordinating stakeholders to create a practical definition of a circular economy for OTR rubber products, and integrating this into the Scheme
- pursuing a global leadership role in the circular economy for tyres, commensurate with Australia's unique place in the global mining and primary industry economies
- developing a centre of expertise to advocate greater transparency of impacts and opportunities across supply chains
- exploring emerging technologies which may enable 'higher order' circular economy outcomes
- expanding roles and new business models across the OTR rubber product supply chain, including retailers, logistics and after-sales care and maintenance services
- advocating to public bodies at regional, state and territory, and national levels on what they can do to help.

Roadmap to 2030

When we began our research, our aim was to explore the size of the issue and examine how to:

- bring the whole supply chain of OTR rubber products into the Scheme
- improve the recovery rate of used OTR rubber products and develop new markets to encourage collection, recycling and investment
- identify and assess options for used OTR rubber product users in remote locations
- engage with all stakeholders to understand the issues from all angles
- learn from other parts of the world and how they have approached the issue, including relationships with indigenous groups.

Taken together, these objectives all aim to create a circular economy for OTR rubber products as soon as possible. From where we are now it seems unlikely we will achieve this goal in just seven years. But every journey starts with one step, and this report seeks three main tasks: collaborate, review and build.

Collaborating on requirements and potential solutions

The aim of this report is to define the scale of the issue and explore the scope of any solution. Ultimately, stakeholders will need to agree, or compromise, on what it is we are trying to achieve and establish some milestones so we can gauge our progress.

Extensive consultation with stakeholders will be required throughout. Any proposed changes to the Tyre Product Stewardship Scheme will only succeed if all parties have had input and agree on the proposals.

It's easy to talk about getting alignment and sharing leadership, but they are often difficult to practice. It is up to us collectively to make all the signals to stakeholders point in the same direction, so any decision becomes a 'no-brainer'. However the issue affects the operations of our mining, agriculture and other sectors, we all share responsibility for finding ways to say 'yes'.

While the Scheme functions nationally, we don't expect a one-size-fits-all approach will necessarily be the best solution. Rather, the solutions will need to be tailored to the needs of each geographical area and the industries operating in them.

We can achieve recovery in significant quantities by exploiting the most relevant features that determine *where and how* OTR rubber products are used across the country.



Reviewing regulations and the Scheme

To determine how to improve OTR rubber product recovery in each state and territory, we will need to examine waste and resource recovery policy and regulatory settings at the national, state and territory levels. This will give clarity to all parties and enable us all to pull in a common direction.

Any proposed recovery solutions will need to align with:

- resource recovery targets at the national and state/territory levels
- national bans on the export of wastes including waste tyres
- national environment protection and biodiversity conservation requirements, including decarbonisation targets
- regulatory and licence settings for managing regulated and controlled wastes
- state and territory energy-from-waste policies
- general environmental duty and chain-of-responsibility requirements
- known, implementable social engagement practices
- laws, regulations and guidelines relevant to waste and resource recovery
- legislation, policies and other operating conditions that apply to the mining and agriculture sectors
- community expectations, including perspectives from indigenous peoples and local communities.

The exemptions that allow in-pit disposal and stockpiling are out of step with the regulations that apply to the rest of the country. Users and recyclers of OTR rubber products should start preparing for the possibility that governments mandate recovery in future, and we should all be ready to support any regulation to be harmonised across states and territories.

The Tipping the Balance: Research Report main report does not recommend any specific regulatory instruments, but recognises that some regulatory change is certainly needed to grant confidence in high recovery rates for OTR rubber products. Any regulatory changes must be in collaboration with the OTR tyre user and recycling sectors, and involve a transition period to avoid disrupting industries, introducing sudden new costs, or distorting markets.

The report does note that each catchment area has its own unique differences and requirements. Regulations will need to take this into account, while also recognising that larger companies operating nationally in multiple states will need consistency.



Building a circular economy

This report recognises the value of a circular economy that emphasises the continuous re-use of a substantial amount of OTR rubber products. Many mining companies and tyre manufacturers, particularly larger ones with considerable national and global tyre market presence, are interested in a 'tyres-into-tyres' recovery solution. These companies, with multi-year OTR tyre budgets reaching hundreds of millions of dollars, offer significant potential for developing new business models for OTR tyre recovery and supply in Australia.

TSA's collaboration with the tyre industry reveals global manufacturers' readiness to explore and invest in circular economy-aligned technologies, businesses, and service models. Initiatives include acquiring recycling companies, piloting tyre leasing models, and developing technologies for re-purposing end-of-life tyre materials. This foundation enables the development of new commercial arrangements between manufacturers and customers, given shared interests and compatible objectives.

Every step taken to encourage and develop a circular economy is worth taking. Other countries have demonstrated the economic, environmental and social benefits of creating a circular economy based on OTR tyres, and now it is Australia's turn. The ultimate aim would be a 'tyres-into-tyres' model, but there are many other possible approaches and we may need to build these over time to achieve that aim.

Getting from where we are now to that aspiration will require innovative thinking and extensive stakeholder collaboration, but there is every reason to believe that with the right stewardship scheme design and regulation, tailored to the needs of regions and businesses, we can achieve it.

What happens next?

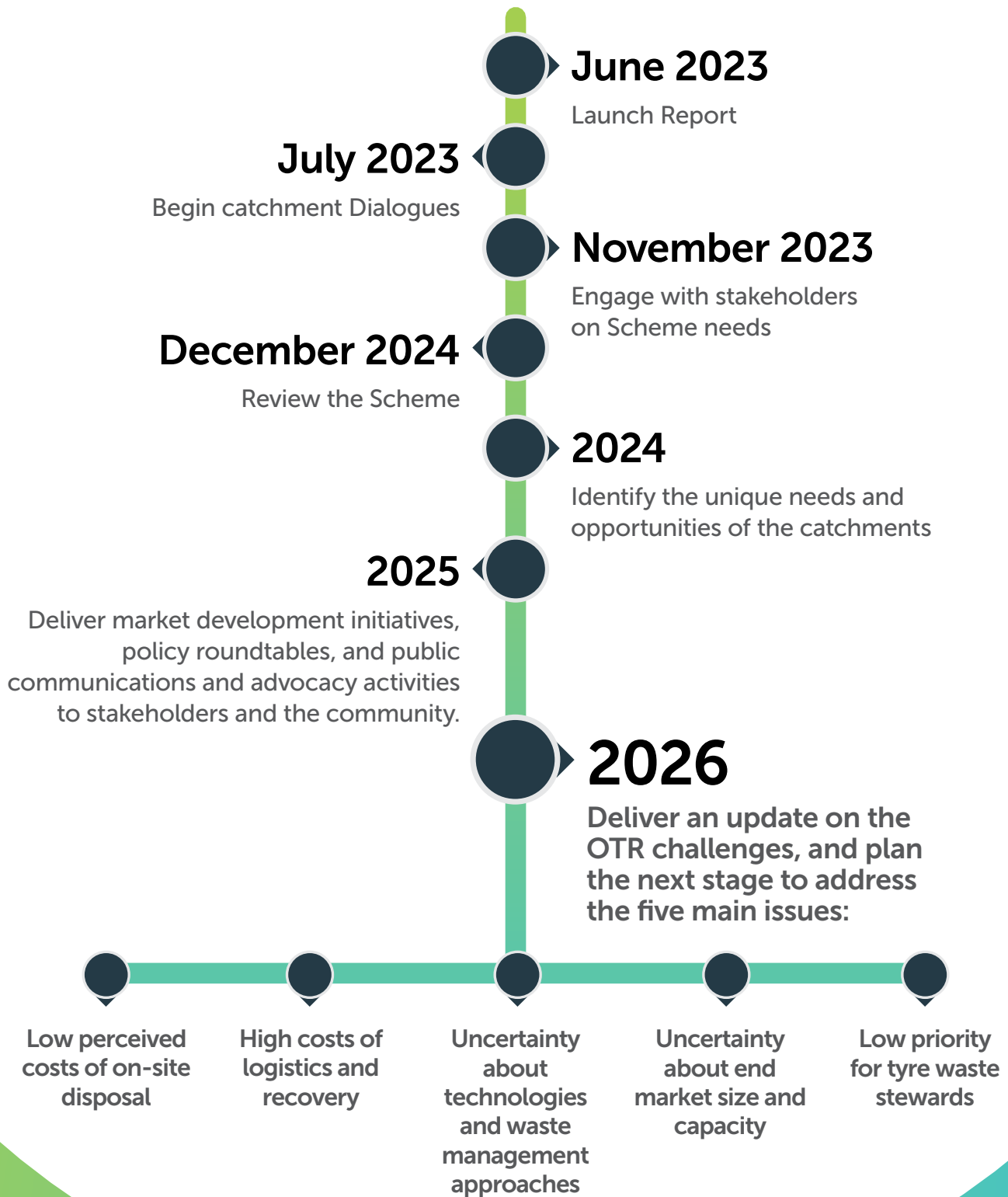
Australia's approach to recovering resources from OTR rubber products is not going to get any clearer or easier if we simply ignore it. There is clear evidence that current OTR rubber product management methods are behind acceptable standards and global management.

It is time to accept the evidence, think about the future we want and act on the choices we can make today.

TSA has already begun to engage with our stakeholders to deliver on many of the proposals within this business case. Seven OTR tyre importers began contributing to the Scheme in 2022. Our trials in the Bowen Basin and Hunter Valley are progressing well, and engagement in Pilbara, Northern Territory and Queensland is showing enthusiasm from industry and government to build the circular economy for OTR rubber products (and all tyres) and we will continue to drive this goal.

Our market development activities continue to show value and the spirit of Australian innovation to turn waste into valuable products, and we will continue to support commercialisation of products made from tyre-derived material. Research – technical, practical and economic – is already underway, continuously building on our knowledge. We have established working groups with industry to review policy issues and propose practical solutions, and we will grow this as more stakeholders join us in these efforts.

Milestones





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