National End-of-Life Tyres Options project

Investigation report – off-the-road tyres and related products

Department of Water and Environmental Regulation

Prime House, 8 Davidson Terrace Joondalup Western Australia 6027

P +61 8 6364 7000 F +61 8 6364 7001 National Relay Service 13 36 77

wa.gov.au/dwer

© Government of Western Australia

August 2025

This work is copyright. You may download, display, print and reproduce this material in unaltered form only (retaining this notice) for your personal, non-commercial use or use within your organisation. Apart from any use as permitted under the *Copyright Act 1968*, all other rights are reserved. Requests and inquiries concerning reproduction and rights should be addressed to the Department of Water and Environmental Regulation.

Acknowledgements

The Department of Water and Environmental Regulation would like to thank all the stakeholders who provided input during the consultation phase of the National End-of-life Tyres Options project.

For more information about this report, please contact our Circular Economy Directorate staff at the Department of Water and Environmental Regulation via the waste reform email address at wastereform@dwer.wa.gov.au.

Disclaimer

This document has been published by the Department of Water and Environmental Regulation. Any representation, statement, opinion or advice expressed or implied in this publication is made in good faith and on the basis that the Department of Water and Environmental Regulation and its employees are not liable for any damage or loss whatsoever which may occur as a result of action taken or not taken, as the case may be in respect of any representation, statement, opinion or advice referred to herein. Professional advice should be obtained before applying the information contained in this document to particular circumstances.

This publication is available at our website www.wa.gov.au/ dwer or for those with special needs it can be made available in alternative formats such as audio, large print, or Braille.



Contents

Executive summary		4
Background		5
Existing information		6
OTR tyres – summary of opportunities		
Improved management and repair		8
Disposal and recovery costs		
Transport		
Handling		
Onsite or adjacent processing		
Regional and remote infrastructure		
OTR tyres – summary of opportunities		13
Conveyor belts and tracks – information and issue Available information and gaps		14
Conveyor belts		
Rubber tracks		
Findings		
Glossary		17
Appendix: OTR tyre – technologies and services.		
References		23



In 2023, Australian environment ministers agreed that 'Western Australia would lead on the development of national principles for product stewardship for tyres', progressed through a national collaborative project (the project) on options for end-of-life tyres (EOLTs).1

The project has sought to establish a collective understanding of the problems associated with EOLTs, including for off-the-road (OTR) tyres. Conveyor belts and rubber tracks (related products) were also considered. The project has sought to identify and assess possible policy solutions which suit the Australian context, while aiming to manage tyres and related products consistent with the waste hierarchy and a circular economy.

The overall project has reviewed data and information that is relevant to many different classes of tyres. Most on-road tyres (for cars and trucks) have good recovery rates, while OTR tyres - particularly from mining and agriculture - have poor recovery.

OTR tyres and related products have some key issues and information gaps, and there is less clarity about the challenges and opportunities for these products.

The project established a jurisdictional working group (working group), with representatives from New South Wales, Queensland and Western Australia, to explore the issues and data gaps around OTR tyres and related products.

The working group sought feedback from key OTR tyre stakeholders through direct discussions to support the OTR tyre investigation and provided a brief (OTR brief) to support those discussions.

This report summarises the OTR investigation and its findings.

¹ See the glossary at the end of this document for unfamiliar terminology.



In June 2023, Australian Environment ministers agreed that 'Western Australia would lead on the development of national principles for product stewardship for tyres', progressed through a national collaborative project (the project) on options for end-of-life tyres (EOLTs). This included consideration of:

- on-the-road tyres (used for cars and trucks)
- off-the-road (OTR) tyres used in industries such as mining and agriculture
- conveyor belts and rubber tracks (related products).

The project aimed to establish a collective understanding of the problems with EOLTs, including OTR tyres and related products, and assess possible policy solutions.² The project subsequently considered policy options to suit the Australian context, while aiming to manage tyres and related products for consistency with the waste hierarchy and a circular economy (see Figure 1).3

The overall project reviewed data and information relevant to many different classes of tyres. Most on-road tyres (used for cars and trucks) have good recovery rates, while recovery for OTR tyres is poor (see Figure 2).

Figure 1 Tyre and conveyor belt management with respect to the waste hierarchy.

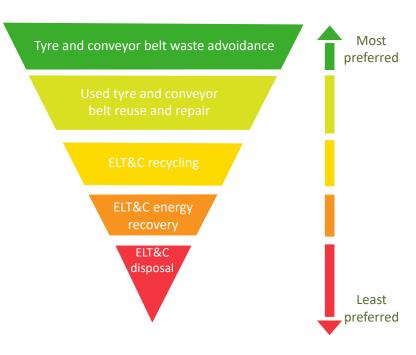
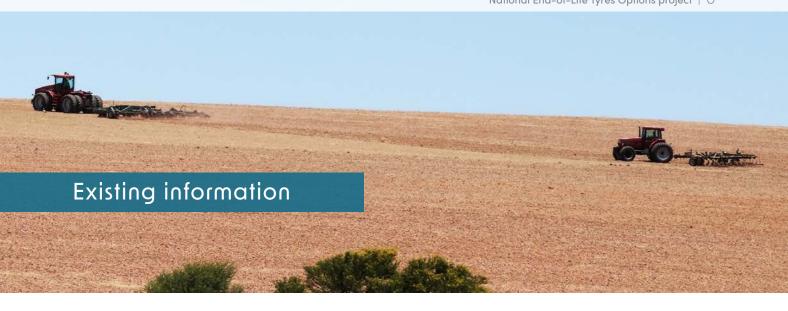


Figure 2 National levels of recovery versus non-recovery for various classes of tyres in 2023-24 Source: TSA 2025



OTR tyres and related products have some key issues and information gaps, and there is less clarity about the challenges and opportunities for these products.

- The overall project report was released alongside this OTR Investigation report (DWER 2025).
- Figure 1 shows how tyre and conveyor belt management options align with parts of the waste hierarchy. It is sourced from a recent TSA publication (see TSA 2024a).



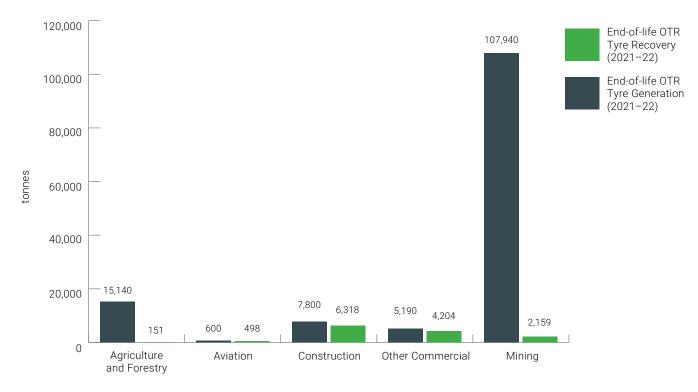
Information for this OTR investigation was drawn from readily available sources (see References on page 20). Key information on OTR tyres and related products in the Australian context has been recently released (TSA 2023a; TSA 2023b),⁴ some of which sets out details on the consumption and fate of end-of-life OTR tyres (and related products). Nevertheless, a variety of key data and information gaps and uncertainties still exists.

To address these data and information issues, the working group sought stakeholder viewpoints (informed by the investigation's OTR brief) and insights on the challenges and opportunities for OTR tyres and related products.

Figure 3 provides estimates for end-of-life OTR tyres in 2021–22 and shows the generation and recovery of end-of-life OTR tyres, with the loss of resources from OTR tyres predominantly from the mining and agriculture sectors.

These national figures are broad estimates that are likely to need further refinement to support informed decision-making around OTR tyres, with data on related products being less robust.

Figure 3 Generation and recovery of end-of-life OTR tyres for key sectors for 2021-22. Source: Derived from data in TSA 2023a.



Several other reports provide information that is relevant to OTR tyres and some of these reports also cover related products (see REC & BBEC 2020; Boxall et al. 2023; and Kaksonen et al. 2024).

OTR tyres can be a significant operational expense for their consumers and many factors influence OTR tyre service life (see Diagram 1).

Optimising tyre service life can align with higherorder outcomes in the waste hierarchy (see Figure 1) and support the transition to a circular

economy, as well as provide financial value to consumers. Where barriers can be lowered, the sustainable management of OTR tyres becomes possible (including through avoidance, repair, reuse and recovery), especially if an improved framework for end-of-life tyres can support better outcomes for these products.

Diagram 1 Factors affecting OTR mining tyre service life. Source: Michelin (2021) - used with permission from Michelin and originally derived from Ishikawa (1976).

Applications

Climate conditions

Nature and gradient of the site road

Cycle length

Site haul road design

Design of the bends

Machine type and size

Cornering speed

Average speed

Density of the materials transported

Distribution of the load

Position of the wheel on the vehicle

Process

Procedures

Frequency of overloading

Maximum speed

Operator skill

Machine behavior

Tyre structure Type of tread pattern Tread depth

Choice of tyre

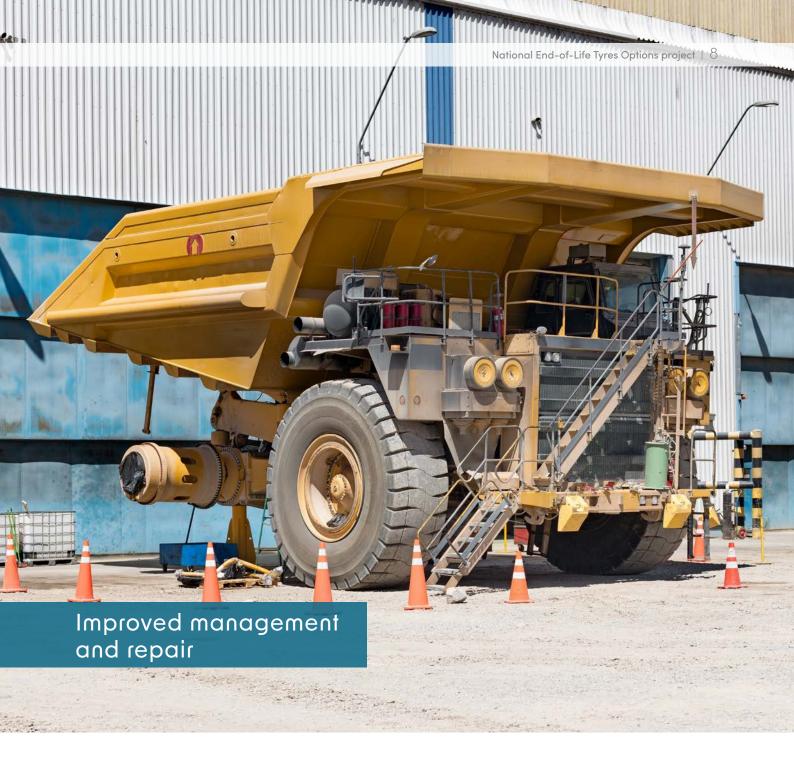
Type of tyre

Maintenance of site roads Maintenance of loading areas Maintenance of unloading areas Inflation pressure monitoring Inspection of machines Regular tyre inspections

Tyre repair

Regrooving Retreading

Maintenance



Stakeholders confirmed that OTR tyre use involves specific factors that influence tyre wear rates and failures, and many OTR users are focused on tyre service life optimisation.

Nevertheless, there is still likely to be scope to support better practice through further guidance and information provision to optimise tyre service life across industries. This could support improved operational practices where feasible. Existing information could inform any new guidance work, possibly covering onsite constraints, operational factors and management approaches. This could

also capture onsite and offsite maintenance and repairs (including hot-vulcanised repairs, buffing, relugging, regrooving and retreading).8

Incentivising improved management and repair activities could give effect to outcomes higher up on the waste hierarchy, to support greater circularity and potentially reduce costs. Incentives to improve OTR tyre circularity might be underpinned by standards and quality control and quality assurance systems, with government provision of guidance and information to help support wider adoption of better practice.

⁵ Examples include Michelin 2017; RSHQ 20005; Winterbourn accessed 2024a; Zhou 2007.

⁶ These have been identified as important considerations by some sources (see Kal Tire 2019; Shakenov et al. 2022).

For previous examples see Haselgrove 2021a; Informa Insights April 2015; Leonida 2022; Wilson 2022.

Service provider examples around Australia include Tyre Doctor, Big Tyre, Tytec, Specialised Tyre, and OTR Australia.

The direct costs for lawful onsite management of OTR tyres in mining operations have been estimated to be up to \$50 per tonne. However, these estimates may not cover the full financial costs of onsite disposal, including site preparation, longer-term monitoring and potential reputational costs (which could undermine the social licence for operations).

The costs for OTR tyre disposal in other industries will vary, and depend on:

- any use of onsite facilities (where it is legal)
- use of regulated landfills, typically with gate fees (and possibly levies)
- use of disposal by some other means (legal or otherwise).

Transport and logistics costs for OTR tyre recovery can also vary, depending on:

- the density of the load (which can be optimised by pre-processing tyres into pieces and by improving the packing efficiency of tyre materials)
- local infrastructure and logistic capacity (at generation and recovery sites)
- transport distances (and any issues with transport routes).

Collection costs for OTR tyres from regional areas¹⁰ are reported to be between \$333 to \$600 per tonne and from remote areas¹¹ between \$474 to \$767 per tonne. The transport component of collection costs can be compared on a cost per tonne kilometre (\$/tonne km) basis, which allows comparative assessment of different transport options and approaches. Note the transport component cost is a key part of the overall cost per tonne to transfer OTR tyres between locations but it is not the only cost.

Finding ways to reduce costs for OTR tyre recovery should be explored, as current recovery costs for recycling large OTR tyres may be more than 5 per cent of the purchase price, depending on the transport costs, the recovery type and the scale of the recovery process;

Some financial costs that may affect decision making around processing include:

- mechanical processing for making crumb rubber can cost more than \$600 per tonne
- pyrolysis has more cost variability, as it is heavily dependent on process scale and the degree of size reduction that a pyrolysis process needs
- the cost to prepare and deliver tyre derived fuel (TDF) to export markets is reported to be between \$285 and \$300 per tonne.

 $^{^{9}}$ For examples of reported tyre disposal costs for mining operations, see GRPL 2012; WCL 2021.

¹⁰ Assumes regional areas are up to 500 km from processors.

Assumes remote areas are up to 1,000 km from processors.

For previous estimates for costs for tyre recovery and tyre-derived product delivery to market, see Boxall et al. 2023; Goksal 2022; Kaksonen et al. 2024; TSA 2023a.



The main factors affecting road transport costs for commodities and goods include:

- input costs (fuel, labour, capital, maintenance and fixed costs)
- density of materials and the efficiency of packing in transport vehicles (see above)
- size of transport trailers
- specific requirements for transport (such as for dangerous goods or oversized cargo).

CSIRO's Australian supply chain transport and logistics dashboard provides current estimates for road transport and logistic expenses across a range of commodities and goods, but it does not specifically have figures for reverse logistics for end-of-life products.13

The road transport cost estimates in Table 1 include commodities that may share some of the transport characteristics of EOLTs (after size reduction), which helps to give a sense of the likely transport costs for tyres. With respect to OTR tyres that have undergone size reduction, transport costs below \$0.20/tonne km might be too optimistic, while anything above \$0.30/ tonne km might be too conservative for a well-run operation.

Modifying the dashboards to include reverse logistics activities could inform a range of recovery opportunities and support increased circularity in Australia.

In addition, the evolution in transport systems is likely to reduce transport costs over time for a range of commodities and goods,14 while opportunities for backloading and the use of takeback clauses in procurement might also be investigated to help manage costs. 15

Table 1 Road transport costs for different trip types for three commodity types. Source: CSIRO, accessed 2024.

Commodity sector	Short trip	Medium trip	Long trip
	\$/tonne km		
Horticulture	\$0.341	\$0.222	\$0.225
Wood products	\$0.257	\$0.196	\$0.198
Chemicals	\$0.243	\$0.155	\$0.184

¹³ A user Guide for the supply chain benchmarking dashboard is available online at https://benchmark.transit.csiro.au/docs/user_guide_dashboard.pdf

¹⁴ Potential cost reductions from the evolution of transport systems are covered elsewhere (see Dawkins & Gündogdu 2021; Engholm et al. 2020; EVC & ATA 2022).

¹⁵ For example, Whitehaven Coal Ltd has raised takeback clauses in a report (WCL 2021).



Good assessment processes for determining the repairability or end-of-life status of OTR tyres can inform the pathway for an OTR tyre and support its efficient and effective handling. This can help with the transport of whole OTR tyres going to repair (or specialised recovery) or OTR tyre pieces going to various types of recycling.

Previous studies have considered size reduction technologies for tyres (Kaksonen et al. 2024) and how material density and packing efficiency supports transport efficiency for EOLTs (Matthews 2005).

The appendix provides examples of OTR tyre recovery technologies. These include pre-processing technologies and products derived from repurposed OTR tyres and related products.

Generators of end-of-life OTR tyres may want to consider ways to collaborate to cost effectively access technology and/or services that support sustainability. In 2024, the Australian Competition and Consumer Commission (ACCC) released a guide on Sustainability collaborations and Australian competition law, 16 which should provide more clarity.

Guidance, information and reviews have also helped to demonstrate and inform possible approaches to collaboration to reduce the costs for organisations in other industry sectors, including within the mining and agricultural industries of Australia and elsewhere.¹⁷

Onsite or adjacent processing

Where sufficient supply exists, and under certain policy settings, onsite/adjacent processing might be worth considering. However, this would require effective partnerships between waste generators and recyclers and/or tyre brand owners. Several examples of onsite processing of OTR tyres exist globally, with pyrolysis being preferred by some key proponents. However, pyrolysis requires matching technologies and process conditions to target wastes and the intended end-markets for pyrolysis outputs, while these proposals may also have other requirements. Description of the sufficient of the sufficient sufficient

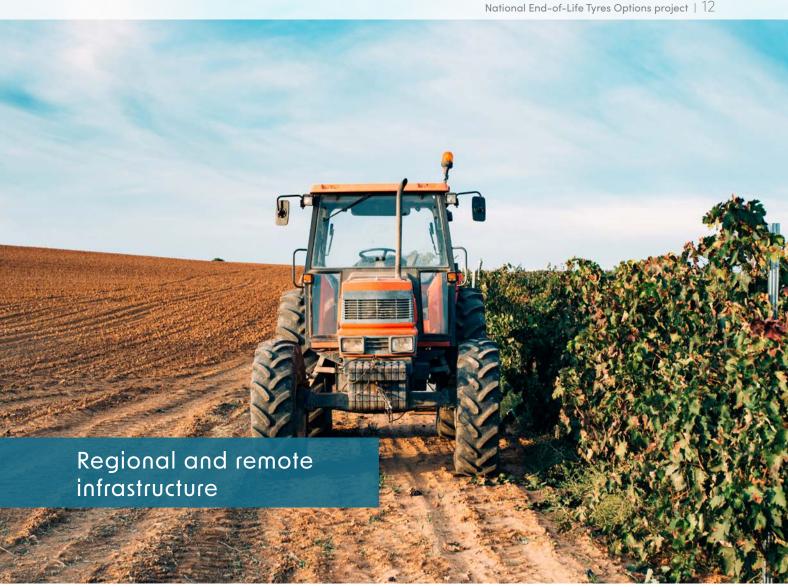
¹⁶ The final guide was released on 18 December 2024. See ACCC 2024.

¹⁷ Examples include Clark et al. 2022; Kenkel & Long 2007; NRSAMDB n.d.; US EPA 1994.

¹⁸ In Chile Kal Tire has set up pyrolysis processing for OTR tyres (see Kal Tire 2023; Zhou 2019).

Some examples of sources that cover pyrolysis and its constraints include Czajczynska et al. 2017; Han et al. 2023; Lewandowski et al. 2019; TSA 2024b; Zerin et al. 2023.

²⁰ Proposals for pyrolysis and other thermal treatments will need to consider any existing frameworks within jurisdictions for energy from waste (waste to energy), along with other specific requirements.



Regional infrastructure development is a complex area, where many factors influence what is put in place, yet such infrastructure plays an important role in reducing costs for improved circularity.

Funding support from governments can help develop infrastructure projects, particularly where they:

- support other policy initiatives²¹
- help with Australia's capacity to supply critical resources into markets²²
- assist local communities and contribute to sustainability outcomes.23

Regional and remote OTR tyre repair or recycling capacity can support higher-order recovery (TSA 2024a), while it may offer opportunities to reduce costs for OTR tyre generators (where they can access services more easily) and help support improved sustainability.

Nevertheless, establishing regional and remote recovery infrastructure faces a variety of constraints, including labour availability and affordability; sufficient sustainable supply of feedstock; and the potential for higher transport and logistics costs.

Some promising technologies may offer the opportunity to access newer markets for higher-value tyre-derived products (TDPs).²⁴ These technologies might warrant further investigation, especially if they could be established in regional areas.

²¹ This has been noted in previous studies. For example, see DCCEEW accessed 2024.

²² Development of Australia's critical resources may be supported by (and help support) complementary regional infrastructure, including recycling infrastructure (see PwC 2022, p.6; CofA 2023b).

For further discussion of local benefits from regional infrastructure development, see CofA accessed 2024; CofA 2015; DITRDCA 2023.

²⁴ The potential access to higher-value markets for tyre-derived products and the associated enabling technologies have been detailed in previous studies, including Kaksonen et al. 2024; TSA 2024a; Valentini & Pegoretti 2022; Zheng et al. 2022.



Several opportunities have been identified as avenues to reduce the costs and logistic difficulties with collecting and processing OTR tyres for recovery (see Table 2).

Table 2 Opportunities to reduce costs and issues with OTR tyre recovery.

Approach	Description	Comments (source/s)
Backloading	Backloading of used tyres when delivering new tyres.	More viable where processing is near OTR tyre distribution centres. This is a recognised way to deliver cost savings where it can occur. ²⁵
Onsite or local processing	Either into intermediate products (such as tyre pieces) or via more complete processing (using technologies such as pyrolysis).	Using tyre size reduction equipment is a standard financial consideration to support recovery. However, onsite or adjacent processing typically requires more effort and partnership, with a key consideration being suitable technology choice. Where this can occur, it may reduce overall costs for transport.
Expanding repair opportunities and higher-order processing	Emerging approaches may support better outcomes via reducing costs and/or access to more profitable markets.	OTR tyres are high-value products – extending their life and recovering valuable constituents (such as natural rubber) should be a policy focus. Regional repair infrastructure and emerging processing options have the potential to reduce costs over time. ²⁶
Business models	Use of business models involving backloading, such as for tyre takeback, trade-in and leasing. Use of specialised contracts to optimise tyre service life.	These can build in take-back and backloading as part of their contract. Also, improved operations and maintenance systems (using better monitoring and assessment of tyres for improved outcomes) can be part of contracts under some types of business models.

This has been raised in several reports, including Matthews 2005; REC & BBCE 2020; WCL 2021.
 This has been raised in other work, including Kaksonen et al. 2024; TSA 2024a; Valentini & Pegoretti 2022; Zheng et al. 2022.



Available information and gaps

Information on conveyor belts and rubber tracks have been estimated previously (TSA 2023a; Boxall et al. 2023), with other sources providing information on use-cases and recovery examples, or historic information and further useful context.²⁷ However, more work is likely to be needed to gain a better understanding of the end-of-life fate of these products and their recovery challenges, along with any opportunities for improved outcomes.

Conveyor belts

Table 3 shows previous estimates for conveyor belt consumption and indicates that a significant proportion of the conveyor belts consumed in Australia are manufactured locally, with around 35 per cent of all belts likely to be reinforced with steel and about 65 per cent with textile materials.

In 2021–22, conveyor belt consumption included 17,900 tonnes in WA, 4,429 tonnes in Queensland, 3,963 tonnes in New South Wales, 2,735 tonnes in Victoria and lesser amounts in other jurisdictions (TSA 2023a). These figures reflect the scale and types of industry activity across jurisdictions. Key industry sectors (and large industry players) determine the main types and sizes of belts that are used across Australia (Matthews 2005; TSA 2023a).

Conveyor belt manufacturers and service providers emphasise optimising belt service life, which can support productivity and reduce waste, and in some cases use conveyor belt products that can reduce operational greenhouse gas emissions.²⁸ There is a range of services offered by current providers supporting conveyor belt management, including operational and maintenance services, belt collection, used resale and/or recovery services.²⁹

Table 3 Estimates for conveyor belt consumption by source and variant. Source: TSA 2023a.

Conveyor source and variant	Conveyor consumption estimate	
	Lower	Upper
Conveyor source	tonnes/year	tonnes/year
Conveyor imports	30,000	35,000
Onshore conveyor manufacturing	30,000	50,000
Total	60,000	85,000
Conveyor variant	tonnes/year	tonnes/year
Steel reinforced	20,000	30,000
Fabric reinforced	40,000	55,000
Total	60,000	85,000

Reconditioned conveyor belts have parallels to tyre retreads, because new wearing material can be bonded to the product's structural materials, as long as the structure has not been compromised. Reconditioned belts are estimated to cost up to 35 per cent less than new belts depending on the belt type and its condition (Matthews 2005; TSA 2023a).

Some sources indicate conveyor belts can pose challenges for recycling, with steel in conveyor belts being a key issue that needs to be considered when planning to recover them.³⁰ Previous estimates have been determined for conveyor belt fate (TSA 2023a), but stakeholders noted conveyor belt fates were likely to need further investigation.

²⁷ See ABHR 2021a; ABHR 2021b; Davis 2021; Matthews 2005.

For further details see ABHR 2021a; Haselgrove 2021b.

²⁹ Examples include Andromeda Industries accessed 2024; Moor Marine accessed 2024; RBM accessed 2024; RubberGem accessed 2024.

³⁰ Further information on conveyor belt recycling and some key constraints are provided by Boxall et al. 2023; TSA 2023a.



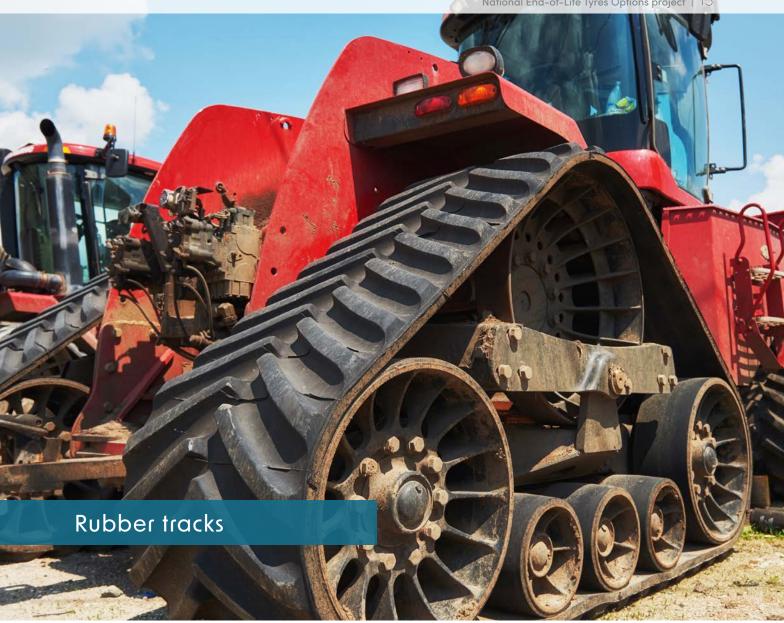


Table 4 sets out estimates for rubber track consumption, with most of the tracks consumed in Australia used in construction (TSA 2023a).

Table 4 Estimates of rubber track consumption in Australia by key industry sector. Source: TSA 2023a

5.11	Rubber track consumption estimate		
Rubber track consumption sector	Lower	Higher	
	tonnes/year	tonnes/year	
Construction	18,750	22,500	
Agriculture	6,250	7,500	
Total	25,000	30,000	

Victoria consumed the most tracks, followed by New South Wales, Queensland and WA – which mostly reflected the construction levels in each jurisdiction – but little (if any) track recycling seems to be occurring in Australia (TSA 2023a).

The fates of rubber tracks and their compatibility with existing recovery infrastructure and systems are likely to need further investigation.

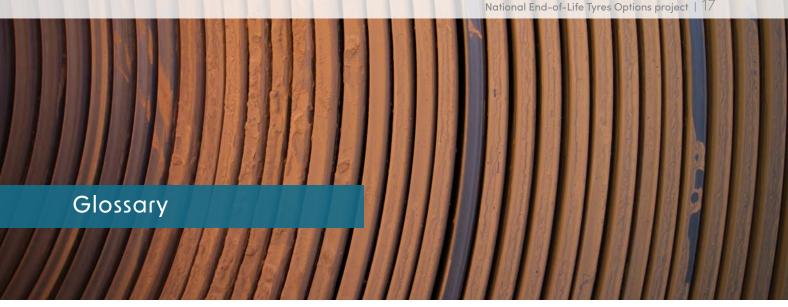


Several themes emerged during the OTR investigation which warrant further work and consideration, including the need for improved data, more guidance and research, improved quality systems and standards to support better outcomes, and improved infrastructure.

The OTR investigation found:

- Data and information there is a need for further data gathering and validation on the consumption and fate of OTR tyres (and related products) that might proceed independently of any other actions.
- Management and repair further provision of information and guidance on better practice may support reduced OTR tyre wear rates and tyre failures.
- Management and repair investigate how standards, quality control systems and quality assurance systems might support better-practice OTR tyre management across industries (by generators directly and by service providers), recognising this may be complementary to other initiatives.
- **Disposal and recovery costs** clarification of the full costs for onsite disposal of OTR tyres could help with decision-making around improving OTR tyre circularity.
- **Disposal and recovery costs** further investigations are needed to improve estimates on the range of costs associated with various OTR tyre fates, particularly across use cases, product types and sectors.
- **Transport and handling** better estimates and tools are needed to fully understand the range of transport and handling costs for end-of-life OTR tyres (and related products), especially emerging from regional and remote locations, including where tyres have undergone some type of pre-processing.
- **Transport and handling** investigate how standards, quality control systems and quality assurance systems might support improved end-of-life transport and handling of OTR tyres across industries, and how these could complement other initiatives.

- Onsite or adjacent processing review onsite/adjacent processing projects in Australia and elsewhere to determine key benefits and barriers that may influence wider adoption, investigate examples where net benefits seem to emerge from onsite/ adjacent processing, and report the core technologies and critical success factors for those projects.
- Regional and remote infrastructure highquality OTR tyre repairs and retreading services can support savings for OTR generators, but those services tend to become more viable the closer they are to OTR tyre users, which may be supported through better information and marketing about the existing range of options.
- Regional and remote infrastructure emerging processing technologies and new end markets for higher-value commodities may support sustainable recovery pathways for OTR tyres - further investigation is likely to be needed to confirm the circumstances and timing for the commercial readiness of technologies (including in regional and remote Australia) and the capacity of emerging higher-value markets to take these commodities.
- Regional and remote infrastructure consider how existing and potential support mechanisms may be used to accelerate regional and remote infrastructure, particularly where such infrastructure might also contribute to other policy goals.
- Sustainability outcomes provide information and guidance to support effective and efficient (and lawful) collaboration to improve the sustainability of transport, handling and processing of end-of-life OTR tyres (and related products), which can contribute both to the policy goals of governments and the environmental, social and governance reporting needs of industry.



Some of the definitions have been sourced from the TSA's Guidelines for the Tyre Product Stewardship Scheme (TPSS) (TSA 2019).

Term	Definition
ACCC	Australian Competition and Consumer Commission
AS4457	Australian Standard AS 4457-1997 Earth-moving machinery – off-highway rims and wheels – maintenance and repair
CofA	Commonwealth of Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DITRDCA	Department of Infrastructure, Transport, Regional Development, Communications and the Arts
EMM	Environment ministers' meeting – a periodic meeting between Australian environment ministers to assess key environmental issues and progress policy solutions
End-of-life tyre	A tyre that is deemed to be no longer capable of performing the function for which it was originally made
EOLTs	End-of-life tyres
ESG	Environmental, social and governance encompassing the range of non-financial considerations that might influence decision-making (particularly financial decision-making), which typically captures environmental issues, social issues, and corporate governance.
Higher-order recovery	Recovery, where more resource value is captured from products and materials, which typically might require more advanced or sophisticated methods and interventions to maximise that resource capture.
Lower-order recovery	Recovery, where the capture of resource value from products and materials is more limited, which might require less advanced or sophisticated methods and might need less intervention, reflecting the reduced resource value captured from waste.
Off-the-road tyre	Typically, a larger tyre used in industries such as mining, agriculture and construction, made to operate under specific use cases that differ from the conditions usually encountered on normal sealed or unsealed roads.



Term	Definition
OTR	Off-the-road
PIA	Policy impact analysis – formal Commonwealth process to compare policy options, which typically includes economic assessment across various options and associated public consultation.
Recovery	Where material and energy resources are captured from waste for some other use with an aim to gain some net benefit.
Recycling	Where material resources are captured from waste for some other use with an aim to gain some net benefit.
SAC ME-063	Standards Australia Committee ME-063
TDF	Tyre-derived fuel – a fuel derived from end-of-life tyres, which can include a range of tyre-derived materials used to produce energy or heat (including whole tyres or shredded tyres).
TDP	Tyre-derived product – any product produced from rubber, steel, textile or other material recovered from recycling end-of-life tyres.
tonne kilometre	A metric used in the freight industry to measure transport quantities, which can be abbreviated to tonne km
TSA	Tyre Stewardship Australia
US EPA	US Environmental Protection Agency



Brand and technology	Information
Eagle International Punch Cutter II	
Portable product is designed to split OTR tyres into two halves, cutting through the centre of the tread.	
A blade is used to punch the tyre while a programmable logic controller (PLC) controls the rotation of the tyre and the punching process, allowing the operator to set the machine, press the start button, and let it run.	
Minimum tyre capacity	Rim size 39 inches
Maximum tyre capacity	Rim size up to/including 70/70-57
Operational capacity	5-6 OTR tyres/hour
Product info.	https://wasteinitiatives.com.au/product/tyre-shears/mobile-tyre-punch-cutter/
Distributor info.	https://wasteinitiatives.com.au/
Brand and technology	Information
EcoGreen Equipment Eco Razor 63 Provides high-quality rubber removal from OTR tyres and preparation for downstream processing. Removes rubber from all three sides of the tyre.	
Minimum tyre capacity	Not identified so far
Maximum tyre capacity	Rim size up to 63 inches
Operational capacity	Up to 10 tyres per hour
Product info.	https://ecogreenequipment.com/equipment/eco-extractor-63/
Distributor info.	https://ecogreenequipment.com/

Brand and technology Information Gradeall Multi-machine set up Processing may involve the use of several pieces of equipment, including: an OTR splitter, which halves the tyre an OTR tyre sidewall cutter an OTR shear to cut tyres into smaller sections and/or a baler to improve the transport of tyre pieces. Minimum tyre capacity Tyre diameters from 1,200 mm Tyre diameters to over 1,800 mm Maximum tyre capacity Variable (depending on set up) Operational capacity Product info. https://gradeall.com/application-type/tyres/ Distributor info. https://gradeall.com/ Brand and technology Information Kal Tire OTR tyre recycling facility (Chile) The Kal Tire OTR tyre thermal conversion facility is near mines in Antofagasta, Chile.

Minimum tyre capacity	Not identified so far
Maximum tyre capacity	Up to 63 inch tyres (ultra-class OTR tyres)
Operational capacity	Up to 20 tonnes/day
Product info.	www.kaltiremining.com/en/news-release/otr-tire-recycling-facility/
Distributor info.	www.kaltiremining.com/en/

Brand and technology Michelin Mining Tyre Recycling Plant (Chile)

Michelin IP resizing machine to feed high-technology secondary recycling solution (MRP, Pyrolysis).

Similar facility, in partnership with Neuma Peru, is under construction in Peru, with similar proposals being explored for other locations globally.



Minimum tyre capacity	45 inch rim sizes
Maximum tyre capacity	63 inch rim sizes
Operational capacity	7,000 - 30,000 tonnes per year
Product info.	Rubber chips from 30 to 100 mm
Distributor info.	www.michelin.com

Brand and technology

Rubberbras (in partnership with Michelin)

Recycle and reuse of mining tyres (Brazil).

Rubberbras uses machines designed by Michelin (via a development partnership) in a size-reduction recycling process for mining tyres.

Rubberbras has also developed other machines to produce covering plates made from rubber derived from mining tyres. The rubber plates are attached to wear surfaces on ore processing and industrial equipment to extend their operational life by reducing impact and abrasion damage.

Information

Information



abradion damage.	
Minimum tyre capacity	From 35 inches
Maximum tyre capacity	Up to 63 inches
Operational capacity	10 to 20 tonne/day
Product info.	https://rubberbras.com.br/aplicacoes/cubo-inferior-do-silo/
Distributor info.	https://rubberbras.com.br/

Brand and technology Information RubberGem DairyGrip Supplied in long lengths, with no joins to reduce lifting and damage. Includes an integral steel cable system for structural stability over time. It can be used with automatic scrapers, skid steers, and tractors, making cleaning easy and efficient. Target input materials Heavy duty end-of-life mining conveyor belts **Target products** High-traffic matting mostly used in dairy industry Operational capacity Thousands of tonnes per year Product info. https://www.rubbergem.com/products/dairygrip/ Manufacturer info. https://www.rubbergem.com/ Brand and technology Information Salvadori MT-REX Can load tyres with a forklift. Automation allows load and leave. It discharges downsized rubber onto a conveyor. Adjustable tyre cut sizing to optimise for shredding. The modular unit can be relocated. Minimum tyre capacity From 45 inches Maximum tyre capacity Up to 63 inches

Downsize a 5,000+ kilogram tyre in one hour or less

www.salvadori.com/recycling/machines/mt-rex/

www.salvadori.com/recycling/

Operational capacity

Product info.

Distributor info.



Andromeda Industries (accessed 2024), Rubber belt division – about us, Andromeda Industries, https://andromeda-industries.webflow.io/rubber/about-us.

ABHR (Australian Bulk Handling Review) 2021a, 'ESS engineers conveyor maintenance collaboration', ABHR, vol. 26, issue 6, (November/December 2021), page 35, https://issuu.com/primecreativemedia-2016/docs/bhr1121_lr.

ABHR (Australian Bulk Handling Review) 2021b, 'Common causes for conveyor maintenance', ABHR, vol 26, issue 6, (November/December 2021), pp. 36–37, https://issuu.com/primecreativemedia-2016/docs/bhr1121_lr.

ACCC (Australian Competition & Consumer Commission) 2024, *Sustainability collaborations and Australian competition law*, ACCC, Canberra, www.accc.gov.au/media-release/accc-releases-final-guide-on-sustainability-collaborations.

Big Tyre (accessed 21 May 2025), OTR tyres, Big Tyre, https://bigtyre.com.au/tyres/otr.

Boxall NJ, Tobin S, Minunno R, Cheng KY, Zaman A & Kaksonen AH 2023, *Exploring opportunities for increasing value recovery from end-of-life tyres and conveyor belts in Western Australia*, National Environmental Science Program, <u>www.nespsustainable.edu.au/boosting-circularity-end-life-tyres-and-conveyor-belts</u>.

Clarke D, Swain K, Pantges S & Bukowski A 2022, *How co-ownership and common-user infrastructure can kickstart Australia's new economy minerals boom*, McCullough Robertson Lawyers, <u>www.mccullough.com.au/2022/10/10/how-co-ownership-and-common-user-infrastructure-can-kickstart-australias-new-economy-mineral-boom</u>.

CofA (Commonwealth of Australia) (accessed 2024), *Northern Australia agenda*, Department of Infrastructure, Transport, Regional Development, Communications and the Arts, www.infrastructure.gov.au/territories-regions-cities/regional-australia/office-northern-australia/northern-australia-agenda.

CofA (Commonwealth of Australia) 2023, *The Australian Government guide to policy impact analysis*, Department of the Prime Minister and Cabinet, Canberra, Department of the Prime Minister and Cabinet, https://oia.pmc.gov.au/resources/guidance-impact-analysis/australian-government-guide-policy-impact-analysis.

CofA (Commonwealth of Australia) 2023b, *Critical Minerals Strategy* 2023–2030, Department of Industry, Science and Resources, www.industry.gov.au/publications/critical-minerals-strategy-2023-2030.

CofA (Commonwealth of Australia) 2015, *Our North, Our Future: white paper on developing Northern Australia*, Department of Infrastructure, Transport, Regional Development, Communications and the Arts, www.infrastructure.gov.au/department/media/publications/our-north-our-future-white-paper-developing-northern-australia.

CSIRO (Commonwealth Scientific and Industrial Research Organisation) (accessed 21 May 2025), Supply chain dashboard, CSIRO, https://benchmark.transit.csiro.au.

Czajczyńska D, Anguilano L, Ghazal H, Krzyżyńska R, Reynolds AJ, Spencer N & Jouhara, H 2017, 'Potential of pyrolysis processes in the waste management sector', Thermal Science and Engineering Progress, vol. 3, September 2017, pp. 171-197, https://doi.org/10.1016/j.tsep.2017.06.003.

Davis, S 2021, 'Maintaining belt conveyors (bulk talk)', Australian Bulk Handling Review, vol. 26, issue 6, (November/December 2021), pp. 38-39, https://issuu.com/primecreativemedia-2016/docs/bhr1121_lr.

Dawkins T & Gündoğdu C 2021, Autonomous trucks: an opportunity to make road freight safer, cleaner and more efficient, World Economic Forum, www.weforum.org/publications/autonomous-trucks-an-opportunity-to-makeroad-freight-safer-cleaner-and-more-efficient/.

DCCEEW (Department of Climate Change, Energy, the Environment and Water) (accessed 2024), Investing in Australia's waste and recycling infrastructure, DCCEEW, Canberra, www.dcceew.gov.au/environment/protection/ waste/how-we-manage-waste/recycling-modernisation-fund.

DWER (Department of Water and Environmental Regulation) 2025, National End-of-Life Tyres Options project - Project report, DWER, Western Australia, <u>www.wa.gov.au/service/building-utilities-and-essential-services/</u> waste-management.

DITRDCA (Department of Infrastructure, Transport, Regional Development, Communications and the Arts) 2023, Regional Investment Framework – the Australian Government's approach to supporting strong and sustainable regions, DITRDCA, Canberra, www.infrastructure.gov.au/territories-regions-cities/regional-australia/regionalinvestment-framework.

Engholm A, Pernestal A & Kristoffersson, I 2020, 'Cost analysis of driverless truck operations', Transportation Research Record 0(0) 1-14, https://doi.org/10.1177/0361198120930228.

EVC (Electric Vehicle Council) & ATA (Australian Trucking Association) 2022, Electric trucks: keeping shelves stocked in a net zero world, EVC, https://electricvehiclecouncil.com.au/electric-trucks-keeping-shelves-stocked-<u>in-a-net-zero-world/</u>.

Goksal, FP 2022, 'An economic analysis of scrap tire pyrolysis, potential and new opportunities', Heliyon 8 (2022) e11669, https://doi.org/10.1016/j.heliyon.2022.e11669.

Green Rubber Pty Ltd 2012, Recovery, recycling and downstream product manufacture for end of life mining industry OTR Tyres, submission to the Australian Competition and Consumer Commission (ACCC), on the Australian Tyre Industry Council applications for authorisation (REF: A91336-A91337), ACCC, www.accc.gov. au/public-registers/authorisations-and-notifications-registers/authorisations-register/australian-tyre-industrycouncil-authorisation-a91336-a91337.

Han W, Han D & Chen H 2023, Pyrolysis of waste tires: a review, Polymers, vo. 15, issue 7, 1604, https://doi. org/10.3390/polym15071604.

Haselgrove S 2021a, 'LSM's TMS saves tyres, fuel and lives', Australian Mining, www.australianmining.com.au/ Isms-tms-saves-tyres-fuel-and-lives.

Haselgrove, S 2021b, 'Fenner Dunlop gauges conveyor belt performance with BeltGauge', Australian Mining, www.australianmining.com.au/fenner-dunlop-gauges-conveyor-belt-performance-with-beltgauge.

Informa Insights 2015, The unheralded and forgotten role tyres play in mining operations, Informa Connect (Mining & Resources), www.informa.com.au/insight/the-unheralded-and-forgotten-role-tyres-play-in-miningoperations.

Ishikawa K 1976, Chapter 3 (Cause-and-effect diagram [CE diagram]) in Introduction to Quality Control, Asian Productivity Organization, Tokyo.

Kaksonen AH, Gazeau B, Ruiz Cáceres AM, Cheng KY, Minunno R, Zaman A & Boxall N 2024, Best practice case studies for increasing value recovery from end-of-life tyres and conveyor belts, National Environmental Science Program, www.nespsustainable.edu.au/boosting-circularity-end-life-tyres-and-conveyor-belts.

Kal Tire 2019, Improving haul road conditions: 'You See an Immediate Effect', Australia's Mining Monthly, 26 April 2019, www.miningmonthly.com/partners/partner-content/1361318/improving-haul-road-conditionsimmediate-effect.

Kal Tire 2023, Turning waste mining tires into value: building a business case for OTR recycling, www.whyafrica. co.za/building-greater-circularity-into-business-models/.

Kenkel P & Long G 2007, Joint machinery ownership - organizing a machinery cooperative, University of Wisconsin Centre for Cooperatives, Madison, https://resources.uwcc.wisc.edu/agriculture/Org_Machinery_ Coop.pdf.

Leonida C 2022, 'Learning to roll with the times - mining tires', Engineering and Mining Journal, April 2022, pp 46-52, https://d34bcnn0i1cgfm.cloudfront.net/files/uploads/2022/04/Mining-Tires-EMJ_April-22.pdf.

Lewandowskia WM, Januszewicza K & Kosakowski W 2019, 'Efficiency and proportions of waste tyre pyrolysis products depending on the reactor type - a review', Journal of Analytical and Applied Pyrolysis 140 (2019) 25, https://doi.org/10.1016/j.jaap.2019.03.018.

Matthews, M 2005, Used tyre recycling industry triple bottom line analysis, Waste Authority, www. wasteauthority.wa.gov.au/images/resources/files/2019/11/Used_Tyre_Recycling_Industry_Triple_Bottom_Line_ Analysis.pdf.

Michelin 2021, Michelin earthmover – use and maintenance guide, Michelin, www.michelinb2b.com/wps/ b2bcontent/PDF/TECHNICAL_Usage_and_Maintenance_Guide.pdf.

Moor Marine (accessed 2024), Conveyor belt solutions - rubber conveyor belt recycling and repurposing services, https://www.moormarine.com/conveyorsolutions.

NRSAMDB (Natural Resources South Australia Murray-Darling Basin) n.d. Collaborative farming, NRSAMDB, https://cdn.environment.sa.gov.au/landscape/docs/mr/collaborative-farming-fact.pdf.

OTR Australia (accessed November 2024), Tyre servicing, OTR Australia, https://otraustralia.com/services/tyreservicing.

Pricewaterhouse Coopers 2022, Accelerating Australia's critical minerals opportunity, Pricewaterhouse Coopers, Australia, www.pwc.com.au/mining/critical-minerals/accelerating-australias-critical-minerals-opportunity.html.

REC (Randell Environmental Consulting) & BBEC (Brock Baker Environmental Consulting) 2020, Mining industry off the road used tyre analysis, TSA, www.tyrestewardship.org.au/tools-and-resources/mining-industry-off-theroad-otr-used-tyre-analysis.

RSHQ (Resources Safety and Health Queensland) 2024, Recognised Standard 13 - Tyre, wheel and rim management, RSHQ, www.resources.gld.gov.au/_data/assets/pdf_file/0004/986071/recognised-standard-13. pdf.

RSHQ (Resources Safety and Health Queensland) 2005, Safety and maximisation of tyre life, (Mines safety bulletin no. 54), RSHQ, www.rshq.gld.gov.au/safety-notices/mines/safety-and-maximisation-of-tyre-life.

Rubber Belt Mart (accessed 2024), Second hand conveyor belt, Rubber Belt Mart, www.rubberbeltmart.com.au/ usedbelt.

RubberGem (accessed 2024), Conveyor belts, RubberGem, www.rubbergem.com.au/what-we-recycle/conveyorbelts.

Shakenov A, Sładkowski A & Stolpovskikh I 2022, Haul road condition impact on tire life of mining dump truck, Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu, December 2022, No. 6, https://doi.org/10.33271/ nvngu/2022-6/025.

Specialised Tyre and Rubber Repairers (accessed November 2024), Repairs, Specialised Tyre and Rubber Repairers, https://specialisedtyres.com.au/repairs.

Standards Australia Committee ME-063 2008, AS 4457.2-2008 Australian Standard earth-moving machinery - off-the-road wheels, rims and tyres - maintenance and repair (Part 2: Tyres), Standards Australia, www.intertekinform.com/en-au/standards/as-4457-2-2008-130476_saig_as_as_276323.

Tyre Doctor (accessed November 2024, Our services, Tyre Doctor, https://tyredoctor.com.au/meet-tyreoctor/ our-services.

TSA (Tyre Stewardship Australia) 2019, Guidelines for the Tyre Product Stewardship Scheme, TSA, www.tyrestewardship.org.au/tools-and-resources/accc-authorisation.

TSA (Tyre Stewardship Australia) 2023a, Tipping the balance – the business case for a circular economy for Australia's off-the-road tyres, conveyors, and tracks, TSA, www.tyrestewardship.org.au/tools-and-resources/ tipping-the-balance-research-report-off-the-road-tyres-conveyors-tracks.

TSA (Tyre Stewardship Australia) 2023b, Tipping the balance – the business case for a circular economy for Australia's off-the-road tyres, conveyors, and tracks (summary and action plan), TSA, www.tyrestewardship.org. au/tools-and-resources/tipping-the-balance-research-report-off-the-road-tyres-conveyors-tracks.

TSA (Tyre Stewardship Australia) 2025, Australian tyre consumption and recovery - 2022-23, TSA, www.tyrestewardship.org.au/wp-content/uploads/2023/11/Australian-Tyre-Consumption-2022-23.pdf.

TSA (Tyre Stewardship Australia) 2024a, Analysis of the material circularity of management options for tyres and conveyor belts, TSA, www.tyrestewardship.org.au/tools-and-resources/material-circularity-of-managementoptions-for-tyres-and-conveyor-belts.

TSA (Tyre Stewardship Australia) 2024b, Pyrolysis of end-of-life tyres, TSA, https://www.tyrestewardship.org.au/ tools-and-resources/pyrolysis-of-end-of-life-tyres.

TSA (Tyre Stewardship Australia) 2025, Australian tyre consumption and recovery - 2023-24, TSA, www.tyrestewardship.org.au/tools-and-resources/tyre-consumption-recovery.

Tytec (accessed November 2024), About Tytec, Tytec, www.tytec.com.au/about_tytec.html.

URS 2005, Financial and economic analysis of the proposed used tyre product stewardship scheme, Australian Competition and Consumer Commission, www.accc.gov.au/system/files/public-registers/documents/ D12%2B149379.pdf.

US EPA (United States Environmental Protection Agency) 1994, Innovative methods of managing environmental releases at mine sites, US EPA, https://archive.epa.gov/epawaste/nonhaz/industrial/special/web/pdf/innovate. pdf.

Valentini F & Pegoretti A 2022, 'End-of-life options of tyres: a review', Advanced Industrial and Engineering Polymer Research, vol. 5, issue 4, October 2022, pp. 203-213, www.sciencedirect.com/science/article/pii/ S2542504822000392/pdf.

WCL (Whitehaven Coal Limited) 2021, Tarrawonga Coal Mine waste tyre disposal - modification report, WCL, www.planningportal.nsw.gov.au/major-projects/projects/mod-9-waste-tyre-disposal.

Wilson, D 2022, Kal Tire mining secures tyre management contract with Roy Hill, Retreading Business, www.retreadingbusiness.com/kal-tire-mining-secures-tyre-management-contract-with-roy-hill.

Winterbourn (accessed 2024 a), Tips for effective OTR tyre management, Tyre Response Group, https://tyreresponsegroup.com/effective-otr-tyre-management.

Zerin NH, Rasul MG, Jahirul MI & Sayem ASM 2023, 'End-of-life tyre conversion to energy: A review on pyrolysis and activated carbon production processes and their challenges', Science of The Total Environment, vol. 905, 20 December 2023,166981, https://doi.org/10.1016/j.scitotenv.2023.166981.

Zheng X, Pramanik A, Basak AK, Prakash C & Shankar S 2022, 'Material recovery and recycling of waste tyres a review', Cleaner Materials, 5 (2022) 100115, https://doi.org/10.1016/j.clema.2022.100115.

Zhou J 2007, Investigation into the improvement of tire management practices (a thesis submitted in partial fulfilment of the requirements for the degree of Master of Applied Science, University of British Columbia, Canada), Internet Archive Scholar, https://open.library.ubc.ca/soa/cIRcle/collections/ubctheses/831/ items/1.0081066

Zhou V 2019, Turning used mining tyres into a resource, 11 November 2019, article in Safe to Work (Mining), https://safetowork.com.au/turning-used-mining-tyres-into-a-resource.

