



QUEENSLAND RESOURCE RECOVERY INDUSTRIES

10-YEAR ROADMAP AND ACTION PLAN
AUGUST 2019

The Department of State Development, Manufacturing, Infrastructure and Planning

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Foreword

We're committed to supporting new and innovative solutions to our collective waste challenge and ensuring the correct incentives are in place to drive investment into resource recovery industries.

Our aim is to make Queensland a world-leader in projects involving resource recovery, recycling and the remanufacturing of materials and to support our long-term vision to attract investment, develop new industries and grow jobs.

Broad and diverse, resource recovery industries impact many sectors. The supply chain commences with the design of products and, following initial use, continues through collection and sorting processes, to the re-use, recycling and recovery of waste as a resource.

Part of a suite of wider government activities, the Queensland Resource Recovery Industries 10-Year Roadmap and Action Plan is another demonstration of the Queensland Government supporting investment through reducing waste going to landfill and another leap forward in our journey towards a zero-waste future.

A key action under the Waste Management and Resource Recovery Strategy, this Roadmap sets out a plan for supporting industry growth and job creation in resource recovery industries over the next 10 years.

Economically, we know that by supporting resource recovery industries to grow, new jobs will be generated for our communities and businesses can confidently invest in Queensland. By encouraging investment and innovation in the waste industry we'll also deliver long-term environmental benefits.

The \$100 million Resource Recovery Industry Development Program, an action of this Roadmap, acts to accelerate the growth of resource recovery industries that increase recycling activities, divert waste from landfill and reduce stockpiling in Queensland.

This program along with other targeted incentives will ensure Queensland attracts investment to support ongoing economic growth, the creation of new jobs, and upskilling opportunities for the workforce, as well as building capacity and new markets in regional areas of Queensland.

As our government looks to build a sustainable economy, initiatives like this not only support the development of new industries, they support Queensland investment and jobs by creating new products from waste, growing industry and reducing the impact on our environment.



The Hon. Cameron Dick MP

*Minister for State Development,
Manufacturing, Infrastructure
and Planning*





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Our vision

Our vision is for sustainable resource recovery industries that provide measurable economic and environmental benefits to the Queensland economy, create new jobs, provide upskilling opportunities for the workforce, and build capacity and new markets in regional areas of Queensland.

The ongoing development of markets for recycled and repurposed material through investment in modern efficient facilities and processes will reduce the amount of waste going to landfill and will assist Queensland to become a zero-waste society.

Working closely with industry and other stakeholders, we've developed a series of roadmaps focused on emerging priority sectors with global growth potential. The Queensland Resource Recovery Industries 10-Year Roadmap and Action Plan is a key action under our Waste Management and Resource Recovery Strategy (Waste Strategy), which sets the high-level agenda for the future of waste management and resource recovery in Queensland.

The Roadmap provides industry, local government and other stakeholders with an overview of our plan to expand and enhance this established industry sector, and support new technologies for it to grow. It will guide the sustainable growth and development of Queensland's resource recovery industries by facilitating investment and market capacity-building, and coordinating appropriate land-use planning frameworks to realise the economic opportunity the Waste Strategy presents.

These actions will provide business and industry with the confidence to invest in Queensland, creating new jobs, providing upskilling opportunities for the workforce, and building capacity and new markets in regional areas of the state.

Delivery of the Roadmap will be led by the Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP). Actions will align with the Waste Strategy being delivered by the Department of Environment and Science, to ensure economies of scale and a whole-of-government approach to growing the waste and resource recovery sector, attracting investment, supporting jobs growth and regional development opportunities, and diverting waste from landfill.

We are committed to supporting resource recovery industries to meet the waste avoidance and recovery targets set by the Waste Strategy.

WASTE AND RESOURCE RECOVERY INDUSTRIES CONTEXT



The Waste Strategy provides a comprehensive and coordinated framework to deliver on the principles of the circular economy. This includes actions to avoid waste and to assist with long-term, sustained growth in the recycling and resource recovery sector to help retain the value of materials in the economy for as long as possible. It will do this by promoting more sustainable waste management practices for business, industry, local governments and households in concert with the establishment of a progressive and stable policy and regulatory framework. The introduction of a waste disposal levy provides the funding framework to implement the Waste Strategy, and acts as a disincentive for inter-state dumping practices.

Resource recovery industries in Queensland

Resource recovery¹ is the general term for the process of collecting useful wastes and end-of-life materials so they're available as an input to create valuable products as new outputs.

Resource recovery industries encompass the full waste supply chain, from collection and transfer to sorting, remanufacturing and the production of energy-from-waste (EfW).



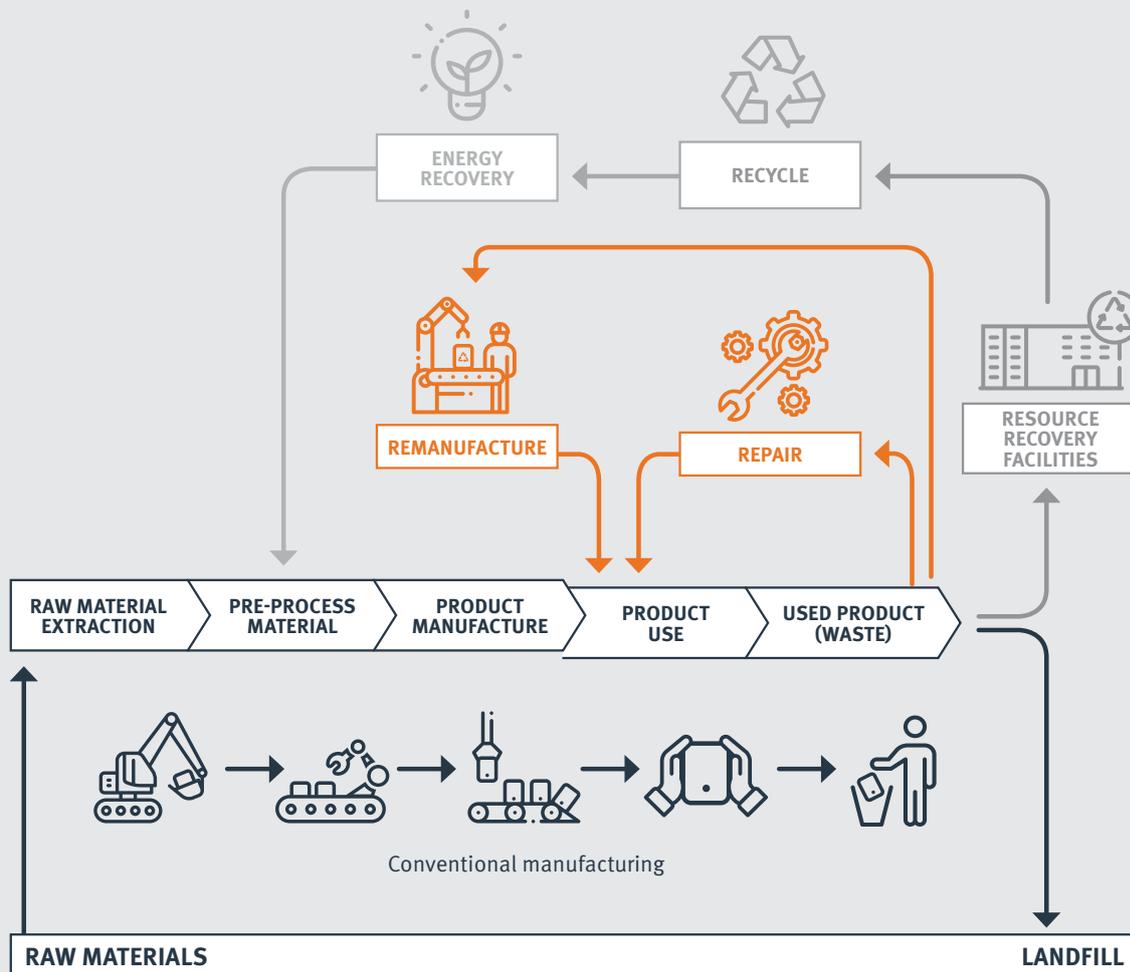
Current environment

In FY2018, 55 per cent of waste was sent to landfill and 45 per cent of waste was recovered for other uses. In Queensland, the most common facilities undertaking resource recovery activities are composting facilities for organics (mostly open windrow), material recycling facilities (MRF) for specific recyclable materials, and construction and demolition waste processing facilities. There are discrete facilities using technologies such as anaerobic digestion, mechanical-biological treatment (MBT) and thermal waste-to-energy processes although these are not widespread.

We are actively looking for opportunities to support new resource recovery projects through programs such as the Resource Recovery Industry Development Program and industry development activities. Government will support industry to overcome some of the typical barriers encountered by emerging or new technologies, including access to funding, business case development, commercialisation partnerships and the de-risking of projects.

Development of new resource recovery facilities generally requires a long-term perspective. In addition to feedstock supply, it needs to consider integration with land-use planning, land development (particularly industrial

RESOURCE RECOVERY INDUSTRIES SUPPLY CHAIN



Source: adapted from the Scottish Institute for Remanufacture (W. Ijomah et al 2007)

land development), transport planning and adherence to environmental regulations and policy.

The development pathway for new facilities varies according to the facility type, scale and location. However, it can run over several years as activities related to business case development, procurement and approvals are undertaken. These include market supply and demand studies, planning approvals, securing a suitable site, finding investment partners, contract tendering, and facility design and construction.

Some of the more advanced processing facilities represent significant capital investments and are only cost-effective where large volumes of feedstock are

available, making them more challenging to implement in regional Queensland.

By working to ensure the establishment of investment-ready projects in Queensland, new jobs will be created, upskilling opportunities for the workforce will occur, and new markets in regional Queensland will be realised.

Resource recovery actions can extend the life of existing landfills and reduce the need for new landfills while also helping to maximise the value from waste materials. Resource recovery delays the need to use raw materials in the manufacturing process as quality recovered materials can be used as an input substitute.

¹Resource recovery: when energy, a material or a product is taken from waste and re-used (*Resource Recovery Grants Fund Guidelines*).

Resource recovery includes energy recovery from waste, although recycling and re-use options are preferred. It excludes options that recover no value from waste, such as incineration.

Some waste types are more valuable and suitable for recovery than others and can move across regional boundaries. For example, higher-value materials such as recyclable packaging, scrap metals and waste oils will be transported to facilities where they can be reprocessed or exported for reprocessing. Although a recovered paper mill operates in Brisbane, much of Queensland's paper and

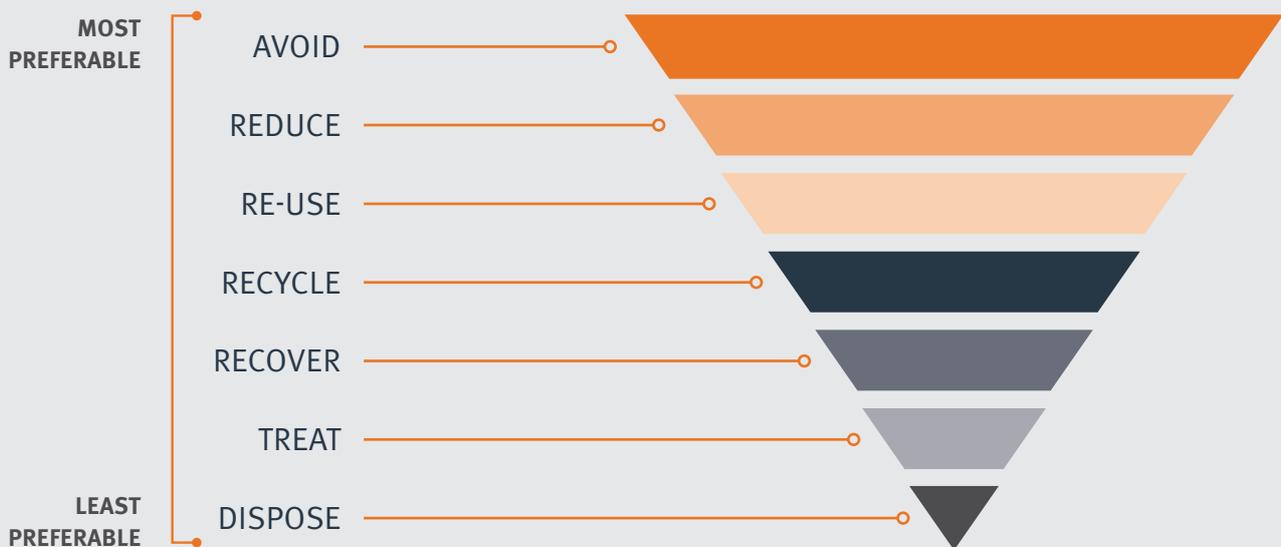
cardboard waste and plastic waste is exported interstate or internationally for reprocessing.

Besides price, other drivers for interstate or international waste transfer include the availability of specialist resource recovery or remanufacturing facilities, regulations, landfill acceptance criteria and landfill gate specifications.

Recovered organic waste product, such as compost, and recycled waste from built environment activities is mostly processed and utilised closer to the source of generation. This is due to the high costs of transporting these waste materials, relative to the value of the material.

WASTE HIERARCHY

The waste hierarchy framework guides the order of preference for managing waste. It prioritises in this order: the *avoidance* of unnecessary resource consumption; the *reduction* of waste generation and disposal; the *re-use* of waste resources without further manufacturing; the *recycling* of waste resources to make the same or different products; the *recovery* of waste resources including the recovery of energy; the *treatment* of waste prior to disposal, including the *reduction* of the hazardous nature of waste; and finally, the *disposal* of waste, only if there's no viable alternative.



Source: Waste Reduction and Recycling Act 2011 (Qld), section 9



In the current linear 'take-make-use-dispose' model of waste management, waste that's not recovered is generally sent to landfill close to the source of generation, often within the local government area where it was generated. However, there are instances in Queensland where waste must be transported to other regions for disposal, usually when there is no available disposal facility in the local council area.

Waste will follow the path of least cost, and for many materials that leads to landfill.

Historically, Queensland hasn't had strong or stable policy drivers in place to drive resource recovery or discourage landfilling of waste. This position has led to a significant discrepancy between waste policy and outcomes in Queensland and other mainland states. It has also resulted in market conditions that have not supported the development of facilities to reprocess waste materials or remanufacture from recovered resources.

Although EfW is a lower priority on the waste hierarchy, proven technological processes can provide a viable alternative to landfill and stockpiling of wastes that can't be viably recycled or re-used, and can generate attractive co-location opportunities.

Fortunately, Queensland is a leader in biofuels and bioenergy production and is home to several biomass energy facilities fuelled by bagasse as well as ethanol from sugarcane waste. We are working to enlarge the emerging biotechnology and bioproducts industry through business development support and funding opportunities. These initiatives are outlined in the Queensland Biofutures 10-Year Roadmap and Action Plan.

There is a natural cross-over between biofuels and resource recovery, particularly in the management of organic waste materials. Current research and projects in the planning phase could potentially see the increased diversion of organic waste from landfill to biofuel and bioenergy projects.



Waste as a resource

Households, businesses, institutions and organisations generate waste. Waste generators are grouped into three major waste streams depending on the source: municipal solid waste, construction and demolition waste, and commercial and industrial waste.

Municipal solid waste (MSW):

Waste produced primarily by households and collected by or on behalf of local councils. It includes other waste generated by local councils such as from public-place bins and council operations.

Commercial and industrial waste (C&I):

Waste produced by institutions and businesses, including industries, restaurants and offices.

Construction and demolition waste (C&D):

Waste generated from building and construction activities, including road and rail construction and excavations.

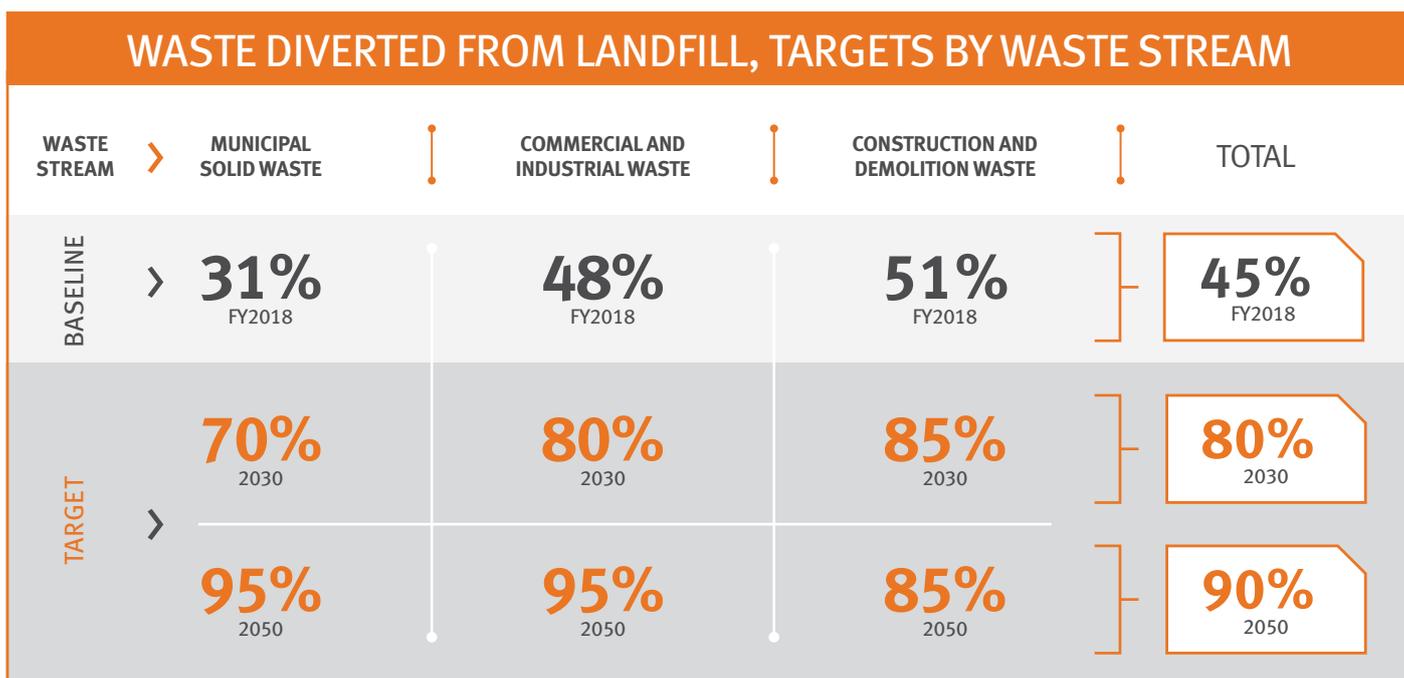
Putting a higher price on waste materials will incentivise investment in new processes and facilities, stimulate

economic activity in the sector, create new jobs, and divert waste from landfill.

The Waste Strategy sets ambitious targets for the achievement of greater resource recovery across each waste stream and a long-term target of only 10 per cent of total waste going to landfill by 2050.

The proportions of different materials contributing to each waste stream will differ, as will the resource recovery potential. For example, most glass waste is generated by households, while source material in the C&D waste stream is predominantly concrete, brick and soils generated by the building industry.

The Waste Strategy has identified a number of waste streams that require increased action to improve recycling performance.



Source: (Queensland Waste Strategy – key performance targets, QTC, 2018)

Note: These rates reflect the proportion of waste that's recycled or recovered, excluding material from which energy is recovered.

CORE WASTE TYPES IN QUEENSLAND²



BUILT ENVIRONMENT WASTE

In Queensland, built environment waste³ comes from major commercial or residential developments, road and transport projects undertaken by or for state or local government, and small-scale home or commercial construction and renovation.

Built environment waste comprises waste types such as concrete, bricks, rubble, contaminated soil, timber, plasterboard and asbestos-related materials. Most source material in the C&D waste stream is generated by the building industry. At 5.3 million tonnes in FY2018, C&D is the largest waste stream in Queensland, representing around 49 per cent of total waste generated⁴.

It's also one of the easier streams to recycle. There is strong market demand for clean, recycled concrete aggregates, especially in South East Queensland (SEQ), as major contractors and government seek to meet their sustainability targets. The introduction of the Waste Levy will encourage greater investment in reprocessing facilities and equipment in SEQ. However, challenges will remain for regional areas with smaller scale building and construction activity.

Built environment waste types will either be pre-sorted (separated at source) or collected in mixed loads, for example, skip bins. Mixed built environment waste collected via skip bins is more difficult to recycle than pre-sorted waste, as waste materials that are mixed together require more advanced sorting, with product contamination an issue.



ORGANIC WASTE

Organic waste includes food, garden and agricultural waste. Organic waste from food is the largest type of waste by weight in MSW. Most food waste comes from households and the general community. Other generators of food waste include food manufacturers and hospitality and food service businesses.

Food and other organic waste can be used in the production of compost or as feedstock for technologies that create biofuels or bioenergy. The production of compost accounts for most of the organics currently recovered but is a challenging business in Queensland due to low-value or undeveloped markets, contamination concerns and basic

processing technologies, although there is scope for the development of new market opportunities.

For example, anaerobic digestion technologies, commonly used in the UK, Europe and other countries to produce biofuels and bioenergy from other organic waste, also present an opportunity for Queensland.

Greater recycling of organics presents an economic opportunity but will require a change in collection systems and the adoption of proven technological advancements in processing methods.



PLASTIC WASTE

Plastic can be recycled back to its previous form (bottles, containers) or used to produce other products such as furniture, building materials or as an element in road pavements, although only small volumes are recycled into new products in Queensland.



ELECTRONIC AND BATTERY WASTE (E-WASTE)

The quantity of used batteries is rapidly growing across Australia and the volumes of electrical equipment and battery waste going into Australian landfills are increasing. Around 70 per cent of the toxic chemicals found in landfill are a result of batteries and other e-waste; a major cause of environmental harm if not managed correctly⁴.

Disposing of batteries and e-waste to landfill isn't only harmful to the environment, it is also a lost economic opportunity as the valuable but potentially hazardous materials they contain such as lead, nickel, cadmium or mercury, could potentially be recycled.



GLASS

Most glass waste (74 per cent) is generated by households⁴. Glass recovered in SEQ is reprocessed into new products. Outside of SEQ, glass is increasingly being reprocessed into secondary sand products used in road construction or as bedding sand.

While glass waste isn't a major contributor to the total waste generated in Queensland, more effective collection processes and less contamination will ensure improved recovery rates.



PAPER AND CARDBOARD

Established markets exist in Queensland for recovered paper and cardboard (PAC), although recovery rates need to improve if we are to meet our recycling targets as set in the Waste Strategy.

Despite having a paper mill that exclusively uses recovered fibre feedstock, Queensland has one of the lowest recovery rates across all Australian states and territories. Higher-performing jurisdictions recycle over 75 per cent of PAC waste each year⁵.

Source-separated PAC products are much more valuable as these are easier to recycle. By comparison, paper and cardboard collected in a co-mingled recycling stream must be sent to an MRF to be sorted into high, medium and low grades before pulping.

Of the PAC waste collected for recycling in Queensland each year, more than half is sent interstate or overseas. Changing global markets and more stringent quality standards on recovered recyclables have significantly impacted the export market for recycled waste materials from Australia, including from Queensland.



TYRE WASTE

Tyres are a regulated waste in Queensland.

Most recovered tyre waste is shredded and exported overseas as fuel for cement kilns. Domestic recycling options are well established but constrained by market outlets for the products. Official data does not capture all tyre waste, and better outcomes can be achieved with the development of appropriate end markets and innovative technologies.



TEXTILE WASTE

Discarded leather and textile products, if not donated for re-use, will mostly end up in landfill.

² The Australian Government, in its annual *National Waste Report*, identifies nine core waste categories and outlines the type of waste materials included in each. In Queensland, core waste categories align with the national categories, however, use slightly different terminology.

³ Built environment waste is commonly called construction and demolition waste (C&D)
⁴ *Recycling and waste in Queensland 2018* (nearly 1 million tonnes of C&D waste came from interstate)

⁵ *Economic opportunities for the Queensland waste industry: final report* (figures are FY2017).

CASE STUDY: A1 RUBBER

What happens to end-of-life vehicle tyres when they stop rolling? In the hands of A1 Rubber, they're transformed into innovative rubber floor surfaces as they continue their journey in the circular economy.

Many old tyres end up dumped in landfill or illegally dumped. Fortunately, Yatala-based A1 Rubber recognises tyres as a valuable waste resource. Using its state-of-the-art manufacturing equipment (mostly designed by CEO John Randel and built on site), the company transforms more than 10,000 tonnes per annum of recycled rubber into a variety of new rubber flooring products.



A1 Rubber employs more than 57 staff at its Brisbane factory and its distribution warehouses in Queensland, New South Wales and Victoria.

Its Queensland-based facility is equipped with leading-edge technology to ensure a high level of quality control and product consistency that meets Australian Standards, local and state EPA requirements plus international sporting association standards.

'We're constantly innovating and insisting on sustainable solutions,' says John Randel. 'For example, we're recycling all our own internal production waste into noise dampening "acoustic product" solutions for multi-storey living.'

Along with its world-class recycled rubber manufacturing technology, A1 Rubber only uses safe raw materials, produces products with a long, useful life, and ensures all product manufacturing waste is re-used.

The circular economy

As nations around the globe work on ways to reduce, identify and develop alternatives to landfill disposal, the circular economy model provides an economically, socially and environmentally sustainable alternative to established norms.

Rather than following a linear 'take-make-use-dispose' model, circular economy principles consider opportunities across the entire supply chain to retain and circulate resources in the economy at their highest value for as long as possible. The waste management and resource recovery sector can play an important role in the transition to a more circular economy. Applying circular economy principles to the sector needs to reflect:

- avoiding waste generation (for example, banning single-use lightweight plastic shopping bags and better product design)
- designing products to last longer, be remanufactured, re-used, and recycled and that are created wholly or partly from recovered materials, and designing out unnecessary packaging
- an efficient and integrated recovery, reprocessing and market cycle for waste streams that can't be avoided.

The circular economy model views materials as a valuable resource and encourages the circulation of these resources in the productive economy for as long as possible. It's about retaining value in resources and adding value to waste materials, with a preference for local use, providing opportunities for new and innovative business ideas and new types of jobs. It has the potential to transform the way we design, teach and invest, and how we buy products, gradually moving towards an economy where there's no waste and we use fewer virgin resources.

We have set a bold vision to become a zero-waste society. Adopting and implementing the circular economy model will be an important step towards achieving this vision.



OUTLINE OF A CIRCULAR ECONOMY

PRINCIPLE 1

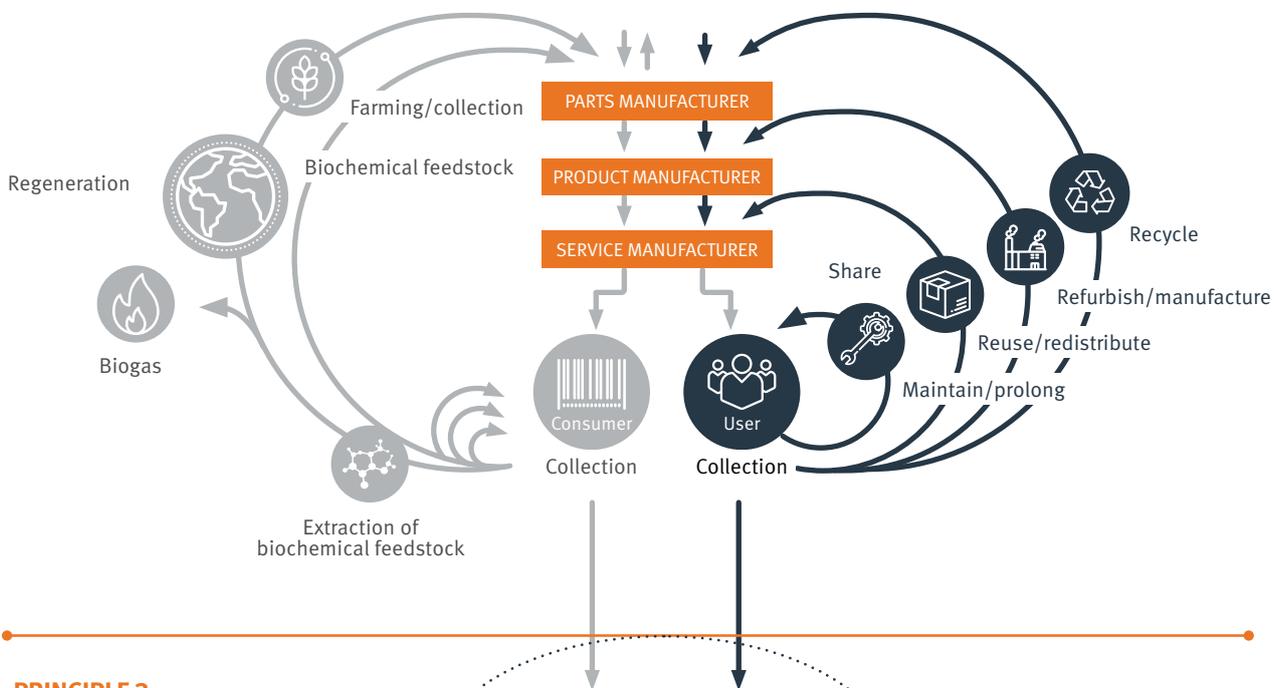


REGENERATE SUBSTITUTE MATERIALS VIRTUALISE RESTORE

Renewables flow management

Stock management

PRINCIPLE 2



PRINCIPLE 3

Minimise systemic leakage and negative externalities

PRINCIPLE 1

Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows. ReSOLVE levers: regenerate, virtualise, exchange.

PRINCIPLE 2

Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles. ReSOLVE levers: regenerate, share, optimise, loop.

PRINCIPLE 3

Foster system effectiveness by revealing and designing out negative externalities. All ReSOLVE levers.

Actions to date

We have already commenced setting a supportive policy environment for resource recovery industries and committed financial incentives to support the acceleration of successful projects to market. This Roadmap details how the Queensland Government will support the growth of new technologies and the expansion of established industries.

The Queensland Government's Waste Strategy sets the high-level agenda for the future of waste management and resource recovery in Queensland.

The Waste Strategy's vision is for Queensland to become a zero-waste society, where waste is avoided, re-used and recycled to the greatest extent possible, and where strategic investment in diverse and innovative resource recovery technologies and markets will produce high-value products and generate economic benefits for the state.

The Waste Strategy has three strategic priorities, being to:

- reduce the impact of waste on the environment and communities
- transition Queensland towards a circular economy for waste
- build economic opportunity.

Commencing on 1 July 2019, the Queensland Government Waste Levy underpins the objectives of the Waste Strategy and will be initially set at \$75 per tonne of general waste sent to landfill. Combined, the Waste Strategy and the Waste Levy will act to:

- reduce the incentive to dispose of waste to landfill
- ensure material currently disposed to landfill is more attractive as a feedstock diverted to recycling and bioindustries
- facilitate and encourage waste and recycling infrastructure investment
- incentivise new industries that manufacture products for re-use, recycling and reprocessing.

Other Australian and international jurisdictions have achieved positive results by adopting a comprehensive waste management and resource recovery strategy accompanied by a waste levy. We've committed to ensuring the introduction of the levy will have no direct impact on households. Together, the Waste Strategy and Waste Levy will work to change waste management behaviour and,



along with funding and other incentives, will drive the growth of resource recycling industries in Queensland.

The Waste Strategy sets ambitious targets for the reduction of waste to landfill in Queensland. Along with targeted financial incentives, it will enable the step-change required to grow resource recovery industries in the state.

By providing industry and local governments with an incentive to recover and recycle material currently going to landfill, new economic opportunities can be created while providing long-term protection of our natural environment.

RESOURCE RECOVERY INDUSTRY DEVELOPMENT PROGRAM (RRIDP)

The \$100 million RRIDP is funded from the Waste Levy and will be used to develop high-value resource recovery industries. The focus of the RRIDP is to support the development of projects that divert waste from landfill, reduce stockpiling, and encourage activities that facilitate waste avoidance and increase recycling activities.

Financial assistance may be provided for the development of eligible projects that:

- facilitate recycling activities, waste avoidance and landfill diversion (including the diversion or reduction of waste material stockpiling)
- enhance economic development opportunities through the development of advanced processing and technology capacity
- facilitate and encourage waste infrastructure investment
- promote regional market and job development opportunities.

We've announced funding directed to projects of varying scales and areas of focus. Grants will be awarded through a competitive process.



QUEENSLAND WASTE TO BIOFUTURES FUND (W2B FUND)

In 2018, we announced \$5 million in funding to support the development of waste to bioproducts, biofuels and bioenergy projects in Queensland. The Queensland Waste to Biofutures Fund (W2B Fund) provides matching grants of up to \$1 million for eligible projects under two funding pathways:

- Pathway 1: Grants for installation of new technology, plant and equipment.
- Pathway 2: Grants for research and collaboration projects that accelerate the commercial readiness of a Queensland biofutures facility.

Projects from the Queensland biomanufacturing and biorefining sectors can deliver transformative environmental, economic and social outcomes for Queensland. They may also contribute to the objectives of the Advancing Queensland Priorities and the Waste Strategy by:

- enhancing the commercial development of Queensland's biofutures industry
- increasing Queensland's capacity in resource recovery and the production of biofuels and bioenergy, particularly in regional areas of Queensland
- moving Queensland towards a circular economy by managing materials and resources to retain value and minimise residual waste, and developing local economies

The W2B Fund closed in May 2019 and applications are currently being assessed.





The opportunity

Economic value and jobs for Queensland can be created through the development of the resource recovery industries. Best practice examples from Queensland and other jurisdictions in Australia demonstrate the capacity for jobs to be created once waste is recovered⁶. For every 10,000 tonnes of waste that goes to landfill, it's estimated that fewer than three jobs are supported, but where that waste is recovered, it's estimated there are more than nine jobs created⁷.

SEQ has modern waste and recycling facilities and the private sector already plays a major role in the collection, transfer, disposal and processing of waste. Some regional areas of Queensland are home to leading best practice examples in organics processing, recovering a wide range of commercial, industrial and agricultural wastes. There's potential for similar facilities to be developed in other regions and for these facilities to capture additional organic materials to support landfill diversion targets. Opportunities for more advanced resource recovery facilities in regional areas in Queensland could be supported by regional 'hubs' or precincts where economies of scale are realised.

Moving towards a zero-waste society, supported by transitioning to a more circular economy, will drive new economic activity and employment as resource use is optimised and new markets and technologies are developed.

Matching available skills to emerging jobs is key to accelerated industries development. New technologies and processes will provide challenges to existing operations but also opportunities to create a high-value, skilled work-force. Following principles developed in other industries (manufacturing, for example), existing skills can shift to the required skills without disruption. Embracing Industry 4.0 (the next industrial revolution) and working with other industries to transition to new technologies will provide economic benefits across Queensland.

Significant ongoing commitment from all stakeholders is required to shift the resource recovery industry towards the goal of a more circular economy. Such a transition could deliver a radical and enduring transformation of Queensland's economy, with opportunities to increase economic output and jobs across the state.

Our ambition of a zero-waste society has strong community and industry support and momentum continues to grow.

By identifying waste streams to focus on, we've set an agenda to accelerate change. This includes the introduction of new initiatives and incentives to separate waste and enhance the recoverability of waste streams. We will also work with industry and local governments to develop pilot programs and demonstration projects focused on waste streams. We will continue to roll out the RRIDP, which acts to incentivise industry and local governments to accelerate investment into the industry.

The Waste Levy will propel positive change in Queensland by putting a price on waste and acting as a deterrent to disposing of waste to landfill. Revenue from the levy will be used to facilitate industries development, to expand and advance the resource recovery industry through direct grant funding, and to support other initiatives, for example, the development of resource recovery precincts in the Queensland context.



⁶ *Economic opportunities for the Queensland waste industry: final report (QTC)*
⁷ *Queensland Draft Waste Management and Resource Recovery Strategy*



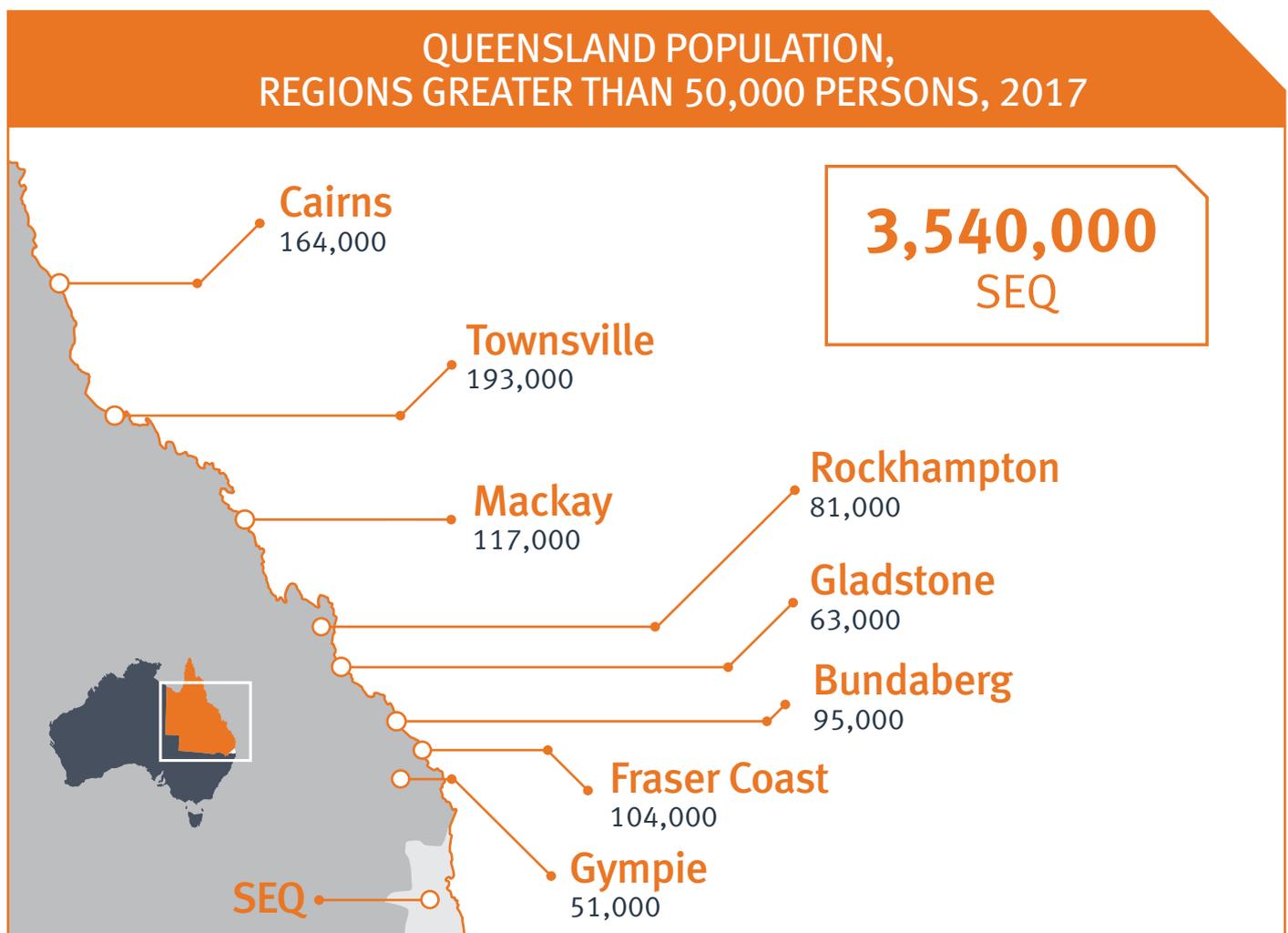
The challenges

In FY2018, Queensland households, businesses and industry generated 10.9 million tonnes of waste, an 11 per cent increase from the previous year and representing a greater rate of increase than population growth⁸.

As Queensland's population continues to grow and consumption increases, effective, fit-for-purpose waste avoidance and resource recovery pathways and solutions need to be continually developed. Managing waste and waste material supply chains in Queensland is more difficult compared to other mainland states such as New South Wales and Victoria due to the state's large land area and its dispersed population.

Around 72 per cent of Queensland's total population reside in the south-east of the state, although this region represents only around 1.5 per cent of the total land area. In contrast, regional communities represent around 28 per cent of the total population. However, these regions cover the remainder of the state and are spread across vast distances⁹.

Added to this are regional economic and climatic characteristics that create significant variation in the types of waste management and resource recovery facilities required. Solutions for resource recovery will need to respond to the specific



Source: QGSO Population Growth Highlights and Trends, Queensland regions 2018
*Population figures are rounded to nearest 1000.

⁸ Queensland Draft Waste Management and Resource Recovery Strategy
⁹ QGSO Population Growth Highlights and Trends, Queensland regions 2018



issues faced by regional communities and local governments, including the very different market dynamics to those of the heavily populated SEQ region.

Although the concentration of Queensland’s population in SEQ creates a challenge, it also presents an opportunity. Waste is usually disposed close to the source of generation. With such a dense population, feedstock for resource recovery industries is assured and economic efficiencies can be attained.

Industry has identified nationwide challenges including a lack of source-separation collection systems, limited facilities for the recovery of mixed wastes, and limited activity to recover putrescible waste from households and small to medium enterprises (SMEs).

Current collection systems are also inadequate to deliver significant further benefits. Better segregation of waste materials at the source will have additional positive implications for MRFs due to the reduction in contamination and will create greater economic flow-on effects.

Other industry-identified challenges include:

- environmental policy and regulatory consistency
- land-use planning consistency and certainty
- data limitations
- under-developed end markets

- social licence to operate
- dynamic feedstock supplies.

Several actions are underway to ensure consistency across environmental policy and regulations for the resource recovery industries, as is work to identify appropriate land-use planning frameworks, dependent upon project scale and location. Work is also being undertaken to develop robust data collection methodologies and reporting processes.

Due to limited markets for some recycled products or waste suitable for recovery, investment in the resource recovery industries has been constrained. Working across government to develop procurement policies that utilise recycled or remanufactured waste products has been identified as a first step towards developing sustainable markets for the resource recovery industries. Such an action will take a combined effort by all stakeholders.

By promoting positive outcomes, government and industry can work together to overcome challenges associated with social licence and community perceptions of the industry through the promotion of positive outcomes. Challenges related to the dynamic industry environment, e.g. where waste feedstock demand may change over time, will need to be managed by industry through appropriate risk mitigation strategies.

Roadmap actions

Our goal is to position Queensland as a leader in resource recovery, reprocessing and manufacturing over the long-term. We will work with key stakeholders to expand capabilities in the resource recovery industries so that Queensland becomes a highly competitive centre for the remanufacture of waste materials into new products.

We will offer industry development support to resource recovery industries looking to employ innovative technologies along the entire supply chain, from collection and transfer to sorting, re-manufacturing and re-use of waste materials.

The Queensland Resource Recovery Industries 10-Year Roadmap and Action Plan establishes an agenda for industry development and incentivisation. This has been developed through consultation with industry and local government. Actions in the Roadmap will drive the implementation of economic opportunities in the Waste Strategy.

Four strategies have been identified that will enable our vision for resource recovery industries to contribute measurable economic and environmental benefits to the Queensland economy. These strategies will:

- accelerate the project pipeline
- drive the development of markets and supply chains across Queensland
- review policy and legislative frameworks to enable industry growth
- encourage the advancement of new technologies.



Strategy actions will help industry and local governments to accelerate investment decisions, modernise and enlarge current operations, enable the development and growth of new resource recovery businesses and supply chains.

The Roadmap will be established, administered and delivered by a dedicated unit within the DSDMIP. This team will work collaboratively across government, industry and research institutions to drive development and investment into the resource recovery industries.

By adopting a partnership approach to the implementation of these actions and supporting initiatives, programs, workshops and services, we can guide sustainable growth in resource recovery industries and work to resolve market inefficiencies.



STRATEGY 1:

Accelerating the project pipeline

RESOURCE RECOVERY INDUSTRY DEVELOPMENT PROGRAM

Direct support for waste and resource industry development initiatives will be provided through the \$100 million RRIDP. The RRIDP provides grant funding to support the acceleration of eligible projects and will kick-start the growth of the resource recovery industries in Queensland. It provides a clear sign to industries that we're committed to co-investment in waste management and resource recovery technologies.

- Deliver the \$100 million RRIDP over three years.

INDUSTRY DEVELOPMENT

By working with proponents, we can accelerate the establishment of new resource recovery facilities and the improvement of existing facilities.

Proponents suitable for positive intervention to fast-track their investment decisions and accelerate project delivery timeframes are those that are likely to establish in Queensland in the future, and who can demonstrate proven technologies, economic benefits to Queensland, and the creation of new jobs and upskilling of the workforce.

Positive intervention could include business case development and market sounding, planning and locational advice, or project facilitation across government. We can further enhance the economic benefits of suitable investments by assisting proponents to establish in locations that optimise market and supply chain development.

- Provide project facilitation services to industry.
- Develop a baseline for resource recovery industries employment growth and economic impact analysis.



PRECINCT DEVELOPMENT AND GUIDELINES

The co-location of complementary industry activities in a precinct has proven successful in other jurisdictions globally. Circular economy precincts elsewhere co-locate industry with technologies that convert waste to bioenergy, which is then delivered back into the precinct (rather than the grid), enabling a flow-through of economic benefits.

Valuable lessons can be gained from these other jurisdictions to inform precinct development guidelines, as can the learnings gained from the facilitation of large resource recovery projects wishing to locate in Queensland. This evidence base will enable us to develop guidelines for precincts at different scales.

Several complementary actions need to occur to drive successful precinct developments and will require considerable collaboration from across government, industry and key stakeholders. The identification of planning pathways to facilitate the development of precincts will need to be determined on a case-by-case basis and will need to consider timeframes required.

- Identify pathways to facilitate precinct development where serviced, connected and available industrial land is in place across Queensland.
- Investigate potential locations for regional resource recovery precincts and identify the appropriate scale and support required to ensure their viability.
- Develop location strategies to ensure critical mass for precincts.
- Investigate and identify suitable industrial lands for precincts, including in regional areas, that will support technologies such as EfW production, and where these facilities are best placed to support future secondary markets.
- Building on completed research, investigate the application of global examples of circular economy precincts to the Queensland context and apply these findings to precinct development guidelines.
- Incentivise projects that align with state priorities for the sector to establish in preferred locations/precincts or to co-locate with complementary facilities.
- Promote the benefits of clustering complementary industries together. Clustering may include industries other than resource recovery industries.
- Identify policy and project facilitation gaps and work across government to ensure alignment for the achievement of key objectives.




RECYCLING

**PLASTIC, METAL,
 GLASS, NEWSPAPER
 & CARDBOARD**
NO PLASTIC BAGS
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 GLASS, NEWSPAPER
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STRATEGY 2: Market and supply chain development

Roadmap actions are focused on providing direct support to industry through industry development initiatives. These actions respond to feedback from industry and other stakeholders and are further supported by the Waste Strategy.

MARKET DEVELOPMENT AND INDUSTRY ATTRACTION

- Deliver a comprehensive analysis of the resource recovery market sector, including the identification of supply chain efficiencies and the promotion of new market opportunities.
- Develop industry attraction programs focused on technologies and industries that will utilise recycled output to develop secondary markets for waste that are valuable and useful.
- Investigate and report on export opportunities for value-added recycled products for the development of secondary markets and to minimise stockpiling of recycled material.
- Coordinate supply chain development services and activities across the state, including customised activities to meet local regional needs, where appropriate.
- Collaborate with regional teams to understand local issues that relate to waste management and resource recovery and develop a model for regional hubs or precincts. This may include analysis of economic cost/benefits to locate certain facilities in regional areas.

- Deliver business development and capability programs, such as workshops led by the department, to enable SMEs and small regional councils to participate fully in market opportunities.
- Aggregated findings arising from the RRIDP will provide government with an evidence base to support the ongoing development of successful incentives and/or initiatives. This data will also help identify gaps in the market and future opportunities as the market matures.
- Analyse aggregated data from the RRIDP to provide insights into opportunities and challenges faced by proponents to inform ongoing market development initiatives.

PROMOTION AND PROCUREMENT INITIATIVES

Government can act as a leader to other organisations through demonstration or promotion of resource recovery projects or processes. Government also has the potential to be a major consumer of recycled products or products with a recycled component.

- Promote exemplar resource recovery precincts in Queensland to demonstrate investment readiness.
- Review resource recovery initiatives on large government-led projects to develop best practice guidelines.
- Investigate opportunities for recycled products or materials to be included in government procurement policies.



STRATEGY 3: Responsive policy and legislative framework

We will review opportunities where the statutory planning framework can be used to enable growth of the resource recovery industries, particularly through the utilisation of suitably located industrial land for new facilities, including for hubs or precincts.

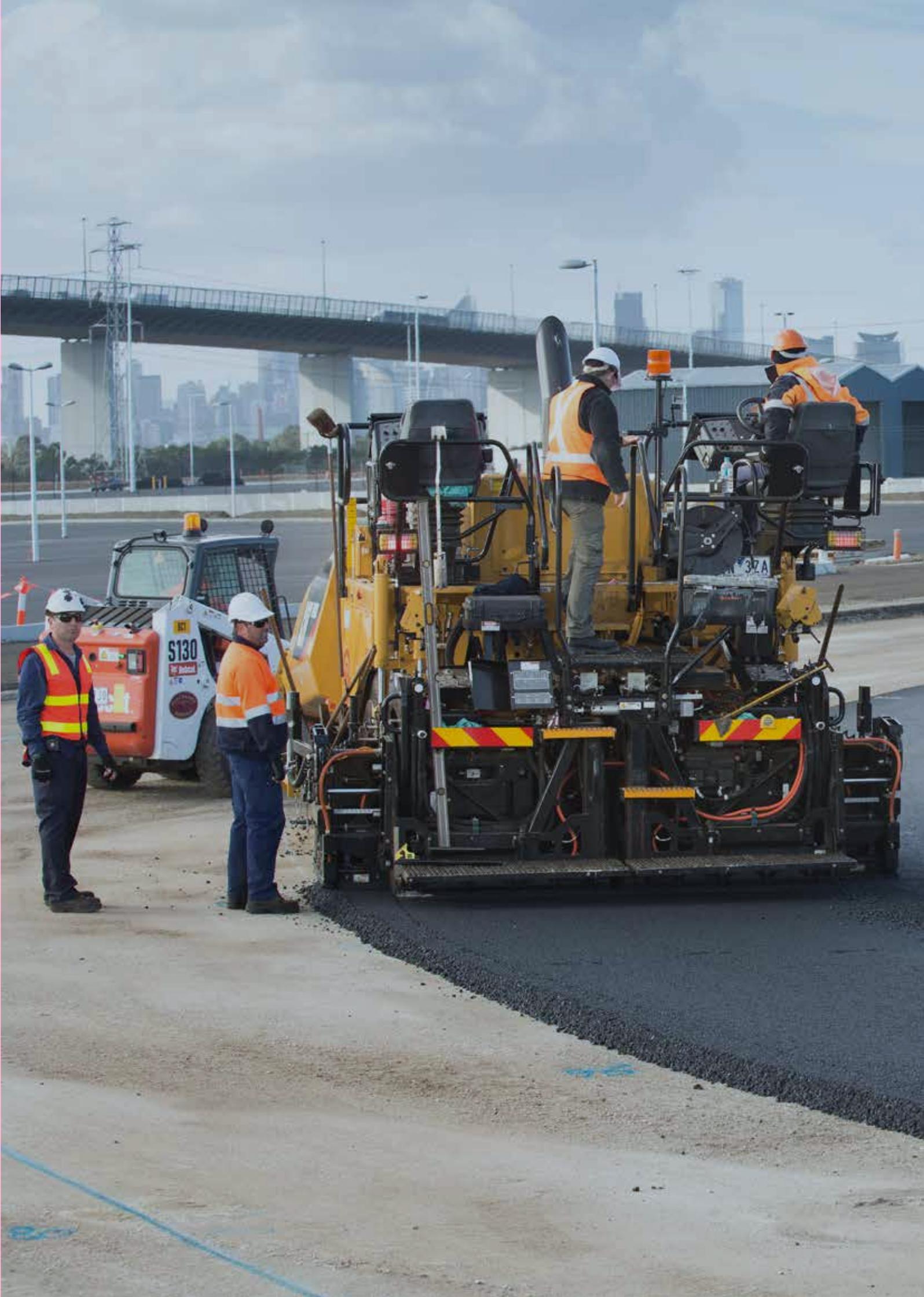
- Ensure planning policy documents adequately provide for the consideration of resource recovery needs and are supported by guidance to further assist the facilitation of resource recovery industries.
- Ensure the availability of adequate and suitable industrial land throughout Queensland is identified.
- Identify pathways to facilitate resource recovery industries that align with state priorities for the sector.

STRATEGY 4: Advancing new technologies

New technologies will need funding and other support to work towards commercialisation and to establish a market for products or recycled materials.

The Roadmap will advance innovative new technologies by providing links to investment funding partnerships and other programs, relationship building activities and the promotion of key achievements.

- Promote advancements in technological processes that work to drive the achievement of a zero-waste society.
- Promote the adoption of internationally best practice technologies and processes that meet environmental and community standards.
- Co-invest in pilot or demonstration projects or commercially scalable projects in Queensland that recycle, re-use or remanufacture waste into new products and that demonstrate a viable market.



Queensland Resource Recovery 10-Year Roadmap and Action Plan

VISION

Sustainable resource recovery industries that provide measurable economic and environmental benefits to the Queensland economy, create new jobs, provide upskilling opportunities for the workforce, and build capacity and new markets in regional areas.

STRENGTHS AND OPPORTUNITIES

- Existing investment in collection and transfer infrastructure
- Potential to create new economic activity and employment

SPECIFIC CHALLENGES

UNDER-DEVELOPED
END MARKETS

POLICY CONSISTENCY

LAND USE
PLANNING CERTAINTY

STRATEGY 1:

Accelerating the project pipeline

ACTIONS

- Deliver the \$100 million RRIDP.
- Provide project facilitation services to industry.
- Develop a baseline for resource recovery industries employment growth and economic impact analysis.
- Identify pathways to facilitate precinct development where serviced, connected and available industrial land is in place across Queensland.
- Investigate potential locations for regional resource recovery precincts and identify the appropriate scale and support required to ensure their viability.
- Develop location strategies to ensure critical mass for precincts.
- Investigate and identify suitable industrial lands for precincts, including in regional areas, that will support technologies such as EfW production, and where these facilities are best placed to support future secondary markets.
- Building on completed research, investigate the application of global examples of circular economy precincts to the Queensland context and apply these findings to precinct development guidelines.
- Incentivise projects that align with state priorities for the sector to establish in preferred locations/precincts or to co-locate with complementary facilities.
- Promote the benefits of clustering complementary industries together. Clustering may include industries other than resource recovery industries.
- Identify policy and project facilitation gaps and work across government to ensure alignment for the achievement of key objectives.

STRATEGY 2:

Market and supply chain development

ACTIONS

- Deliver a comprehensive analysis of the resource recovery market sector.
- Develop industry attraction programs focused on technologies and industries that will utilise recycled output to develop secondary markets.
- Investigate and report on export opportunities for value-added recycled products for the development of secondary markets.
- Coordinate supply chain development services and activities across the state, including customised activities to meet local regional needs, where appropriate.
- Collaborate with regional teams to understand local issues that relate to waste management and resource recovery and develop a model for regional hubs or precincts.
- Deliver business development and capability programs to enable SMEs and small regional councils to participate fully in market opportunities.
- Analyse aggregated data from the RRIDP to inform ongoing market development initiatives.
- Promote exemplar resource recovery precincts in Queensland to demonstrate investment readiness.
- Review resource recovery initiatives on large government-led projects to develop best practice guidelines.
- Investigate opportunities for recycled products or materials to be included in government procurement policies.

- Waste levy provides an incentive for change
- Coordinated policy response across Queensland
- Committed investment and incentives
- Community support to move to a zero-waste society

PRIMARY CHALLENGE

Supporting current industries to modernise and grow while advancing new technologies and product development in under-developed end markets.

DATA
LIMITATIONS

INDUSTRY
ENVIRONMENT

OUTDATED COLLECTION
SYSTEMS

SOCIAL LICENCE

STRATEGY 3:

Responsive policy and legislative framework

ACTIONS

- Ensure planning policy documents adequately provide for the consideration of resource recovery needs and are supported by guidance to further assist the facilitation of resource recovery industries.
- Ensure the availability of adequate and suitable industrial land throughout Queensland is identified.
- Identify pathways to facilitate resource recovery industries that align with state priorities for the sector.

STRATEGY 4:

Advancing new technologies

ACTIONS

- Promote advancements in technological processes that work to drive the achievement of a zero-waste society.
- Promote the adoption of internationally best practice technologies and processes that meet environmental and community standards.
- Co-invest in pilot or demonstration projects or commercially scalable projects in Queensland that recycle, re-use or remanufacture waste into new products and that demonstrate a viable market.



Definitions

Anaerobic digestion: putrescible waste is decomposed under anaerobic conditions in a controlled vessel and the resulting methane (or biogas) is captured and used as an energy source.

Alternate waste treatment: advanced waste processing and recovery technologies that provide an alternate management option to landfill disposal.

Bagasse: dry pulpy fibrous residue that remains after sugarcane or sorghum stalks are crushed to extract their juice. Used as a biofuel for the production of heat, energy, and electricity, and in the manufacture of pulp and building materials

Biosolids: a by-product of sewage treatment processes.

C&D: construction and demolition waste, generated by demolition and building activities, including road and rail construction and excavations.

C&I: commercial and industrial waste, generated by institutions and businesses, including industries, restaurants and offices.

Diversion: waste that would usually be disposed to landfill is diverted to another more productive purpose such as reuse, recycling or energy recovery.

Dry recyclables: material such as paper/cardboard, glass, plastics and metals. Co-mingled recyclables refer to these materials combined in a single collection bin.

EFW: energy-from-waste facility, converts waste (including refuse-derived fuel) into energy (including heat, electricity, gas or liquid fuels) for which there's an economically viable end use. Technologies can include, but aren't limited to: anaerobic digestion, combustion, pyrolysis, gasification and plasma gasification.

Ethanol: produced from biomass mostly via a fermentation process using glucose derived from sugars (sugar cane, sugar beet and molasses), starch (corn, wheat, grains) or cellulose (forest products) as raw materials. In this form, it's renewable. Synthetic ethanol can also be produced from non-renewable sources like coal and gas.

Feedstock: raw materials sourced as inputs for the process.

Inert waste: non-putrescible and generally inorganic waste (mostly from construction and demolition activities including soils, concrete, bricks, tiles, plastic and glass).

In-vessel composting: enclosed composting technologies where putrescible waste is composted under controlled conditions in a sealed vessel, usually used to process more odorous and difficult organic wastes such as food organics and industrial/commercial/agricultural organics.

MBT: mechanical-biological treatment plant, a facility that processes mixed putrescible waste to separate recyclables and an organic fraction from the residual waste.

MRF: materials recovery facility, receives and sorts either source-separated commingled recyclables (clean MRF) or mixed waste (dirty MRF). Materials are sorted through mechanical and manual processes, then consolidated (compacted and baled) and sent to reprocessing facilities.

MSW: municipal solid waste, primarily household waste collected by, or on behalf of, councils. Also includes other waste collected by councils such as from public-place bins and council operations.

Offtake market: the market in which producers of a resource sell.

Open windrow: the production of compost by piling organic matter or biodegradable waste in long rows

Putrescible waste: organic material, including food and garden waste that will decompose as a result of the actions of microbial organisms.

Refuse-derived fuel: fuel manufactured from waste materials by processing mixed waste to take out recyclables, low calorific/wet components and hazardous materials and produce a homogenised fuel material.

Residual waste: waste that's collected separately from households in the residual (or general) waste bin for disposal to landfill.

Resource recovery centre: facility that receives reusable and recyclable materials from households and businesses that would otherwise be destined for disposal. Often combined with a transfer station for residual wastes. May include a resale centre and/or basic reprocessing activities on the same site such as mulching of green waste or crushing of concrete.

Sugarcane ethanol: an alcohol-based fuel produced by the fermentation of sugarcane juice and molasses. A leading renewable fuel for the transportation sector.

Transfer station: facility allowing the drop-off and consolidation of waste and a wide range of recyclable materials. Can be combined with a resource recovery centre and other facilities and may include a resale centre ('tip shop').

Source: adapted from *Queensland waste and resource recovery infrastructure report (Arcadis)* and *Resource Recovery Industry Development Program Guidelines (Queensland Government)*.

Glossary

AD: Anaerobic Digestion

C&D: Construction and demolition

C&I: Commercial and industrial

EFW: Energy-from-waste

FY: Financial year

MBT: Mechanical biological treatment

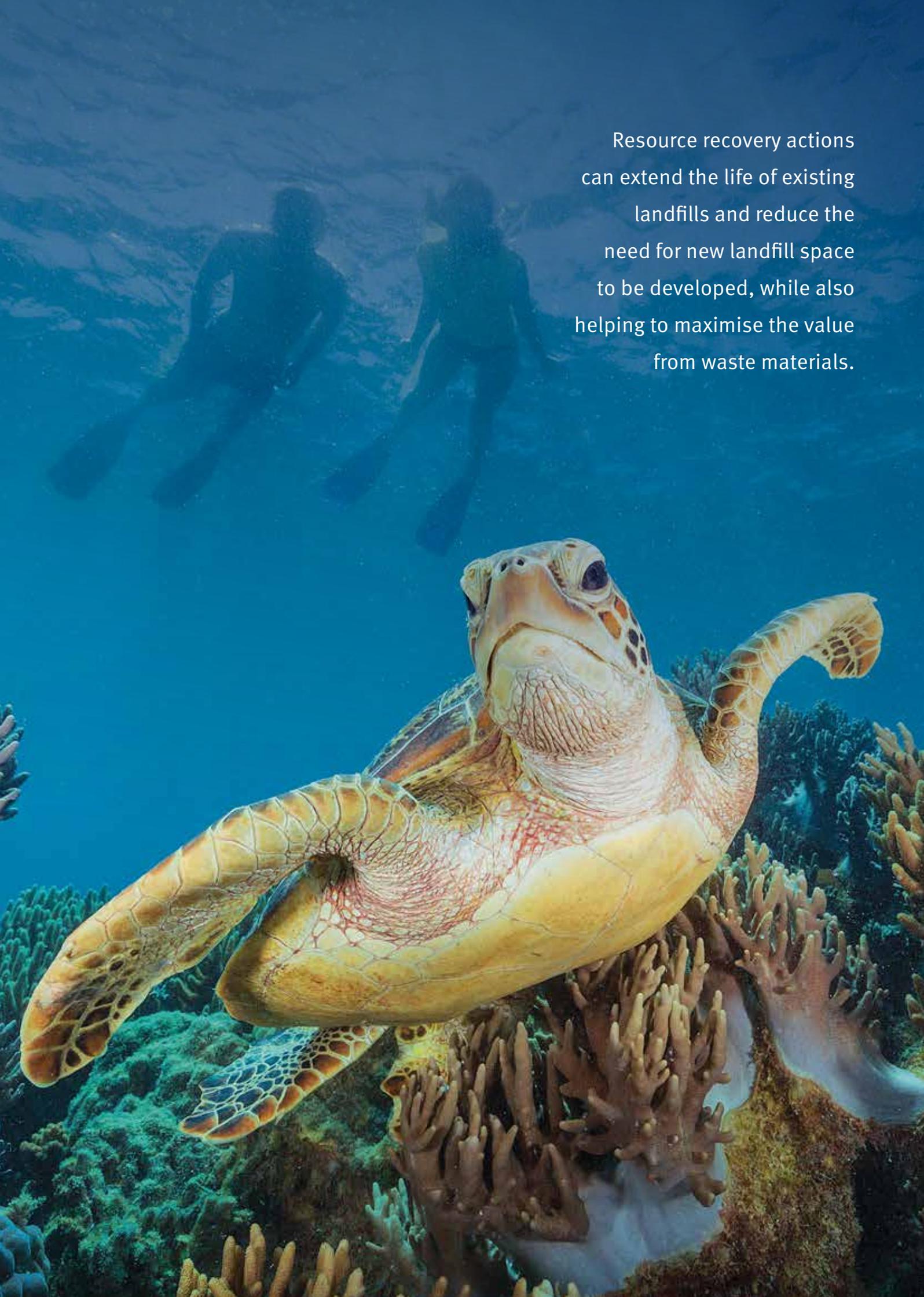
MRF: Material recycling facilities

MSW: Municipal solid waste

PAC: Paper and cardboard

SEQ: South East Queensland

SME: Small to medium enterprises

A large sea turtle, likely a Hawksbill turtle, is the central focus, swimming towards the viewer over a vibrant coral reef. The turtle's shell is a mix of yellow, orange, and brown with distinct scutes. Its flippers are extended, and its head is slightly raised. In the background, two divers in black wetsuits are visible, swimming away from the camera. The water is clear and blue, with sunlight filtering through from above. The coral reef below is diverse, with various types of coral in shades of green, brown, and orange.

Resource recovery actions can extend the life of existing landfills and reduce the need for new landfill space to be developed, while also helping to maximise the value from waste materials.

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