QUEENSLAND REGIONAL BUSINESS CASE FOR A CIRCULAR ECONOMY FOR USED TYRES

South West Queensland

Executive Summary

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Commonly used abbreviations

Abbreviation	Description
COAG	Council of Australian Governments (since dissolved and replaced with National Cabinet)
DES	Department of Environment and Science (Queensland)
DTMR	Department of Transport & Main Roads (Queensland)
EOLT	End-of-life tyres
EPU	Equivalent passenger unit (as a unit of end-of-life tyre volumes) 1 EPU = 8 kilograms; 1 tonne = 125 EPU
FNQROC	Far North Queensland Regional Organisation of Councils
FTE	Full time equivalent (as a unit of employment)
LGAQ	Local Government Association of Queensland
NQROC	North Queensland Regional Organisation of Councils
OTR tyres	Off the road vehicle tyres (as used for mining, agricultural, earthworks and other applications)
SWQROC	South West Queensland Regional Organisation of Councils
TDF	Tyre derived fuel
TPA	Tonnes per annum
TSA	Tyre Stewardship Australia

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- NQROC
- SWQROC
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Executive Summary

Southwest Queensland – as defined within the boundaries of the South West Queensland Regional Organisation of Councils (SWQROC) and its members – is an important and growing regional economy that, despite its limited and dispersed population, seeks to achieve greater success in recycling and alleviating the impacts of waste disposal and illegal dumping. The region has flagged tyre recycling as a priority for better environmental outcomes, based on the opportunity to improve the community's and business' access to tyre recovery services.

Historically, SWQROC has dealt with tyre recovery services that are both tenuous and intermittent, which has contributed to end-of-life tyre stockpiling at tyre retailers, agricultural properties and other premises over indefinite periods. Significant levels of illegal dumping may also occur across the southwest, due to a combination of a limited regulatory presence and large open spaces. While illegal disposal practices cause damage to the environment and related harms, both illegal dumping and stockpiling involve a failure to recover economically important resources and a greater reliance on virgin materials in downstream markets.

The observed stockpiling does not appear driven by an intent to avoid or defer end-of-life tyre management responsibilities, but may be an indication of the limited service levels and high transport costs associated with delivering tyre recovery services to the region. The lack of services is itself factored by the smaller volumes generated within the region; and the distance between SWQROC and recovery operations based in southeast Queensland, which may range between 500 and 1,000 kilometres.

Due to the small volumes at stake, in the order of 100 to 150 tonnes of tyres arising each year, the southwest region is unable to attract investment in a regional facility focused on processing its end-of-life tyres. So a solution is likely to concentrate on options to coordinate demand for tyre recovery services, consolidate tyre volumes, and achieve transport economies. As this may require a third party to act on behalf of tyre generators in the SWQROC region, this third party may carry a level of accountability to ensure the tyre recovery solution represents legitimate recycling, delivers value for money, and does not involve undue levels of commercial risk.

As stated above, the volume of tyres arising from the SWQROC region represents a very small fraction of the 112,000 tonnes of end-of-life tyres generated in Queensland each year. However, the problems faced in southwest Queensland repeat across many parts of the country that are somewhat remote and have modest population levels. A viable and affordable tyre recovery path for southwest Queensland may therefore point the way towards a service model for many other parts of Australia outside the major population and economic centres.

This business case shows that there is no reason to neglect the untapped resources stored within the tyres of cars, trucks, buses and large off the road (OTR) vehicles such as tractors, earthmovers and roadworks vehicles. Moreover, there are options at hand for southwest Queensland to adopt a regional tyre consolidation and collection model that delivers access to reliable, cost effective and legitimate tyre recovery services.

The full capture of these benefits will require that a number of barriers to regional tyre recycling are dealt with, and a failure to take action will ensure the status quo continues. These barriers relate to scaling and logistical challenges for the most part, although it is also useful to examine downstream recovery services and end markets to better understand cost efficiencies and risk profiles relating to each solution. Moreover, any options that allow recovered resources to be used in the southwest Queensland may be of interest, providing the means to adopt a circular economy approach to end-of-life tyres generated in the region.

Should the recommended actions in this business case be adopted through a coordinated approach, the combined effect will be to create conditions for one or more tyre collection services to establish in the region on an ongoing and stable basis. This will diminish the need for stockpiling across tyre retailers, farms and other agricultural holdings; and may reduce the prevalence of illegal dumping of tyres.

End-of-life tyres as an early priority for regional circular economies

Through their regional resource recovery plans, many regional organisations of councils in Queensland are looking into options to move to circular economy models. Such models place emphasis on extracting greater economic and social value from materials circulating through their regional economies. The shift to circular economies is one of three priorities set out in the Queensland *Waste Management and Resource Recovery Strategy*.

One avenue to achieve this end is to adopt stronger measures to divert material from landfill, and stoke local demand for these materials as an input to economic activities downstream of a recovery facility. The business case suggests that tyres present a prime candidate for regional organisations, councils and businesses in the southwest of Queensland to achieve early successes in the transition to a circular economy. This view is shaped from the following observations:

- Current unsustainable practices in managing end-of-life tyres reflect a common problem for which a regional solution may be suitable
- Activities for handling and collecting end-of-life tyres involve manageable levels of complexity – tyres are a consolidated, relatively clean stream with maturing end markets – compared with commingled and/or more highly dispersed waste streams
- Commonwealth and Queensland Governments have both pledged funding for the improved management of end-of-life tyres, in line with helping the community to adjust to the ban on exporting whole or baled waste tyres
- TSA is an established and high performing product stewardship organisation with a pronounced focus on achieving regional outcomes away from larger population centres and spheres of economic activity
- The end markets for tyre derived product substantially involve public procurement measures at the local, regional and state tiers of government, giving local councils and the state government a direct means to drive demand for tyre recovery services.
- In past months, mining companies have expressed an evolving interest in recovering their large OTR tyres, which may be a means to augment the volume of tyres available for recovery, while delivering economies of scale to support investment in a regional solution.

On this basis, circular economy leaders and their stakeholders may consider the merits of regional tyre recovery as an entry point or test bed for circular economy approaches that may then be applied more widely to other products and materials.

Purpose of the business case

This business case aims to shed light on the extent that end-of-life tyres (EOLT, or waste tyres) are a problem in regional Queensland, based on prevailing management practices. It aims to test a range of commercially-led options to alleviate this problem, and which may be enabled through various forms of support and intervention.

Across Queensland, about 112,000 tonnes of end-of-life tyres arise each year, including tyres from passenger cars, trucks and off the road vehicles (used in mines, agricultural land, Defence installations, and on road and civil works projects). Of this quantity, about 67,000 tonnes or 60 % are presently being recovered by recycling facilities concentrated in the state's southeast.

While there is no region-specific data for the total volume of end-of-life tyres generated in the southwest each year, waste tracking data suggests that about 100 tonnes are collected and processed from SWQROC council areas, again using facilities in southeast Queensland.

In the absence of a tyre recovery rate for this region, application of a 60 % recovery rate (from state figures) without modification suggests that about 50 to 60 additional tonnes of end-of-life tyres are generated without being retrieved for recovery. The lack of tracking data for this estimated volume suggests these tyres are being stockpiled, buried in mining pits, or are illegally dumped.

The recovery rate may be somewhat less than this state-based 60 % figure, due to obstacles arising from low quantities and large distances. While tyre recovery is currently occurring to some extent in regional Queensland, there are some concerns relating to:

- Low levels of recovery from some sectors and more remote geographies
- Persistent occurrences of illegal dumping activity
- Limited consideration of the efficiencies, outcomes and risks in relation to one recovery solution over another, which may indirectly impact the cost, stability and environmental benefit of recovery services used by end-of-life tyre generators in regional Queensland.

This work unpicks the barriers and challenges that block regional Queensland from accessing more sustainable and value-oriented methods to manage tyres, and sets out alternative options to recycle tyres arising from the regions in line with their benefit and cost profiles. As requested by TSA and for the purposes of this business case, this work concentrates its analysis and findings on three regional areas of Queensland including regions bounded by:

- The South West Queensland Regional Organisation of Councils (SWQROC)
- The North Queensland Regional Organisation of Councils (NQROC)
- The Far North Queensland Regional Organisation of Councils (FNQROC).

After an initial analysis of the regions, it was determined that the regions could be analysed in terms of tyre recovery options and solutions for two areas, i.e.:

i) The SWQROC region as a single end of life tyre catchment; and
ii) The NQROC and FNQROC regions, treated as a combined end-of-life tyre catchment.

This split structure recognises the potential for a northern located facility to process tyres from FNQROC and NQROC as a single combined market (or catchment); whereas tyres arising from the SWQROC region are isolated by geography from the other two areas and are to be treated as a separate market involving much smaller quantities of tyre material.

Challenges in recovering tyres in regional Queensland

In undertaking this business case, a number of challenges for recovering end-of-life tyres from regional Queensland have come to light. These include to varying degrees across the regions:

- Large distances and small volumes across generators (e.g. tyre retailers, mechanic shops, car dealerships, public and commercial fleets) that are associated with remote locations, creating unfavourable transport overheads and limited scale economies which lead to high costs and/or poor access to tyre recovery services[1]
- Somewhat limited and disconnected resource recovery infrastructure networks in locations further away from main population and economic centres, which are not optimised for the efficient transport and consolidation of regional tyre volumes
- Regulatory gaps in collection and related waste tracking, allowing rogue collectors to set up business to collect tyres without adequate oversight to ensure their destinations involve legitimate disposal and/or recycling activities
- Lack of incentives to end stockpiling of large OTR tyres (e.g. removed from tractors and other farming vehicles) on agricultural properties
- Limited drive for shifting mining operations away from in pit burial of OTR tyres, combined with a lack of signals for the market to provide mining tyre recovery services
- Insufficient monitoring and enforcement of illegal dumping activities in more remote locations, such that there is limited private cost in opting for illicit disposal practices
- Incomplete vision and commitment to the use of tyre derived materials in local applications (even where standards and specifications allow for the use of such materials as a commercial input), which could otherwise help strengthen the case for regional tyre recovery

[1] These employment estimates are based on figures provided during tyre recovery industry engagement.

- Limited knowledge across the tyre recovery industry, regarding the commercial potential of operations devoted to servicing southwest Queensland
- Limited price transparency for those accepting end-of-life tyres on behalf of a third party (e.g. transfer stations and tyre retailers that accept end-of-life tyres from vehicle owners), where the fees charged may not accurately reflect the true cost of recovery.

Additional to the above region-specific challenges, a number of issues are presently impacting the tyre recovery sector more generally. These include, for example, the need to respond to a ban on exporting whole and baled end-of-life tyres and the recent rise in labour and international shipping costs (which affects the use of tyre derived fuel in boilers, kilns and furnaces located throughout Asia). Alongside a shortage of workers available to the tyre recovery industry, these factors have contributed to flow on effects in the industry including a rise in tyre collection and processing fees.

These broader trends and developments add to the above listed regional challenges for tyre recovery. Yet this business case establishes that the impediments to better tyre recovery solutions for southwest Queensland are not insurmountable. Rather, they can be overcome through a combined set of actions that signal a strong commitment to tyre recycling outcomes, and draw private operators to the profitable opportunities at play.

Moreover, should a tyre collection and/or recycling service seize the initiative by working with regional bodies to establish a viable model to service remote communities and businesses in the SWQROC region, they may be positioned to roll this model out to other locations. While this may present a valuable business opportunity, it also extends the reach of tyre recovery solutions to parts of Australia that are currently underserviced, and therefore helps to reverse economic disadvantage and support inclusion in the circular economy.

The opportunity for enhancing the recovery of OTR tyres

The SWQROC region includes commercial activities that generate a quantity of OTR tyres such as cotton growing and other agricultural activities, earthworks, and other economic interests. While mining is a major source of OTR tyres in other parts of Queensland, it would appear to be a more minor source of tyres in the SWQROC region.

In the case of farming businesses, it is understood that OTR tyres (i.e. from tractors, harvesters, cotton pickers and other farming equipment) are often stockpiled on premises. This may involve a sub-optimal use of the land under care while degrading the environment, providing a habitat for vermin and pests, and presenting a fire risk. While this practice may not be preferred by farming businesses, it may be viewed as the only available option within the cost and locational constraints faced by the agriculture sector in southwest Queensland.

Unlike the case for passenger car and truck tyres, a dedicated OTR tyre recovery solution needs to factor in one or more mechanical processing stages at the front end, prior to receival at a facility designed to accept and process passenger car and truck tyres. This can add to the cost of recycling larger OTR tyres compared to on road vehicle tyres.

During a subsidised trial for consolidating, transporting and processing tyres from SWQROC (led by Balonne Shire), a significant volume of material originated from agricultural premises. The largest volume of tyres was sourced from two farming and cotton properties located towards the east of the SWQROC region.

Their participation signals that the agriculture sector may be willing to use tyre recovery services, provided that the services and related transport costs are affordable and available when needed. Farming interests should therefore be approached during efforts to lift the recovery level for tyres arising from the SWQROC region, particularly where the regional partners are seeking to achieve scale economies; or where a minimum volume threshold is needed to secure interest from a commercial tyre collection and recovery service provider.

Benefits of recovering end-of-life tyres

A range of benefits to southwest Queensland arise in more fully and reliably recovering tyres, and shifting further away from practices involving long term stockpiling on agricultural and other properties, illegal dumping, and other forms of disposal.

While a proportion of tyres has been recycled on an intermittent basis, the availability and cost of tyre recovery services undermine the region's capture of those benefits. Recovery levels could stand to improve and recycling services could be more accessible, compared to the status quo.

Environmental benefits from greater tyre recovery include the following:

- Recovery of resources that will otherwise be lost from the productive economy
- Reduced exposure to harms caused by illegal tyre dumping and stockpiling including:
  - Risk of fire and costs associated with fire incident responses
  - Degraded natural environs and species habitats
  - Lost visual amenity, and reduced enjoyment of contaminated landscapes
  - Breeding grounds for vermin and animal and human disease vectors
- The opportunity to set an example and lift the accepted standard for managing end of life products and materials
- Better custodianship of land under the care of agriculturalists, mining companies, public bodies, and others, realising tyre management outcomes in line with a 'caring for country' ethos.

Efforts to raise the level of tyre recycling may need to go hand in hand with effective regulation and enforcement against illegal dumping and restrictions against burial options, to stop leakage away from the recycling supply chain as led by rogue actors and others seeking to avoid responsibility for their waste streams. In southwest Queensland this is all the more important, to help reach threshold volumes that are needed to attract a tyre collection service to the region.

The availability of cost effective recycling services helps to lower the incentive for illegal services and business models, by ensuring that recycling fees for legitimate and trustworthy solutions are priced within affordability. Affordable and readily accessible tyre recovery services (potentially in the form of a regional hub) shrink the opportunity for rogue operators to undercut the market, and weaken the case for generators to avoid or defer the use of tyre recovery services.

Economic benefits for southwest Queensland stem from expanded and affordable tyre recovery services offered to businesses, individuals and councils. At present, those based in the southwest cannot exercise the choice to use tyre recovery services at a similar level to those based elsewhere such as southeast Queensland, and have few legal options that are delivered 'on demand' outside of disposal.

However, there may be additional economic benefits in the form of using recovered tyre products such as crumb rubber to displace the use of higher cost virgin material in a range of applications. The southwest Queensland regional economy may benefit if they arrange for the use of this material with local stakeholders and partners, whereas this benefit will be transferred to other parties if the material leaves the region. Research led by the Australian Flexible Pavement Association shows that the addition of crumb rubber into roads greatly extends the operating lifespan of those road assets, involving costs that are substantial below the cost of similar additives such as synthetic binders imported from Queensland.

The above combined environmental and economic benefits underscore the value of adopting a regional circular economy model for end-of-life tyres, wherein partners collaborate across end markets and supply chains to ensure as much material is retained for local economic use as is warranted, with proactive support to drive demand for tyre derived products.

Recovery options in detail

While some of the key issues for southwest Queensland tyre recovery relate to handling and logistics, it is also useful to consider the activities downstream of collection, and how those activities may have a bearing on the outcomes achieved, and the costs and risks indirectly incurred by end-of-life tyre generators in the SWQROC region.

In investigating different options to improve tyre recycling from southwest Queensland, the business case explored passenger car and truck tyre recovery according to:

- Commercially available technologies and their end markets, including:
  - Shredding to around 50 to 150 mm fragment size, for use as a tyre derived fuel
  - Grinding tyres to a smaller particle granule (for use in niche flooring and surfaces and civil applications) or crumb rubber (for use in road construction and maintenance) alongside recovered steel sold into scrap metal markets
  - Pyrolytic decomposition into carbon char, fuel oil and recovered steel, sold into relevant commodity markets and industrial processes (e.g. roadworks)
- Potential location of domestic and international buyers (relevant to tyre derived fuel only)

The potential to operate a facility in or adjacent to southwest Queensland was not examined in detail, recognising the tyre quantities involved are not sufficient to justify investment in a regional facility whose operations focus on recovering tyres from the southwest of the state. Instead, it is assumed that recovery will involve existing facilities in southeast Queensland.

In short, the following configurations of technology, end market and location were deemed the most likely pathways to improve tyre recovery from southwest Queensland, and were therefore analysed in detail in this business case. This determination is based on their technical capacity to process commercial volumes of tyres at competitive prices; the presence of stable and/or growing markets for their products; the presence of supporting and/or complementary commercial activities, and other factors relevant to a Queensland market context.

Technology	Products	Potential facility location(s)
Shredding plant selling to offshore customers	Tyre derived fuel (for energy users abroad)	Southeast Queensland (existing)
Shredding plant selling to Australian customers*	Tyre derived fuel (for domestic energy users)	Southeast Queensland (existing)
Crumb and granulation plant	Rubber crumb, rubber granule and steel	Southeast Queensland (existing)
Pyrolysis plant	Carbon char, fuel oil and steel	Southeast Queensland (existing)

* See further explanation in the text below.

The option to shred tyres and sell to a domestic energy buyer (marked with an asterisk above) underwent a partial investigation only, due to a lack of market precedents on which to base a confident assessment of supply chain and market risks. The absence of historic buyers in the Australian market prevented a full financial analysis of this option. The report therefore focuses on a discussion of issues and factors for interested parties to attend to in exploring this option further.

The sections below outline key findings from a more in depth analysis contained in the main report, and aim to shed light on comparative strengths and weaknesses of each recovery option.

Indicative profitability of tyre recovery options

In conducting a comparison of alternative options, a key consideration is whether a given model to recover tyres from the regions represents a cost effective solution.

For the purposes of this business case, cost effectiveness was compared by building a financial profile of the different options investigated, factoring in underlying supply chain costs and the availability of revenues from the sale of products and recycling fees. To enable a fair comparison across options, a uniform recycling fee of $6 per passenger car tyre (consistent with prices referenced by regional stakeholders) was applied and it was assumed that tyres were collected from sources in the vicinity of Roma or St George (towards the eastern edge of SWQROC).

Other parameters were as determined according to the technologies, products and end markets in question, and the transport overheads due to processing in southeast Queensland.

The business case recognises that any commercial operator will need to retain a margin above and beyond operating costs, both to deliver profits but also to account for a range of additional business pressures and needs outside of its physical operations. This is treated as a 'surplus net of recycling', i.e. a margin that allows the business to grow over time, deliver returns to shareholders, and weather commercial unknowns that are challenging to predict over the medium to long term.

In principle and for a given recycling fee (as described above), this potential margin serves as an indicator of the cost effectiveness of one recovery pathway over another, and the capacity of the supply chain to withstand less favourable market conditions. For each of the recovery options included in this business case and treated with a set of market-relevant operating assumptions, the figure below sets out projected margins per tonne of tyres processed. A key take away from this figure is that solutions with a higher margin are better positioned to outcompete those with a lower margin, all else being equal. That is, they are reflective of a more economically efficient recovery pathway for the region.

(While the business case looked at the option to recover tyres as a waste derived fuel for domestic cement kilns, an inability (due to a lack of reliable data) to perform a quantitative financial analysis on this option means that it has not been included in the figure below).

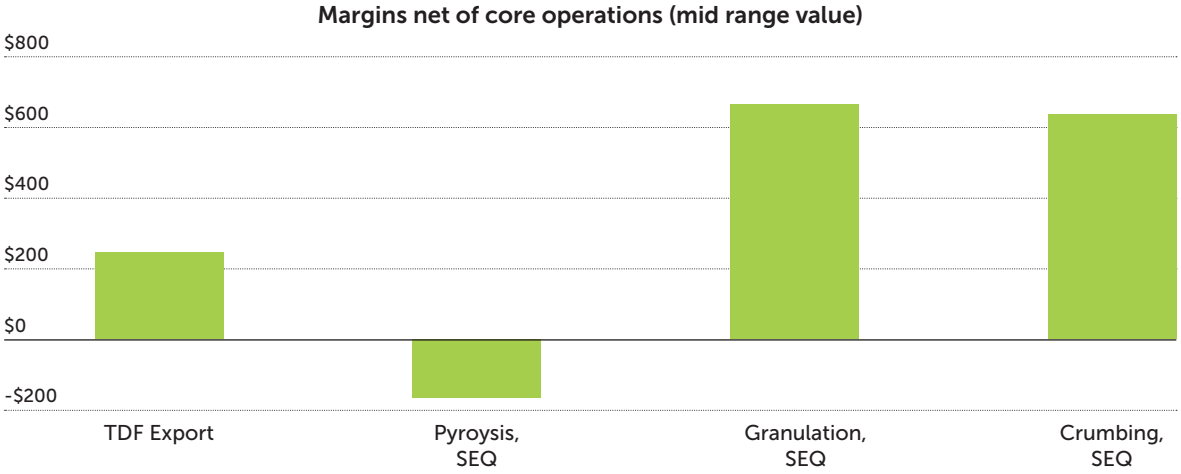

Figure: Mid range surpluses (per tonne) net of recycling operations, estimated for four recovery pathways.

Some factors that drive the observed margins and corresponding cost effectiveness include:

- The high capital costs of pyrolysis plants based in Australia and operating at relevant scales of throughput, combined with the production of commodities currently saleable at the lower end of the value spectrum, lead to low operating margins for this option at the present point in time.
- Although shredding has a comparatively low capital and operating cost profile, international buyers are presently paying low prices for tyre derived fuel (with limited chance of a lift in prices in the foreseeable future) while shipping costs have risen significantly since the Covid-19 outbreak. This results in a net cost to the shredding plant operator, which has to be recovered through recycling fees and leads to eroded commercial margins compared with other options examined.

- A crumbing and granulation facility has moderate to high capital and operating costs compared with shredding, but this is more than compensated by the value of products sold to domestic markets and the avoidance of international shipping overheads.

To summarise, the financial comparison exercise indicates that the most cost effective option for recovering end-of-life tyres from southwest Queensland would involve crumbing and granulation of tyres as suitable for a given feedstock. During industry engagement, it was identified that passenger car, truck and OTR tyres could all be converted to rubber crumb or rubber granule. Additional processing is needed for passenger car tyres, to remove a nylon mesh layer which is not found in truck tyres and OTR tyres, however some operators have managed to overcome this technical challenge.

These processes would leverage existing infrastructure based in southeast Queensland, as the volumes are not adequate for to justify a regional solution.

A market analysis also suggests significant demand for crumb rubber and other products in regional markets in southwest Queensland, although the recycler may need greater certainty of market scale in sectors such as road construction and niche flooring and surfaces, before actively pursuing product sales to buyers and/or downstream operators based in southwest Queensland.

Supply chain and market strengths and weaknesses

A quantitative financial analysis provides partial insight on the commercial viability of different solutions to recover tyres from southwest Queensland. Each supply chain may be exposed to a range of risks and opportunities, both as part of their operating circumstances and in response to evolving commercial environments.

The business case sheds light on these wider factors through a descriptive process, with findings set out as advantages and disadvantages in the table across the following page.

This information may be relevant for those that have a role in bringing together a range of tyre generators and councils in the SWQROC region in a bid to drive sufficient scale of demand for tyre recovery services. Those generators may have questions regarding the downstream fates of their tyres once they are collected, and the table overleaf presents a starting point for further discussion with those generators and a means to navigate trade offs and competing outcomes.

For example, tyre generators may be interested in opting for a recovery solution involving lower commercial risks; reduced greenhouse gas emissions via energy recovery technologies; or the means to reuse recovered materials in the southwest Queensland economy. Alternatively, they may be indifferent to these aspects that sit beyond affordability and legal compliance needs. Nonetheless, it may be prudent for a coordinating body to be prepared for a range of questions and discussion points as it recognises some accountability for downstream activities and impacts.

In the main report, this table contains additional details regarding steps that TSA may take to resolve some of the disadvantages flagged for each technology and end market. These steps are broadly captured within the scope of activities that TSA conducts in its market development operations. These activities may be directly applied to end markets relevant to tyres that originate from southwest Queensland, although a more immediate priority may be to address the logistical and consolidation challenges faced by the region.

Processing technology	End markets	Advantages	Disadvantages
Shredding whole tyres to meet TDF specification *Likely applicable to passenger car tyres only*	Kilns, furnaces and boilers located in Asia (e.g. Malaysia, India)	• Operations well established at commercial scale • Limited capital costs and operating costs (per EPU) • High volume end markets	• Very low value product, often below cost to process • High cost to deliver to international end markets • Exposure to market risks • Limited ability to pivot to more profitable products
Shredding whole tyres to meet domestic use TDF specification (assumed to be consistent with international TDF requirements) *Likely applicable to passenger car tyres only*	Domestic alternative solid fuels (i.e. cement kilns, including cement manufacturing in Queensland)	• Operations well established at commercial scale • Limited capital costs and operating costs (per EPU) • Low cost to ship to target customer(s) • Able to pivot from domestic to international buyers	• Customers yet to emerge, limited price discovery • Many sellers and few buyers – limited market influence • Ongoing risk of collapse in demand without notice • Limited ability to pivot to more profitable products
Pyrolysis to generate thermal desorption products (steel, carbon char, fuel oil) *Applicable to all tyre types*	• Carbon char commodity markets • Low grade fuel oil applications • Recovered steel (scrap metal) markets	• Able to take truck and passenger car tyres without separation • Multiple products allowing some level of market diversification	• Unproven at commercial scale in Australia • Carbon char and fuel oil products yet to attract high demand levels • High capital and operating costs • Exposure to competition from global supply chains
Granulation using rubber crumbing facility *Applicable to all tyre types, although operator may tend to use passenger car tyres if able to remove nylon mesh from product streams.*	• Niche mats and flooring • Niche industrial products • Civil applications • Recovered steel (scrap metal) markets	• Well established at commercial scale • Higher margin products • Established and emerging markets for granule • Options to switch markets based on better returns • Option to switch to crumb products pending acceptance as a road input	• Significant capital costs and operating costs (per EPU) • Some markets yet to fully mature • Some potential challenges in removing and dealing with nylon mesh
Crumbing using a rubber crumb facility *Applicable to all tyre types, although operator may tend to use truck and OTR tyres.*	• Crumb rubber modified spray seals and asphalts • Recovered steel (scrap metal) markets	• Well established at commercial scale • Higher margin products • Stable and growing road building markets for crumb rubber • Potential use in local / regional circular economy • Option to switch to granule products	• Higher capital costs & operating costs (per EPU • Potential that the market becomes flooded with crumb rubber sourced from passenger car tyres (downstream of exported bale and TDF market dynamics)

Value of recovered materials

Regional stakeholders may prefer to support a recovery model that generates higher value outputs, and that makes a greater contribution to the regional economy beyond diverting material from landfill, as opposed to support for a model in which the products hold marginal value and in which the economic utility of the recovery process may be called into question.

To this end, the table below sets out the value of recovered resources across the three main recovery technology and end market combinations studied in this business case. For simplicity, upper estimates of each commodity value are used, noting that caution needs to be exercised in interpreting the figures to allow for price fluctuations over a given period. (Note that, in achieving a 100 % recovery rate, the composition between resources recovered from passenger car, truck and OTR tyres may differ from a 60 % recovery rate, due to an overall shift in the proportion of passenger car, truck and OTR tyres being recovered.)

The figures in this table show that the recovery of tyres through crumbing and granulation may yield resources with an aggregate annual value in the range of $51,000 to $84,000, depending on the recovery rate and throughput achieved. In the case of pyrolysis, this range sits between $16,000 and $26,000, although these estimates are qualified in recognition that tyre pyrolysis is an emerging sector in Australia and market information is therefore limited. In the case of shredding to produce a tyre derived fuel for sale to international buyers, this range is between $5,000 and $8,000 per year. However, market research during the business case reveals that some tyre shredding operators are willing to offload tyre derived fuel at no charge to the customer, so actual revenues from its sale may be substantially less than the figures used here.

Table: Annual market value of recovered materials for a given set of technologies and their recovered products.

Resource	Volume (60% recovery)	Sales	Volume (100% recovery)	Sales
Shredding to produce tyre derived fuel				
TDF (at $50/t)	100 tonnes	$5,000	160 tonnes	$8,000
Total		**Total**	**$5,000**	**$8,000**
Crumbing and granulation				
Rubber granule (at $600/t)	20 tonnes	$12,000	40 tonnes	$24,000
Rubber crumb (at $800/t)	40 tonnes	$32,000	60 tonnes	$48,000
Steel (at $240/t)	30 tonnes	$7,200	50 tonnes	$12,000
Total		**$51,200**		**$84,000**
Tyre pyrolysis				
Carbon char (at $200/t)	25 tonnes	$5,000	40 tonnes	$8,000
Fuel oil (at $140/t)	30 tonnes	$4,200	48 tonnes	$6,720
Steel (at $240/t)	30 tonnes	$7,200	48 tonnes	$11,520
Total		**$16,400**		**$26,240**
Recycling fees (at $750/t)	100 tonnes	**$75,000**	160 tonnes	**$120,000**

Addressing logistical challenges in the SWQROC region

Independent of the supply chains and end markets for recovering tyres from the SWQROC region, a key issue for reliable and affordable tyre recovery concerns the efficient transport of end-of-life tyres. In practice, tyre recovery from the SWQROC region is likely to hinge on an ongoing commercial relationship with a collection service who is able to collect end-of-life tyres from across the whole region, as the volumes are not sufficient to support efficient recovery via multiple collection service providers. That collector could be an intermediary with multiple commercial relationships with recovery facilities, or may be a vertically integrated collection and processing service provider.

While Balonne Shire was able to run a consolidated tyre collection trial in which 300 tonnes of accumulated tyre material was recovered, there is the ongoing risk that the volumes that periodically accumulate in the future are of marginal value for a commercial collection partner. At minimum, the trial worked as a means to test market interest and better understand the conditions needed for an operator to fill this regional gap in the market on a more permanent basis..

During industry engagement, operators advised that they would need to collect about 150 tonnes per collection run from a single point in the region's east (such as Roma or St George) which, at current levels of tyre generation and consolidation, could be amassed over an eighteen month period. Regional partners and TSA may seek to lift this volume through, for example:

- More effective and targeted approaches to reduce instances of illegal dumping and drive the uptake of legitimate recycling services
- Engagement with generators of larger volumes of OTR tyres, such as cotton growers and other primary producers, who may be stockpiling end-of-life tyres on their properties and who may be interested in affordable tyre recovery services
- Exploration of options to link up tyre recovery supply chains involving surrounding cities, townships and commercial activities such as those in the Darling Downs region
- Exploration of best practice approaches to scaled transport of end-of-life tyres, including options using joint procurement, better use of existing and planned infrastructure such as transfer stations, use of backhauling arrangements, and widening collection services to cover other end of life products such as white goods, packaging or scrap metal.

Having a larger scale of tyres recovered from the SWQROC region and surrounding areas may help to drive transport efficiencies for tyre recovery supply chains, while potentially encouraging competition in the market. It may also help ensure a continued tyre recovery market presence in the region while improving the rate of recovery.

The need to address illegal dumping and rogue collection services

The project team understands that illegal dumping takes place in Queensland, both due to end-of-life tyre generators deliberately engaging in dumping practices; and due to rogue operators acting as responsible tyre collectors / recyclers while undercutting legitimate service providers. TSA's Queensland auditor and the Queensland Government advise that forestry plantations have been used as dumping grounds, while councils report that roadsides are also impacted by dumping. Local media also identifies farmland as being despoiled by tyre dumping activity.[2]

This suggests a need to ensure broad monitoring and enforcement measures against illegal dumping are effective, and to ensure the waste tracking system is able to recognise and generate intelligence on rogue operators acting outside the legal framework.

Some actions to address these potential deficiencies include:

- Adoption of novel tracking (e.g. electronic tagging) of tyres, so that a trail of responsibilities can be determined from illegally dumped tyres
- Use of geospatial imaging methods to help identify dump sites across the state

[2] https://bundabergtoday.com.au/news/2022/03/28/queensland-farms-becoming-dumping-grounds/

- Performance review of licensing and waste tracking systems, to ensure fitness in preventing rogue operators from competing with legitimate tyre collectors and recyclers
- Focused education of tyre generators including tyre retailers, mechanics and car dealerships, to help them discern between rogue and legitimate operators, and to ensure they understand their responsibility to manage end-of-life tyres appropriately.

While these areas fall within the Queensland Government's responsibilities to lead, there may be a role for TSA and councils to provide input and/or work as partners in pilot projects. TSA may also have a role to support knowledge transfer from other states that may have trialled or fully implemented more effective tracking and monitoring technologies to prevent inappropriate waste management practices.

Capturing the opportunity through coordinated efforts

The business case establishes that tyre recovery from the southwest region of Queensland could be improved in a number of ways. These improvements span the augmented collection and supply of end-of-life tyres to strengthening the demand for tyre derived products, and may include points along the supply chain between these two extremities.

Irrespective of the tyre recovery solution serving the regions, there is a basis to tighten regulation and enforcement activities to lower leakage of usable tyre resources to other practices like illegal dumping. Similarly, end-of-life tyre transport and consolidation arrangements for the region could be rendered more efficient, using a combination of:

- Back hauling and reverse logistics
- Coordinated and shared use of collection services, potentially involving other materials
- The use of transfer stations and other sites as a regional resource consolidation network that functions as a series of nodes to drive collection and transport efficiencies
- Leveraging collection services for centres and businesses in the adjacent Darling Downs.

In terms of supporting demand for products derived from tyres recovered from the SWQROC region, this business case notes that some products – such as steel, crumb, granule and tyre derived fuels – have relatively established end markets that are able to absorb the quantity of products from the SWQROC region over a given time period. Other end markets, such as those for pyrolysis products, may be more tenuous due to a range of factors that go beyond the issues particular to the SWQROC region.

TSA and partners may elect to apply their existing market development expertise and functions to one or more of the end markets for tyre products from the SWQROC region, according to their preferred balance of benefits and outcomes. If the SWQROC councils had an interest in achieving circular economy outcomes from tyre derived products sourced from the region, the immediate opportunity lies in the use of crumb rubber in road building and maintenance projects; although there may be the option to use rubber granule in recreational and sporting surfaces and/or civil works (e.g. permeable pavements).

Table: Overview of actions to address barriers and points of friction in improving tyre recovery from the SWQROC region.

Thematic focus	Response	Lead organisations
Illegal dumping of end-of-life tyres	Improved licensing and waste tracking/ reporting systems for tyre collectors and recyclers. Improved monitoring (e.g. geospatial imaging) and tracking (e.g. electronic tags) of dumping and stockpiles. Greater efforts towards surveillance and enforcement against illegal tyre disposal.	DES with TSA and council support Note: Organisations nominated may be revised in line with establishing an independent environmental regulatory body.
Increased recovery of tyres from selected OTR vehicle industries	Direct engagement with cotton and other agriculture sector sources and their OTR tyre suppliers, aiming to determine a service model and equipment suitable for processing and collecting their end of life OTR tyres. This action may uncover solutions where suppliers agree to take back OTR tyres, potentially leveraging intermediate storage points (which may include transfer stations or other depot facilities).	TSA with council, DES and industry body support, along with leading OTR tyre users.
Consolidated handling and transport Transport efficiencies gained through intra-regional linkages	Investigate opportunities to: • Better leverage public infrastructure (e.g. transfer stations) as a transport and consolidation network across the region • Establish and expand collective procurement of tyre recovery and collection, which may include request for backhauling services • Synchronise collection schedules with services delivered to main centres in the adjacent Darling Downs region	Councils and tyre recovery sector, with TSA support
Demand for end products, as relevant to encourage stable and mature markets	Proactive road construction and maintenance procurement settings, favouring the use of (locally supplied) crumb rubber in place of synthetic polymer binder where relevant, in spray seal and asphalt roads. Exploration of increased use of rubber granule in civil works (permeable pavements), traffic management devices, and niche surfaces (e.g. playground and sporting field surfaces) owned and used by local government. Exploration and uptake may be supported through research funding, demonstration projects, and dedicated regional collaboration bodies (e.g. technical / advisory groups).	Local and state road network managers, supported by TSA, LGAQ and DSDILGP Local and state civil asset managers and engineers, supported by DES, LGAQ and TSA

Taking the next steps for tyre recovery in regional Queensland

The above table sets out recommended actions for TSA, Queensland Government, regional bodies and councils, and other partners to drive a sustained solution for tyre recovery in southwest Queensland. In the near future, it would be suitable to widely engage with current and aspiring tyre recovery businesses on the opportunity to deliver services tailored to customers based in the region. Based on their interest and feedback, it may then be suitable for the partners to develop and commit to a coordinated plan to deliver the recommended actions.

As a national product stewardship organisation, TSA is uniquely positioned to play a lead role in facilitating and coordinating phased implementation of actions to achieve regional recovery as outlined above. Yet there is a strong argument for leadership from SWQROC and the Queensland Government, based on the preferred approach to realise the Queensland *Waste Management and Resource Recovery Strategy* through the development and adoption of regional resource recovery plans.

A collaborative approach between TSA and local, regional and state tiers of government may help to establish a precedent partnership framework that may be applied to other product stewardship priorities of the Queensland Government.

Similarly, a successful regional collaboration model for improved tyre recovery may provide lessons for TSA to adapt elsewhere, particularly in more distant and sparsely populated regions across Australia that face problems in recovering tyres and which have features in common with the southwest of Queensland.

TyreStewardship AUSTRALIA

Australian Government Accredited Product Stewardship Scheme

Tyre Stewardship Australia's National Tyre Product Stewardship Scheme has been recognised as best practice product stewardship by the Commonwealth Government. The accreditation, under the government's new Recycling and Waste Reduction legislation, provides independent verification of the Scheme's positive environmental and human health outcomes and will help TSA expedite the markets, funding and solutions associated with end-of-life tyres.