

13 December 2019

Infrastructure Victoria
Level 33, 140 William Street,
Melbourne, Victoria 3000

SUBMISSION: Recycling and resource recovery infrastructure evidence based report, October 2019

Dear Infrastructure Victoria,

We are writing to submit our feedback, on behalf of Licella Holdings Ltd ('Licella') and iQ Renew Pty Ltd ('iQ Renew'), regarding the above mentioned report *Recycling and resource recovery infrastructure*.

We strongly agree with the statement from the draft National Waste Policy 2018 that *"Waste is often thought of as a PROBLEM to be managed rather than a resource with VALUE"*. This view needs to be changed and this report by Infrastructure Victoria is a critical opportunity to do this for the State. To address Victoria's waste challenges and transform its recycling sector into one which leads the way for other States, industry needs the support of the Victorian Government to bring innovative solutions for glass and plastic to the Australian market in the near future.

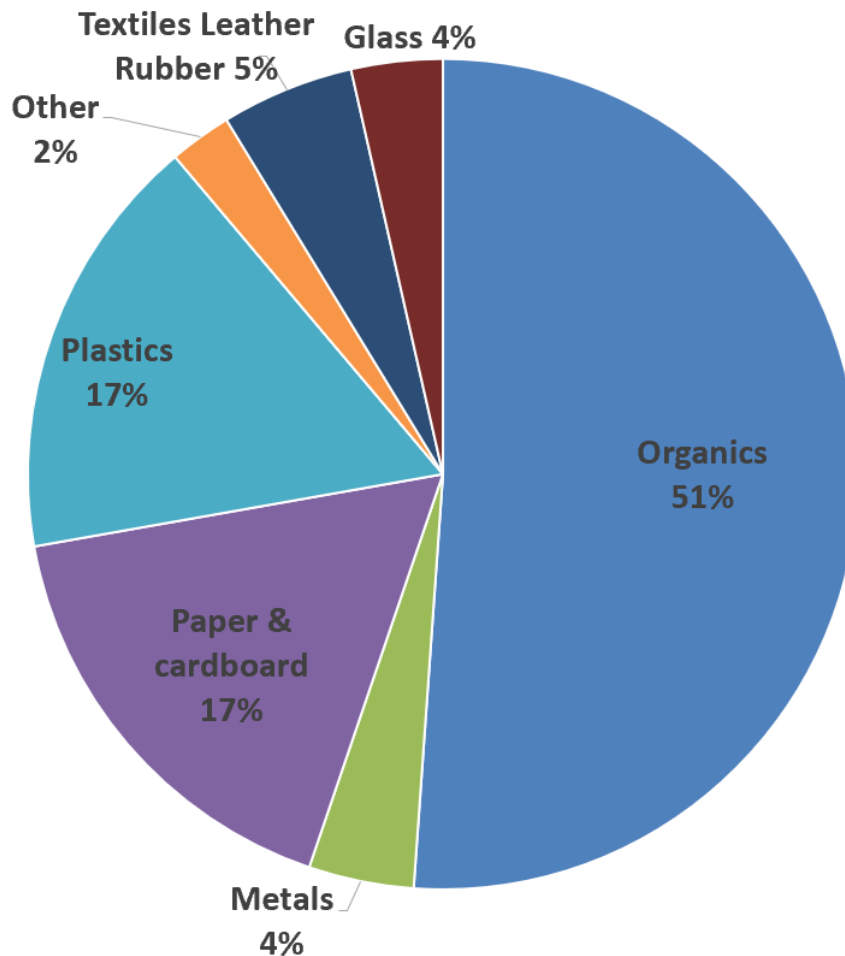
Licella and iQ Renew are uniquely placed to deliver innovative, industry-leading resource recovery and recycling solutions for the widest range of waste plastic, waste glass and even End-of-Life Tyres. iQ Renew is the only company in Australia to offer both physical and chemical recycling of plastic – meaning we are uniquely positioned to recover almost 100% of plastic. Licella's patented Catalytic Hydrothermal Reactor (Cat-HTR) technology can chemically recycle End-of-Life Plastic and End-of-Life Tyres that would otherwise be sent to landfill into valuable fuels and chemicals, including those to make new plastic. A truly circular solution as we transition to a circular economy.

Compared to waste to energy (incineration of plastic to create electricity or replace gas), our Cat-HTR process produces 80-100% more value with 45% less carbon emissions. Plus, chemical recycling supports the established waste hierarchy.

One commercial-scale Cat-HTR chemical recycling plant would process around 20,000 tonnes of End-of-Life Plastic a year, producing 17,000 tonnes or 119,000 barrels of recycled oil (based on an 85% oil yield from plastic). This "Plasti-crude" oil is a direct substitute for fossil oil in many applications, including the production of new plastics (making it a truly circular solution for currently non-recyclable plastic). That is 20,000 tonnes of plastic not going to landfill or our oceans by building just one Cat-HTR plant. We believe that to help Australia become "plastic neutral" will require 40 Cat-HTR facilities that would create at least 720 jobs, including within regional areas.

Data from the National Waste Report (see below) demonstrates that if these resources are removed from mixed waste (MSW) there will be very little material to go into a WtoE facility and certainly not enough to justify the plant. The only way around it will be to cannibalise these waste streams and pressurising councils to not follow the waste hierarchy. Care should also be taken when assessing volume of material available to exclude materials which cannot go into WtoE facilities e.g. concrete and masonry.

Waste Generation by Material Category



<https://www.environment.gov.au/system/files/resources/7381c1de-31d0-429b-912c-91a6dbc83af7/files/national-waste-report-2018.pdf>

WtoE facilities require plastics to be combusted due to their high calorific content required to evaporate the water contained in the organics. It would be highly ironic if Victoria moving away from electricity from high water content brown coal starts relying on electricity from WtoE facilities with similarly high water content MSW. It should be noted that the improved GHG impacts claimed by WtoE facilities is only when compared to landfill, where the organics rot to produce methane. With anaerobic digestion this methane is captured and used to make bio-gas.

We question whether new waste to energy facilities have a place in Victoria's sustainable resource recovery sector. In line with the established waste hierarchy, waste to energy should be viewed only above disposal as the last resort for waste and recovered resources. For Waste to Energy (WtoE) plants to be economic and financeable, they need to have large scale and long offtakes; typically 15+ years and 300k+ tpa. If waste is suitably source separated, the wastes can be easily recycled into higher value products with processes that produce lower emissions, as follows:

- Paper and cardboard recycled into new paper and cardboard;
- Glass recycled into sand and cullet for use in construction projects, as well as high value engineered products (see below);

- Metals and cans recycled into new metals and cans;
- Recyclable plastics, typically PET and HDPE milk bottles, can be physically recycled through flaking and pelletising into new plastic containers;
- Non-recyclable plastics chemically recycled using our Cat-HTR process or other chemical recycling processes into plasti-crudes (uses see below);
- Household organics recycled in anaerobic digestion facilities into biogas and digestate (Milan in Italy is achieving almost 100% recovery of household waste and producing enough power for 24,000 people¹)

Waste from energy should be the last resort for resources not able to be recycled or recovered by other means. Keeping in mind 51% of MSW is organics able to be handled via anaerobic digestion, then 4% glass (100% recyclable as glass sand), 17% is paper & cardboard (recyclable) and 17% plastic (combining physical and chemical recycling can recover almost all of this, including End-of-Life Plastic). The balance does not seem to justify the approval of new waste to energy incinerators.

As the Resource Recovery industry evolves it is also important to have policies that enable and facilitate innovation and not stifle it. You may be interested in Queensland's approach to this, see p15 on of the attached policy discussion paper from Queensland, which seems to us to be a sensible approach.

To truly transition to a lower carbon future, we need to embrace innovative solutions which add the most value and minimise carbon emissions. Solutions such as our Cat-HTR chemical recycling technology, manage carbon more effectively than waste to energy. We believe any future waste policy for Victoria needs to reflect waste to energy as a less desirable, lower value option for waste.

Examples from Licella and iQ Renew include:

- 1. Cat-HTR™: Australian innovation and World-renowned solution for End-of-Life Plastic:**
Low-grade mixed plastic types account for 80% of plastic waste exported in Australia. Largely from municipal recycling, this material has less market demand both domestically and internationally. Part of the solution is to introduce new chemical recycling technologies such as our Cat-HTR™, which can transform mixed post-consumer plastic into high value oil. This can help Australia transition to a plastic neutral future by creating a circular economy for plastic – transforming plastic back to oil to make new plastics. Unlike physical recycling, chemically recycling can process virtually all plastic including multilayer packaging and do this an infinite number of times. The return on investment for a commercial Cat-HTR™ plant is estimated to be between 2.5 - 3 years. Licella's patented chemical recycling platform, the Catalytic Hydrothermal Reactor (Cat-HTR™) economically converts End-of-Life Plastic, which would otherwise go to landfill, into high quality and refinery ready oil to produce new plastics, fuels and chemicals. Our Cat-HTR™ technology is globally recognised as the most commercially advanced HTL platform in the world – the next generation of plastic to oil technologies. Compared to waste to energy, chemically recycling End-of-Life Plastic with the Cat-HTR™ delivers 2-3 times more value with half the CO2 emissions². Compared to older technologies such as pyrolysis, our award-winning Cat-HTR™ platform is proven across the widest range of plastics, including multilayer packaging, without the need to sort plastic into a single stream. We believe that 20-30 commercial Cat-HTR™ plants around Australia would

¹ <https://ec.europa.eu/environment/waste/waste-to-energy.pdf> p8-9

² Licella Holdings data on file: Converting End-of-Life PE to liquid hydrocarbon products creates 80-100% more value than Waste To Energy (WTE), and produces 45% less CO2.

go a substantial way to make Australia plastic neutral, dealing with the more than 50% of plastic we consume that is not able to be physically recycled. A commercial plant would process 20,000 tonnes of End-of-Life Plastic a year – and with the potential for plants in regional areas, this also supports significant job creation for our regions, as well as an opportunity for Australia to lead the world in a sustainable, valuable and lower emission solution for plastic otherwise destined for landfill.

2. **iQ Renew Virtual Quarry: Australian innovation providing valuable new markets for waste glass:** iQ Renew are pioneering a sustainable solution for low-grade glass recovered kerbside by developing a proprietary process to wash and crush recovered glass at large-scale into a range of high quality products. Our “Virtual Quarry” is a secondary processing facility for glass located in Wyong on the NSW Central Coast, and we believe is the only facility of its type and scale in Australia. The finished glass aggregates are currently being used by Councils and civil construction contractors, as well as concrete companies and companies supplying drainage solutions, who use the sand as a filtration medium. The glass can also be used in other high value applications such as floor and wall tiles (~\$400 per tonne), sand blast medium (~\$600 per tonne) and Silica Soil enhancement (\$900 per tonne). This Virtual Quarry recently received expanded development approval to crush and wash 30,000 tonnes of recovered glass annually. iQ Renew’s plan to expand the Virtual Quarry capacity to 110,000 tonnes per annum would be sufficient to process 50% of all recovered glass in NSW.

We believe that there are additional drivers Victoria can implement to increase the re-use, recycling and recovery of resources and reduce the environmental impact of waste, including:

- The key to achieving optimal levels of recycling, especially in municipal settings, is to encourage good source separation at the household level in a consistent manner across councils. Best practise from Europe has proven that separate bins maximise resource recovery and minimise contamination, by having separate collection for :
 - Household Organics
 - Garden Organics
 - Paper and Cardboard
 - Glass/Metal/Cans
 - Plastics
 - Residual Waste (excl batteries³)
- Victoria should also encourage councils to investigate the potential to remove and separate plastics from MSW (red/black bin waste).
- Mandating the use of recycled products by local councils and governments.
- Increase economic incentives for recyclers and manufactures of waste derived products, with government commitment to purchase and build demand for the markets of recycled products.
- Consider introducing plastic recycling obligations for manufacturers similar to those in place in overseas markets. Plastic recycling targets in the form of Packaging Recovery Notes (PRNs) have been in effect in the U.K. for some time with strict packaging recycling obligations for manufacturers of plastic. A PRN is documented proof that packaging material has been recovered or recycled by an accredited recycling company, similar to the CDS Scheme refunds. The regulations have required more than 7,000 firms responsible for generating waste to demonstrate that a certain amount has been recycled. This promotes a shared responsibility for plastic recycling between government and manufacturers. Under the U.K. scheme, firms with recycling obligations contributed £73m in 2017 to the cost of dealing

³ Batteries should be separated from waste as they contain heavy metals and should be separately recycled through other council initiatives e.g. schools, council drop off points etc

with their waste by paying for “recovery evidence notes” from reprocessing plants or exporters.

- Fast track approval of new recycling sites and new recycling technologies (including chemical recycling technology such as Licella’s Cat-HTR™, to help divert significant quantities of plastic from landfill and the natural environment) and which help us reach these ambitious targets.
- Encourage and develop partnerships between government and businesses to help affect the above change.
- Offer incentives to councils and industry to work collaboratively on new projects. Regional benefits from regional innovation in recycling and manufacturing.
- Co-investment by industry and Government to increase the capacity of recycling and resource recovery and in doing so support operators, which in turn will reduce contamination of kerbside recycling.

Waste as a resource – the circular economy

Licella and iQ Renew wish to reinforce the importance of the waste hierarchy (below), consistent with supporting a circular economy.

Figure 1: Waste hierarchy

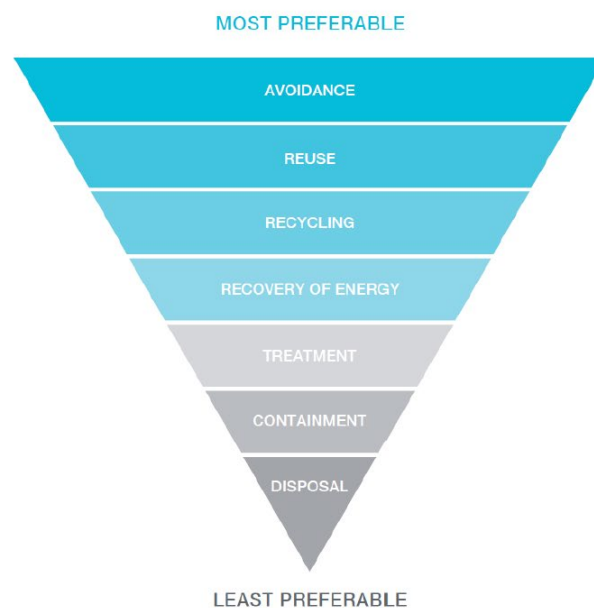


Figure 1. Waste management hierarchy – p10 report

We wish to reinforce the importance of shifting waste management strategy up the value chain to prevention, recycling and reuse and away from incineration and landfill. This is in line with current global views and in particular, the widely accepted EU position paper (The role of waste-to-energy in the circular economy, COM(2017) 34 final, 2017). Within their paper the EU are careful to point out that “*waste incineration with limited energy recovery is regarded as disposal.*”

With this in mind, we believe it is important to focus on source separation enabling recovery via physical and chemical recycling prior to incineration. We believe it is important that any future policy reflects these (waste to energy) as lower value uses and encourages higher value recycling and repurposing.

Investing in waste sorting technology and recycling infrastructure means supporting several key principles including reducing GHG, reducing disposal to landfill and importantly creates more jobs. *'Recycling creates ten times as many jobs as sending waste to landfill or incineration.'* (Connett, 2013).

As noted in the report, finding local sustainable solutions to Victoria's waste plastic and glass is critical to address Victoria's waste challenges and transform its recycling sector into one which leads the way for other States and is on-track to comply with an enhanced National Waste Policy and impending Waste Export Bans.

Investment in the right resource recovery and recycling infrastructure, in line with the established waste hierarchy (p10 of report) will not only help Victoria transition to a circular economy, but also significantly reduce carbon emissions while creating more jobs, high value products from waste and minimising waste sent to landfill.

With proposed Waste Export Bans coming into effect from 2020, there is even more urgency to build and enhance local recycling infrastructure to deal with our own resources and avoid them going to landfill, or the natural environment.

We welcome the opportunity to discuss any aspects of our submission, or any questions regarding Licella and iQ Renew.

About Licella (www.licella.com)

Licella are recognised as the global leaders in hydrothermal upgrading. Licella's proprietary Catalytic Hydrothermal Reactor (the Cat-HTR™) is proven to convert a wide range of waste feedstocks, including End-of-Life Plastic, biomass residues and wood waste and End-of-Life Tyres, into renewable biocrude or synthetic crude, thereby reducing our reliance on virgin fossil crude. Licella's Cat-HTR™ platform can be fully integrated within our partners existing infrastructure, to provide a brand new revenue stream to Resource Recovery.

About iQ Renew (www.iqrenew.com)

iQ Renew is pioneering a commercially and ecologically sustainable solution to our current waste crisis by combining physical and chemical recycling. At present only about half of plastics can be physically recycled. iQ Renew will be able to recycle 100% of post-consumer plastics - creating a truly circular solution. iQ Renew is an Australian company that will deploy the Cat-HTR™ technology in Australia, alongside expanding its physical recycling operations.

Kind regards,



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Energy from Waste Policy

Discussion paper for consultation

Prepared by: Office of Resource Recovery, Department of Environment and Science

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Introduction

Energy from waste (EfW) refers to converting waste materials into fuels, or energy in the form of electricity, heat, or cooling. It is often used interchangeably with the term 'waste to energy'.

Currently there is no nationally consistent policy approach to recovering energy from waste materials in Australia, with a mixture (or absence) of policy settings across the country. The Queensland Government is undertaking consultation to inform the development of an EfW policy which is best suited to our state.

Developing the EfW policy is a key action identified in the delivery of the Waste Management and Resource Recovery Strategy (waste strategy):

The aim of this discussion paper is to seek feedback on how stakeholders see the role and use of EfW technologies in Queensland's approach to waste management. This will help to inform a government policy position and the development of the EfW policy.

This discussion paper identifies a proposed role for EfW in Queensland and how it could support implementation of the waste strategy. The discussion paper also outlines a set of proposed principles to help guide EfW developments in a way that ensures human health and the environment are protected, and maintains the integrity of reuse and recycling activities.

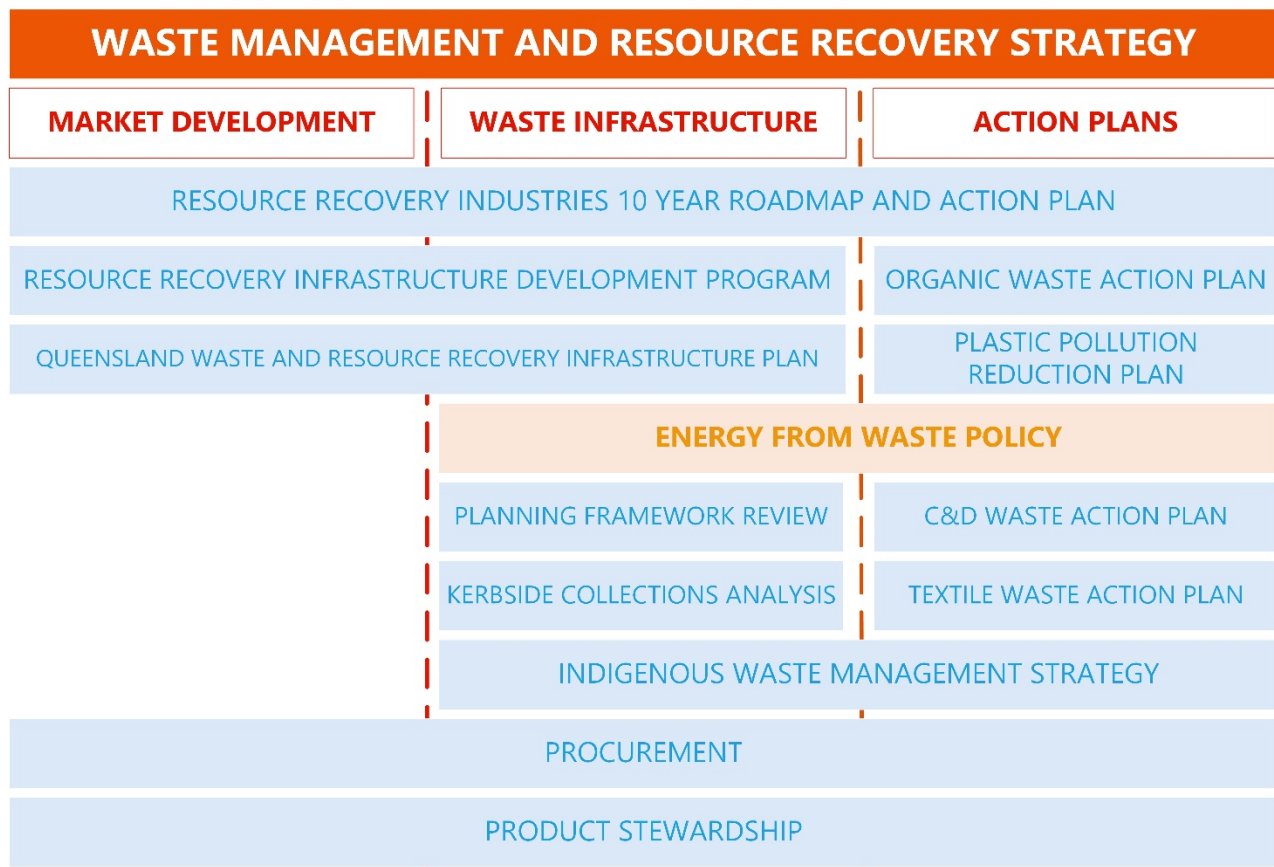


Figure 1: Key actions in implementing the Waste Management and Resource Recovery Strategy

Why does Queensland need an EfW policy?

Released on 1 July 2019, the waste strategy provides a strategic plan for better harnessing the potential value of resources that have traditionally been discarded, whilst reducing the impact of waste on the environment and communities. The waste strategy outlines a vision for Queensland to become a zero-waste society, where waste is avoided, reused and recycled to the greatest extent possible. To support this vision, the waste strategy sets targets to:

- reduce waste generation by households by 25 percent by 2050
- recycle 75 percent of all waste by 2050
- divert 90% of all waste from landfill by 2050.

The waste strategy also identifies the following strategic priorities to help drive a fundamental shift in the way waste is managed and support the envisioned transition to a zero-waste society:

1. reducing the impact of waste on the environment and communities
2. transitioning towards a circular economy for waste
3. building economic opportunity.

Transitioning to a circular economy for waste (priority 2) aims to ensure that products are designed to eliminate waste and pollution, and that products and materials keep circulating in the economy at their highest value for as long as possible. This is done through reuse, repair, re-manufacturing, recycling, and similar activities. When products and materials can no longer be circulated and become waste, the energy embodied in the waste can be harnessed and used before finally disposing of the residues in landfill.

Achieving the waste strategy's recycling targets, and transitioning to a circular economy will take time. During the transitional period, a clear policy position on EfW is needed. Under the Queensland Biofutures 10-year Roadmap and Action Plan, the government has committed to developing a \$1 billion sustainable and export-oriented industrial biotechnology and bioproducts sector attracting significant international investment, and creating regional, high-value and knowledge-intensive jobs. The Queensland Government recognises that producing high-value fuels from waste materials could contribute to the biofutures vision by creating greater employment and economic opportunities, compared to the alternative of disposal in landfills. A clear EfW policy position will recognise the benefits of producing fuels from waste over other forms of energy.

A clear EfW policy position will also provide certainty to proponents. This will help to ensure that the development of the EfW sector in Queensland does not create an over-reliance on EfW as a waste management solution, or create the circumstances that undermine programs or stifle innovation to sustainably reduce, reuse and recycle waste. An EfW policy that outlines a consistent approach and clear guidelines for proponents to follow, will help to ensure that EfW projects meet technical, environmental, regulatory and community expectations and are in the best interest of Queenslanders

A clear policy position will also help to drive greater efficiency in extracting and converting the embodied energy in waste materials into useful energy before final disposal.

A Queensland EfW policy will create a level playing field for new projects and ensure that reuse and recycling activities are not compromised by the current market opportunity in fuel and energy recovery.

Stakeholder consultation

Stakeholders from across industry, federal, state and local government, the environmental advocacy sector, and academia were consulted in the preparation of this discussion paper (Appendix 1).

Waste management and resource recovery in Queensland

In 2017-18, Queensland produced 10.9 million tonnes of waste, of which 4.9 million tonnes of resources, or around 45 percent of the waste generated, were recovered or recycled (Figure 2). The remaining 6 million tonnes were disposed of to landfill. Over the past 10 years, the amount of waste sent to landfill in Queensland has increased while the recycling rate has remained steady. Waste going to landfill represents lost opportunities to extract materials and energy that can replace the use of virgin resources, and reliance on fossil fuel energy.

Snapshot of waste in Queensland

In 2017–2018 ...

10.9
million tonnes

of headline wastes reported

55%



of waste goes to landfill

45%



of waste is recycled or recovered

Local governments sent
340,000 tonnes



of paper and packaging to recyclers



of mixed domestic waste picked up by
weekly council kerbside collection

Organic processors converted
1.4 million tonnes



into products such as soil,
potting mixes and mulches

It cost local governments

\$18.4m

to deal with **6,000 tonnes**



of illegally disposed of waste



37%
increase

in the annual amount
of waste from
interstate sources
sent to Queensland waste facilities

Figure 2: Snapshot of waste in Queensland

The waste strategy sets targets to recycle 50 percent of household waste by 2025, and 75 percent by 2050. It also seeks to divert 90% of waste from landfill by 2050 (Table 1). It is proposed that EfW can help Queensland meet this landfill diversion target by recovering value from waste that is not practical or economically viable to separate and recycle ('residual waste').

Table 1: Waste strategy targets

Description of target	Waste stream	2017-18 Baseline	2025	2030	2040	2050
Waste reduction for households (as percentage of 2017-18 baseline)	Municipal solid waste (MSW)	0.54 tonnes per capita	10%	15%	20%	25%
Waste diversion from landfill (recovery rate as a percentage of total waste generated in 2017-18)	MSW	32.4%	55%	70%	90%	95%
	Commercial and industrial (C&I)	47.3%	65%	80%	90%	95%
	Construction and demolition (C&D)	50.9%	75%	85%	85%	85%
	Overall maximum	45.4%	65%	80%	85%	90%
Recycling rate (as a percentage of total waste generated in 2017-18)	MSW	31.1%	50%	60%	65%	70%
	C&I	46.5%	55%	60%	65%	>65%
	C&D	50.9%	75%	80%	>80%	>80%
	Overall	44.9%	60%	65%	70%	75%

What is EfW?

EfW refers to the recovery of useful energy from waste materials. Energy can be recovered in the form of solid, liquid or gaseous fuels, electricity, heat, or cooling systems. The energy can be used on the site of production to help meet energy demands ('behind-the-meter'), or supplied to other users through a wider distribution network.

Various technologies are available to convert waste into energy. All are broadly based on thermal, biological or chemical processes.

- Thermal technologies use heat to release the embodied energy from the waste. Incineration, torrefaction, pyrolysis, and gasification are examples of thermal EfW processes.
- Biological processes use microorganisms that feed on the waste and produce an energy-rich gas or liquid, which can further be converted to electricity or heat. An example of this process is the fermentation of biomass to produce ethanol.
- Chemical processing uses chemical agents to break down the waste and convert it into liquid fuel. The conversion of waste fats and oils into biodiesel using chemical catalysts is an example of a chemical EfW process.

Different EfW technologies require alternative feedstock and produce different forms of useful energy and residues (Table 2).

Table 2: Summary of EfW technologies

Technology	Potential feedstock	Outputs	Residues	Maturity[1]
Thermal technologies				
Incineration	Mixed MSW, C&I and some C&D waste, woody biomass waste	Heat, electricity, recovered metals, bottom ash	Bottom ash, fly ash, flue gas treatment residues	Internationally mature
Advanced thermal treatment [2]	Pre-sorted MSW, C&I and some C&D wastes and homogeneous streams e.g. tyres, dry organics, plastics	Heat, electricity, syngas, refined oils/chemicals, char	Flue gas treatment residues	Maturing, mature in some jurisdictions (e.g. Japan)
Biological technologies				
Anaerobic digestion	Organic wastes, biosolids from waste water treatment plants	Heat, electricity, biogas, digestate	Wastewater, inert contaminants (e.g. plastics, glass)	Mature internationally. Maturing in Australia
Fermentation	Organic waste with high sugar content	Alcohols, digestate	Liquid residues	Developing
Solid fuel production	MSW, C&I and C&D streams	Combustible solid fuels (e.g. refuse derived fuel)	Solid residues	Mature
Chemical technologies				
Liquid fuel production (other than advanced thermal treatment)	Individual waste streams, e.g. tyres, waste oils, plastics, solvents	Combustible liquid fuels	Process-dependent	Developing

[1] Technology maturity refers to the degree to which it can be demonstrated that the technology can reliably and commercially operate on given waste feedstock.

[2] Examples of advanced thermal treatment include pyrolysis, gasification, and plasma gasification.

Energy recovery in the waste hierarchy

The Queensland Waste and Resource Management Hierarchy (the waste hierarchy) is a framework that guides the order of preference for managing waste (Figure 3). It is enshrined in Queensland law and supported by the vision, targets and actions in the waste strategy.

Waste should be managed at the highest practical level of the waste hierarchy to achieve the best outcome for the environment and for future generations. Economic, social and technological factors all play a role in determining the best practical outcome for specific waste streams.

On the waste hierarchy, energy recovery is preferable to landfill because it recovers some value from the waste, reduces greenhouse gas emissions from organic waste and lessens the legacy impacts of landfills. However, it is less desirable than avoiding the generation of waste, reusing or recycling materials.

The Queensland Government also recognises a hierarchy among EfW technologies, as shown in Figure 3. On this hierarchy, anaerobic digestion, a biological EfW process, is considered as recycling because it preserves nutrients, which can be returned to the soil. This can help to improve soil quality and tackle serious emerging land degradation issues. Anaerobic digestion also produces biogas that can be used as an energy source.

Processes for converting waste to solid or liquid fuels typically include separation or sorting steps to obtain suitable materials. Increased material sorting supports separation of recyclable materials, and the feedstock specifications for fuel production reduce potential conflicts with current or future recycling. This makes fuel production more desirable than EfW technologies, which accept unsorted feedstock.

Combustion and advanced thermal treatment technologies can process the widest variety of materials (residual wastes and recyclable) and thus pose the greatest potential conflict with reuse and recycling. The Queensland EfW policy will be developed to ensure the uptake of EfW does not impact on reuse and recycling activities.

Landfill gas capture and combustion emerged as a technological solution to manage landfill gas. The technology relies on the continued disposal of organic waste to landfill. However, it is still more desirable than landfilling without gas capture or energy recovery and is suitable for landfill sites which will continue to release combustible greenhouse gases for many years after closure.

Energy recovery and the circular economy

Transitioning to a circular economy for waste in Queensland is a priority under the waste strategy. Adopting circular economy principles and shifting away from the linear 'take-make-use-dispose' model will deliver benefits through reduced waste and improved resource efficiency. A circular economy has three main principles:

- design out waste and pollution
- keep products and materials in use through reuse, repair, remanufacture or (as a last resort) recycling
- regenerate natural systems (e.g. produce compost from organic waste to regenerate soils)

When these principles are put into practice during the transition to a circular economy, waste generation will decrease, which will lessen the need for waste treatment and disposal infrastructure, including EfW plants. Making a smooth transition to a circular economy therefore requires striking the right balance of EfW capacity for residual waste. An overcapacity of EfW in Queensland would be a disincentive to circular economy practices.

EfW can play a role in the transition to a circular economy provided the waste hierarchy is used as the guiding principle for waste management, and that choices are not made that undermine higher levels of waste avoidance, reuse and recycling.

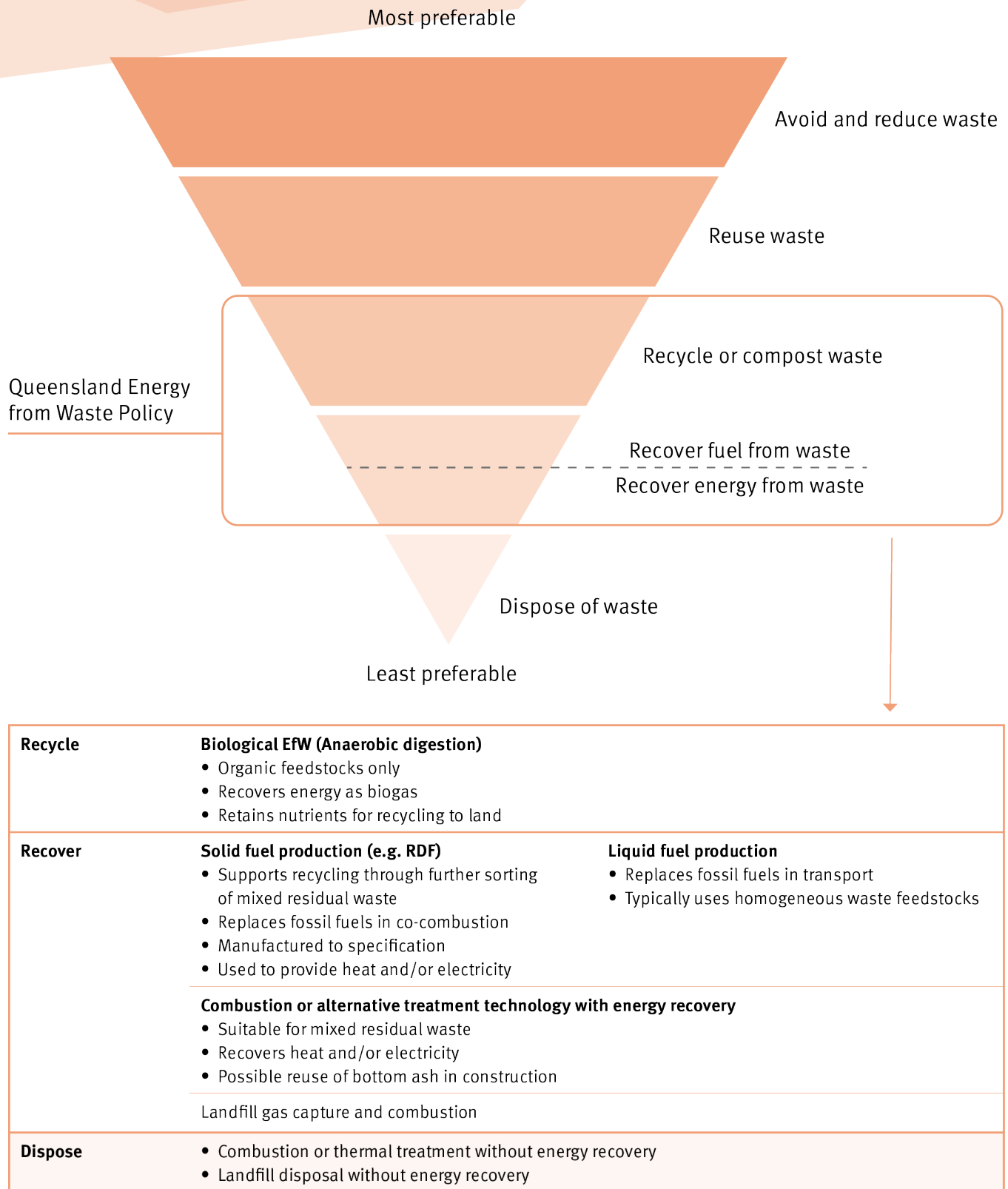


Figure 3: Role of EfW in the waste hierarchy

EfW policy in Australia

From the 1930s to the 1990s, large-scale municipal incinerators and small-scale backyard incinerators without energy recovery, were used for waste disposal in Australia. However, concerns about air pollution and health impacts saw a shift away from incineration to reliance on landfill disposal. Incineration of municipal waste in Australia ceased in the late 1990s.

In the years since, incineration technology has continued to develop around the world, with an increasing focus on energy recovery and pollution control. Over time, environmental regulations and standards have also become more robust and strict to ensure protection of the environment and human health.

More recently, EfW for mixed residual waste as part of an integrated waste management solution has resurfaced in Australia. Several EfW facilities have been proposed in various states, with construction of the first new EfW plant for MSW commenced in late 2018 in Kwinana, Western Australia (WA).

State and territory governments recognise the need for a coherent and strategic approach to this significant, long-term infrastructure, and have begun to develop EfW policies. New South Wales (NSW) published an EfW policy in 2015, and WA issued a position statement in 2013. Victoria, South Australia, the Australian Capital Territory published consultation documents, but have not finalised EfW policies. Tasmania and the Northern Territory have not published EfW policies. The policy and consultation documents released in various Australian states and territories demonstrate broad alignment and address the following key issues:

- application of the waste hierarchy over the short and long term
- the need to control air quality and other environmental impacts and protect public health
- the importance of community acceptance and social licence to operate.

There are key differences in the scope of the policies beyond combustion of mixed residual waste and approaches to demonstrating that residual waste is acceptable for energy recovery.

All current Australian EfW policies draw on the stringent, modern standards and environmental controls developed by the European Union. This makes it easier for technologies which have matured in the European market to be adopted in Australia.

EfW projects in Australia

A range of EfW technologies has been developed in Queensland and around Australia, under existing policy and approvals frameworks. These have generally remained small-medium scale, accepting homogeneous, low risk feedstock, for example:

- combustion of wood and agricultural waste
- pilot scale pyrolysis of waste oil or tyres
- anaerobic digestion at sewage treatment plants, intensive livestock operations and food processing facilities.

The scale and risk of these projects has not warranted any specific policy development.

Over the last five years, larger scale EfW projects have begun to gain traction. Several anaerobic digestion facilities accepting commercial and industrial waste streams are now operational, and the first EfW plant for mixed residual waste is under construction in WA. There are also a number of dedicated facilities producing refuse derived fuel from commercial and industrial waste.

These projects are not funded as essential infrastructure; they are expected to offer an attractive investment for the private sector. The business case for these projects relies on policy clarity and certainty, and on appropriate policy instruments which recognise the financial drivers for EfW investment. These vary significantly between EfW technologies.

Thermal EfW facilities typically have a large capital investment and long asset life of 20-30 years, and rely on gate fees from waste feedstock and the sale of generated energy as the primary revenue stream. Landfill levies enable EfW facilities to charge higher gate fees for waste feedstock, whilst remaining competitive with landfills, and consequently support the EfW business case. Alternatively, banning certain wastes from going to landfill can redirect material to EfW or other recovery facilities, despite higher costs.

In contrast, anaerobic digestion facilities, particularly in the current Australian context, are most frequently co-located within an existing organic waste-producing site such as a sewage treatment plant, food processing facility or intensive livestock operation. Disposal of internally-generated waste and behind-the-meter energy use are the key drivers for anaerobic digestion investments. Acceptance of external waste to boost energy generation and create gate fee revenue is increasingly common, but is rarely the primary driver for facility development. Corporate social responsibility of large organic waste generators, such as major retailers or food producers, can also create the market for anaerobic digestion.

Obtaining approvals for development, environmental and grid connection frequently proves to be challenging for facilities which are the first of their kind in each jurisdiction, even when the proposed technology is mature elsewhere. Clear policy and approvals processes and seed-funding support will help realise EfW opportunities in Queensland.

Case study: Anaerobic digestion at Richgro, WA

Since 2015, compost-producer Richgro has been accepting 35,000 tonnes of commercial and industrial waste feedstock each year for anaerobic digestion.

Organic waste from markets, supermarkets and breweries is converted into electricity, which powers the composting facility. An additional 1.7 megawatts of renewable energy is exported to the electricity grid. Digestate from the anaerobic digestion process is added to Richgro's composting process, thus recycling nutrients back into the soil.

This combination of high-quality feedstock, electricity demand, and a productive outlet for the digestate created an attractive commercial opportunity for large-scale anaerobic digestion. However, seed-funding grants played an important role in helping the project through the lengthy design and approvals process, as the first facility of its kind in WA.



Photo 1: Richgro's anaerobic digestion facility (source: Biogass Renewables)

International EfW policy

Thermal and biological EfW processes and solid fuel production are widely adopted technologies internationally. Local drivers and contexts have shaped markedly different EfW adoption patterns around the world.

Constrained landfill availability is typically the primary driver for extensive EfW development. This can be due to lack of suitable sites, social and environmental concerns preventing new landfills, or legislative instruments such as landfill bans, mandatory waste diversion targets and prohibition of waste transport for disposal.

Social licence to operate is critical and is the common feature of jurisdictions which have established a large EfW fleet. Successful social licence to operate requires accepted emissions control standards, and a perception that EfW provides a useful or necessary urban function through waste destruction and/or provision of affordable heating.

Waste treatment remains the primary purpose of thermal EfW plants. In areas where electricity generation has been specifically incentivised, thermal EfW plants make a very small contribution to national electricity supply and are not discussed within national electricity policies. However, wider renewable energy agendas and incentives can benefit EfW infrastructure, particularly where anaerobic digestion taking only organic feedstock can be classed as a 100 percent renewable source.

The ability to deliver energy in forms other than electricity is an important driver for site selection. For example the proximity to urban populations with demand-led district heating systems, co-location with heat-demanding industrial facilities or biogas injection to an existing gas network can offer attractive co-location opportunities.

Different policy and economic contexts have created uneven development of recycling and resource recovery capacity. Within the European Union, waste export between European Union members helps match waste to its most appropriate use, however some countries are reliant on the import of waste to ensure efficient operation of large scale EfW facilities. Processed engineered fuel production is a relatively inexpensive option which is currently supporting the waste hierarchy during the circular economy transition.

Case study: Refuse-derived fuel at Wetherill Park and Berrima Cement Works

In 2018, ResourceCo in a joint venture with Cleanaway, opened a new resource recovery facility in Wetherill Park, western Sydney. It sorts 250,000 tonnes of waste each year, extracting recyclable materials and producing a refuse-derived fuel (RDF) from suitable residual waste. The RDF replaces over 100,000 tonnes per year of coal consumption at the Boral Berrima cement kiln.

The Wetherill Park facility received \$5 million from the NSW Government and \$30 million in debt finance from the Clean Energy Finance Corporation, recognising the important role that it plays in supporting the waste hierarchy and sorting waste materials to their most appropriate fate.

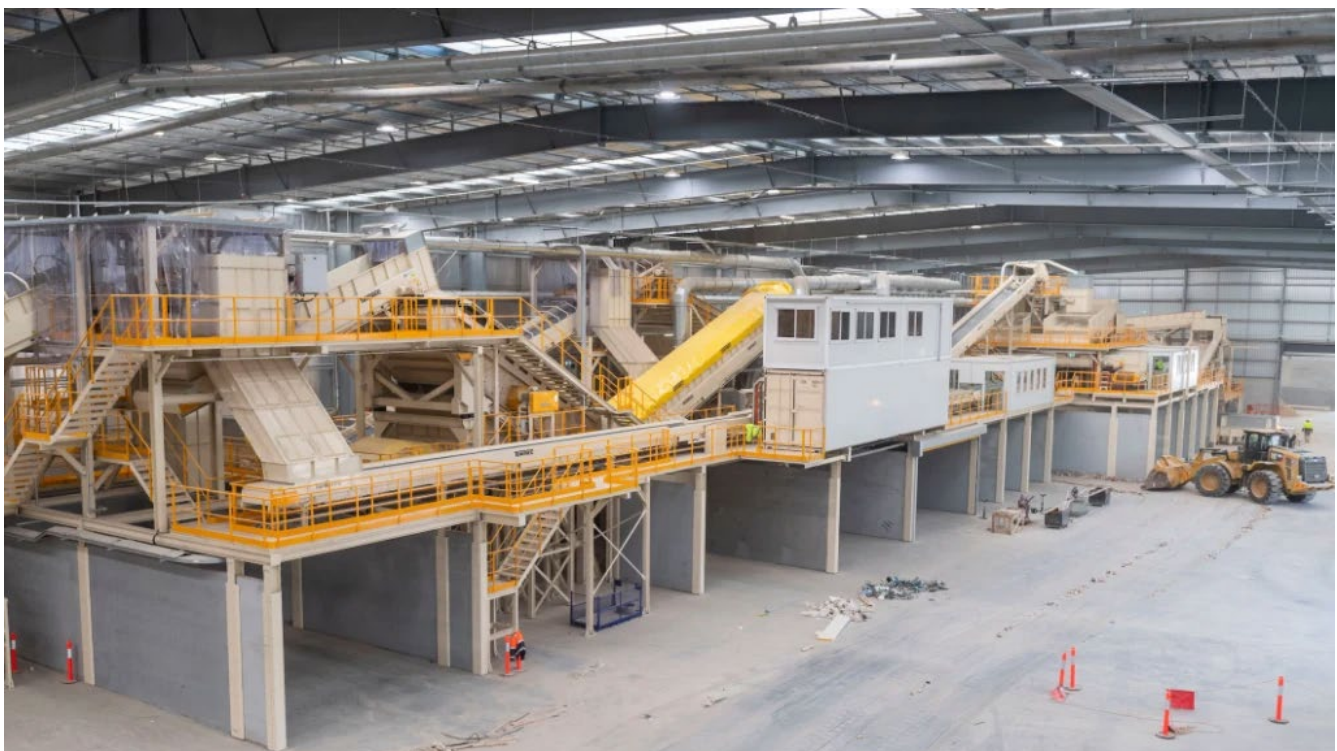


Photo 2: RDF Facility at Wetherill Park (source: ResourceCo)

Towards an EfW policy for Queensland

The role of EfW in Queensland

The importance of prioritising waste avoidance, reduction, reuse and recycling in line with the waste hierarchy cannot be overstated. The Queensland Government has already implemented several initiatives specifically aimed at reducing waste generation and increasing resource recovery. These initiatives, which are anticipated to contribute to sustainable waste reduction and recycling, include:

- a ban on the supply of single-use lightweight plastic shopping bags since 1 July 2018
- a Container Refund Scheme to improve recycling of beverage containers since 1 November 2018
- the development of strategic partnerships to improve the management of organic wastes
- the development of a Plastic Pollution Reduction Plan
- the introduction of a waste disposal levy commencing 1 July 2019
- the delivery of a \$100 million Resource Recovery Industry Development Program over three years
- the development of a \$5 million Waste to Biofutures Fund.

The Queensland Government acknowledges that EfW has a role to play in better waste management for Queensland during the transition to a circular economy. After all practical and economically viable opportunities to reduce, reuse and recycle wastes have been exhausted, EfW can be used to extract useful energy (fuels, electricity, heat) from the residual waste before final disposal. This is consistent with the waste hierarchy (Figure 3).

Thermal EfW technologies cannot contribute to Queensland's recycling targets. However, they can recover value from residual waste that is not practical or economically viable to separate and recycle. This would help Queensland meet its landfill diversion target. The composition of residual waste will change over time as recycling improves and Queensland transitions to a more circular economy. EfW infrastructure must be flexible enough to accommodate this change.

The adoption of EfW in Queensland would complement the delivery of a number of Queensland Government commitments around climate change and industry development as explained below.

Zero net emissions future

The Queensland Climate Transition Strategy sets a vision of a zero net emissions future for Queensland that supports jobs, industries, communities and the environment. This vision represents Queensland's contribution to the global effort to reduce carbon pollution and arrest damaging climate change.

Although the waste management sector in Queensland accounted for less than two percent of the state's greenhouse gas emissions in 2016¹, EfW can contribute to a zero net emissions future in several ways:

- The energy (fuels and power) generated from waste using some EfW technologies can reduce reliance on energy from fossil fuels and avoid the associated greenhouse gas emissions.
- Diverting organic waste (e.g. sugarcane bagasse, and biosolids from the sewage treatment process) from landfill and into EfW potentially produces lower greenhouse gas emissions and in most cases retains nutrient value that can be returned to soils.

Renewable energy target

The path to achieving a zero net emissions future includes a commitment to generate 50 percent of Queensland's energy from renewable sources by 2030. Under the Commonwealth *Renewable Energy (Electricity) Act 2000*, energy derived from organic wastes may be regarded as renewable energy. Any renewable component of electricity generated from waste would be consistent with the Queensland Government's commitment to reach 50 percent renewable electricity generation by 2030. This includes energy derived from wood waste, agricultural waste, food and food processing waste, biomass-based components of municipal waste, landfill gas, sewage gas, and biomass-based components of sewage. This type of energy is also referred to as 'bioenergy'. Energy derived

¹ Queensland Government 2018, *Total annual greenhouse gas emissions*, viewed 19 April 2019, <<https://www.stateoftheenvironment.des.qld.gov.au/pollution/greenhouse-gas-emissions/total-annual-greenhouse-gas-emissions>>.

from waste products made from fossil fuels (e.g. traditional plastics) does not count as renewable energy or bioenergy.

Biofutures sector development

EfW technologies that produce fuels, and recover heat and electricity from organic wastes complement the vision set out in the Advance Queensland Biofutures 10-Year Roadmap and Action Plan (Biofutures Roadmap). The Biofutures Roadmap seeks to create a \$1 billion sustainable biotechnology and bioproducts sector underpinning regional, high-value and knowledge-intensive jobs. Projects supported under the Biofutures Roadmap include, for example, those focussed on the production of transport fuels from organic wastes.

Question

1. Do you agree that energy should be extracted from residual waste materials rather than disposing of those materials to landfill, if there are no other available alternatives for reusing or recycling the waste materials?

Risk-based EfW framework

Proposed principles

Principle 1: A risk-based approach will be used to guide and manage the development of EfW infrastructure.

Rationale:

A three-pathway approach is proposed, to deliver a policy framework that responds appropriately to the different EfW technologies. The three pathways will deliver a risk-based approach that safeguards human and environmental health, while also creating opportunities for greater resource recovery and innovation in Queensland. The three pathways are:

- Pathway 1: Technologies established and operating in Queensland
- Pathway 2: Operationally viable and mature technologies
- Pathway 3: Development and demonstration of emerging technologies.

If this proposed framework becomes policy, any applications received for an EfW environmental authority would be assessed against the framework to determine which of the three pathways and policy requirements, would apply. The characteristics, waste feedstock, and policy requirements associated with each pathway are discussed further below.

Pathway 1: Technologies established and operating in Queensland

Pathway 1 recognises established EfW technologies currently operating in Queensland with known risks. It supports efficient approvals and regulation under existing processes to maximise the environmental, economic and social benefits which these technologies can generate for Queensland.

The Queensland EfW policy will highlight the role that these technologies play within the state's broader resource recovery agenda without creating additional regulatory burden or barriers to project development.

Table 3: Technology characteristics and proposed policy requirements for Pathway 1

Technology characteristics	Technology and waste feedstock examples	Proposed policy requirements
Treats low-risk or homogenous waste streams. Environmental and human health risks of the technology are well understood. Measures to mitigate the risks are known and effective. Any risk remaining after application of the mitigation measures is low. Regulators and the wider community have confidence the facility can be managed in a safe and appropriate manner.	Combustion with energy recovery uncontaminated biomass (e.g. untreated timber or agricultural biomass). Energy recovery from bagasse. Combustion of shredded tyres/tyre derived fuel in cement kilns. Anaerobic digestion of sewage sludge. Anaerobic digestion of single stream organic waste (e.g. from food processing or intensive livestock operations). Landfill gas capture and combustion.	<i>The EfW policy would set clear requirements and expectations regarding:</i> Obtaining appropriate development approvals and environmental authorities under existing regulatory frameworks. Complying with operating conditions imposed under existing licencing frameworks, including standards for air emissions and disposal of residues. Applying the waste disposal levy on any residues disposed to landfill.

Pathway 2: Operationally viable and mature technologies

Pathway 2 will help Queensland take advantage of mature EfW technologies that have been proven in other jurisdictions. Mature technology refers to technology with a proven track record that can reliably and commercially operate on given waste feedstocks. This pathway will give regulators and communities confidence that technologies which are new to Queensland will be safe and reliable. A clear and rigorous policy for bringing EfW technologies into Queensland will allow proponents of mature and well-proven technologies to navigate the approvals process confidently and efficiently, while deterring inappropriate or risky projects.

Provision of detailed operational data is key to this pathway because the performance of EfW technologies varies significantly with size, and feedstock composition. Under Pathway 2, proponents would have to provide decisions-makers with appropriate and accurate performance data from a fully operational reference facility to assess the potential environmental and human health risks of the proposed facility.

Table 4: Technology characteristics and proposed policy requirements for Pathway 2

Technology characteristics	Technology and waste feedstocks examples	Proposed policy requirements
The technology is well understood and has been operating at full scale with similar waste for at least five years in a jurisdiction similar to Queensland. Environmental and human health risks have been identified and controlled to acceptable levels in a jurisdiction similar to Queensland. Standard guidelines, practices and operating controls are available from other jurisdictions. The proponent can provide at least three years of operational data from a reference facility operating at full scale with similar feedstock under comparable regulatory governance. Data from the design, modelling or commissioning phases alone is not acceptable to demonstrate operational performance. The operational data would include air emissions, energy balance and mass balance. Characterisation of the feedstock used to generate the performance data, and the resulting outputs/residues would also be needed.	Combustion of mixed residual waste (MSW/C&I) with energy recovery. Advanced thermal treatment of some homogenous wastes or pre-treated waste. Co-combustion of RDF in industrial facilities. Biofuel production from agricultural waste using established processes.	<i>The EfW policy would set clear requirements and expectations regarding:</i> Obtaining appropriate development approvals and environmental authorities under existing regulatory frameworks. Engaging with the community and obtaining social licence to operate. Responsibilities on the waste generator and facility operator to ensure that the feedstock is consistently appropriate, is residual, and that there is no practical higher order use under the waste hierarchy. Specific testing, monitoring and reporting requirements to build regulatory and community confidence in the sound performance of the facility. Compliance with relevant international best practices (refer to section below on "Managing Potential Environmental Impact"). Applying the waste disposal levy on any residues disposed to landfill.

Pathway 3: Development and demonstration of emerging technologies

Pathway 3 will support innovation and entrepreneurship in Queensland in a safe and transparent way. The Queensland government actively supports research, development and commercialisation of new technologies through programs like the Queensland Biofutures Roadmap, and this work will be complemented by the Queensland EfW Policy.

Pathway 3 will allow Queensland to take the lead in establishing new EfW technologies which tackle challenging feedstocks, unlock high-value resources or develop new technologies to suit our regional centres.

Table 5: Technology characteristics and proposed policy requirements for Pathway 3

Technology characteristics	Technology and waste feedstocks examples	Proposed policy requirements
The technology has been validated in a laboratory setting with intended feedstock, but has not been proven at full scale with intended feedstock. The effective mitigation measures for the potential operational or legacy risks of the technology have not been demonstrated. Technology Readiness Level 7 to 9 under the Australian Renewable Energy Agency classification guidelines² (see Table 6).	New processes for biofuel production from waste feedstocks. Small-scale mixed-waste EfW units. Advanced thermal treatment of mixed waste.	<i>The EfW policy would set clear requirements and expectations regarding:</i> Application of the precautionary principle as set out in the Intergovernmental Agreement on the Environment³. That is, where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. Obtaining appropriate development approvals and environmental authorities under existing regulatory frameworks. The scale and throughput of the activity, and duration of any environmental authority issued for the activity. Agreed criteria to demonstrate the technology performance over an agreed duration and allow the regulator and the community to understand risks and mitigation measures. Smooth transition to Pathway 2 once the technology has demonstrated adequate technical performance.

Table 6: Australian Renewable Energy Agency Technology Readiness Levels²

Summary of the nine Technology Readiness Levels
1. Basic principles observed and reported 2. Technology concept and/or application formulated 3. Analytical and experimental critical function and/or characteristic proof-of-concept (proof of concept validation with analytical or laboratory studies) 4. Technology basic validation in a laboratory environment 5. Technology basic validation in a relevant environment 6. Technology model or prototype demonstration in a relevant end-to-end environment 7. Technology prototype demonstration in an operational environment 8. Actual technology completed and qualified through test and demonstration in an operational environment 9. Actual technology proven through successful operations

² Australian Renewable Energy Agency 2014, *Technology readiness levels for renewable energy sectors*, viewed 19 April 2019, <https://arena.gov.au/assets/2014/02/Technology-Readiness-Levels.pdf>

³ Department of Environment and Energy, *Intergovernmental agreement on the environment*, viewed 20 May 2019, <https://www.environment.gov.au/about-us/esd/publications/intergovernmental-agreement>

Questions

- Does the proposed three-pathway framework for EfW technologies provide an appropriate, risk-based approach? What additional or alternative characteristics of EfW proposals should be considered?
- How should a proposal or technology type transition from Pathway 3 (demonstration) to Pathway 2?

Safeguarding the waste hierarchy

Proposed principles

Principle 2. The Queensland Government must consistently apply the waste hierarchy. Regulation and policy must ensure that energy recovery does not undermine recycling, and that disposal does not undermine appropriate energy recovery.

Principle 3. Energy recovery is only appropriate for residual wastes which it is not practically or economically viable to recycle.

Principle 4. The composition of residual waste will change over time as recycling improves and Queensland transitions to a circular economy. EfW facilities must be designed to accommodate this change.

Rationale

It is essential that government policies consistently reflect the waste hierarchy, which places EfW below recycling but above disposal. Waste materials can be diverted to higher-order reuse or recycling through source-separation, or through sorting of mixed wastes, and only residual waste must be used for energy recovery.

Some EfW technologies require separated, uncontaminated feedstocks, for example conversion of waste oils to biofuels, or anaerobic digestion of food waste. These technologies do not typically pose a risk to higher order recovery because they are selective about feedstock. Engagement with waste generators to obtain acceptable, clean feedstock can be a challenge for these types of facilities.

Setting the parameters around what is considered 'residual waste' will help to ensure that EfW does not undermine reuse and recycling. Residual waste refers to the waste remaining after all practical and economically-viable measures have been taken to reuse and recycle waste. In practice, this requires separating recyclable waste at the source of generation (e.g. kerbside), or pre-processing the waste stream at the EfW facility. The residual waste streams that may be potentially suitable for EfW are summarised in Table 7.

Table 7: Key waste streams potentially suitable for EfW

Key waste streams	Suitability for EfW
Municipal (MSW) – includes kerbside collections, bulky household waste, street sweepings, litter, and illegally dumped waste.	General waste (red bin lid) from councils that also offer a kerbside recycling (yellow bin lid) service are generally suitable for thermal EfW. Street sweepings, and illegally dumped waste.
Commercial and Industrial (C&I) – encompasses many sources and compositions, from small businesses and shopping centres, to large, industrial processes.	Dry C&I residual waste are suitable for processing to a refuse-derived fuel. Some organic C&I streams (e.g. food-processing waste) are highly suitable for anaerobic digestion. Mixed residual C&I is suitable for thermal EfW infrastructure.
Construction and demolition (C&D) – dominated by heavy, inert materials such as soil, concrete, brick rubble and steel.	Only a small fraction of C&D materials, such as wood waste, could be sent for energy recovery.
Other streams – includes agricultural waste and similar waste streams, which are not generally captured in waste data.	Organic waste are highly suitable for production of biogas or liquid fuels. Other homogenous, source-segregated waste types such as tyres or non-recyclable plastics are suitable for EfW.

Source separation of recyclables

EfW operators provide an end-of-pipe service and thus have little influence over the source separation processes of waste generators. However, clearly articulated waste acceptance criteria, as part of an environmental authority for an EfW facility, can define the waste types accepted at the facility and can be used to prohibit or deter clearly inappropriate loads, such as single-stream recyclable materials.

It is important that EfW facilities for mixed residual waste can adapt to changes in the residual waste stream over time. For example, most councils will need to implement source separation of organic material to meet the recycling targets within the waste strategy. Also, residual waste will decrease over time as advances are made in waste avoidance practices, and recycling technologies. EfW facilities accepting residual waste from councils would be expected to plan for and accommodate this change.

Waste pre-processing at EfW facility

Pre-sorting of mixed residual waste to extract recyclable materials prior to energy recovery is another option. However, this imposes a significant additional cost for energy recovery facilities and recovers lower quality and contaminated recyclable materials which are difficult to process.

In order to genuinely safeguard the waste hierarchy, any policies which restrict waste acceptance at EfW facilities in order to protect higher order material recovery, must also apply to landfill disposal.

Questions

4. What role should facility operators, collection contractors and local councils be expected to play in ensuring that only appropriate residual waste is accepted for energy recovery?
5. What should the requirements be for safeguarding current and future resource recovery? Does the solution involve source-segregation, pre-processing or both?
6. Should the Queensland Government ban specific materials from EfW facilities, or from both landfill and EfW facilities?

Promoting genuine energy recovery

Proposed principle

Principle 5. To be considered genuine energy recovery, thermal EfW facilities must meet a minimum energy efficiency threshold that is consistent with international best practice.

Rationale

Genuine energy recovery is an important criteria for thermal EfW. The type of energy produced by thermal EfW plants depends on the specific technology (see Table 2), but mainly includes heat and/or fuel such as syngas produced by gasification technologies. The heat produced may be used to produce hot water, or steam (in a steam boiler). The steam is commonly used for industrial or district heating systems, and occasionally as the driving force for cooling and air conditioning systems. It may also be converted to electricity in a steam turbine, which is then supplied to the national grid or used on the site of generation. The energy recovered from waste reduces the consumption of conventional energy from fossil fuel sources.

If an energy recovery requirement is not imposed as part of the approval process for thermal EfW, infrastructure could be developed which accept waste but produce very little or no energy. Whilst this would reduce waste volumes to landfill and potentially produce lower greenhouse gas emissions than landfill for organic waste, it should be considered disposal under the waste hierarchy, and should not receive any incentives on the basis of avoiding waste disposal.

The European Union has developed the R1 Energy Efficiency Formula (the R1 criteria)⁴ to assess genuine energy recovery, and facilities that meet it are classed as recovery rather than disposal. It was developed based on the practical performance of well-designed facilities recovering either electricity, heat or both. The R1 criteria is equivalent to converting approximately 25 percent of the energy generated from the waste into electricity only. Facilities which also capture useful heat achieve a much higher energy efficiency. The relative lack of demand for heat in Queensland's warm climate could make achieving R1 more challenging. Strategically siting thermal EfW facilities to supply heat or steam to industrial processes would support better energy efficiency.

NSW has adopted the R1 criteria in their EfW policy, while other Australian jurisdictions have cited the R1 criteria in their discussions on EfW. The R1 criteria is being considered as the minimum energy efficiency threshold for thermal EfW facilities in Queensland.

It is not proposed to impose energy recovery performance criteria on EfW processes which produce solid, liquid or gaseous fuels, because these processes typically support recycling through source separation and/or additional sorting of mixed waste. In addition, the business model of waste-to-fuel processes relies more heavily on the value of the fuel product, creating a financial driver to maximise fuel quality and energy efficiency. Consequently, they support the waste hierarchy, and energy performance criteria are not required to distinguish them from disposal processes.

Question

7. Should thermal EfW processes be required to meet the European R1 Criteria? Why/why not?

⁴ Guidelines on the R1 criteria are available at: <http://ec.europa.eu/environment/waste/framework/pdf/guidance.pdf>

Managing potential environmental impact

Proposed principles

Principle 6. Queensland should adopt international best practice standards and guidelines for managing the environmental impacts of EfW technologies.

Rationale

The potential environmental impacts of EfW facilities include impacts from air emissions, disposal of residues, odour, dust, noise, traffic, litter/vermin and other amenity impacts. Strong environmental protection measures are needed to minimise these potential impacts on communities and the environment and manage residual risks.

Under Queensland's existing regulatory framework, a proponent for an EfW facility would be required to obtain an environmental authority to lawfully operate the facility. The potential environmental impacts of the proposal would be rigorously assessed as part of this process, and an environmental authority granted only if the facility was deemed able to comply with the state's environmental protection laws.

An EfW policy for Queensland would further safeguard the environment by setting clear standards and requirements for EfW facilities under each pathway, commensurate with the risks. The EfW Policy would also ensure application of the precautionary principle as set out in the Intergovernmental Agreement on the Environment⁵. The precautionary principle requires that, where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In applying the precautionary principle, decisions should be guided by careful evaluation to avoid serious or irreversible damage to the environment; and by a risk assessment of the consequences of various options.

EfW technologies that would fall under Pathway 1, are currently operating effectively and safely in Queensland. These technologies are well understood with risks that can be effectively managed using existing regulatory instruments, guidelines and standard operating controls. In particular, the requirements and conditions applied as part of the environmental approvals process are sufficient to manage the risks. It is not proposed to introduce any additional environmental controls for Pathway 1.

Pathway 2 of the proposed Queensland EfW policy will set clear processes and requirements to support appropriate adoption of EfW technologies which are mature and well-proven in other jurisdictions, but not yet established in Queensland. This process will help to build understanding and confidence among regulators and the community, through rigorous and transparent environmental performance data.

Requirements for environmental controls under Pathway 2 will make use of existing international guidelines and accepted best practice. This will allow Queensland to take advantage of the extensive knowledge developed in jurisdictions where the technology is already mature. It will also allow technology providers to bring mature technologies to Australia and clearly demonstrate acceptable performance based on operational reference facilities that meet the same best-practice standards.

It is proposed to adopt the following European best practice guidance as the primary guidelines for Pathway 2 technologies in Queensland:

- Best Available Techniques Reference Documents (BREF) for Waste Incineration
- BREF for Waste Treatment (includes anaerobic digestion and solid and liquid fuel production).

The current BREF for Waste Incineration was adopted in 2006. An updated version has reached the final draft stage, and is expected to be adopted later in 2019. The updated BREF is based on extensive operational data from incineration facilities across Europe, whereas the current BREF was developed on the basis of 'expert advice'. The BREF for Waste Incineration covers, among other things, limits on emissions to air and water, and requirements for treatment of wastes (e.g. fly ash and bottom ash) from thermal processes.

It is proposed to adopt the updated 2019 BREF in Queensland for thermal EfW technologies under Pathway 2. This would align with the proposed Pathway 2 requirement to present operational data from a reference facility processing similar waste at a similar scale and under a similar regulatory framework.

⁵ More information on this agreement is available on the Australian Government website at <https://www.environment.gov.au/about-us/esd/publications/intergovernmental-agreement>

Once a technology approved under Pathway 2 has become established within Queensland and standard guidelines, controls and regulatory processes have been developed, the technology can transition to Pathway 1 and any future proposals based on the same technology would be assessed under Pathway 1. Environmental controls (e.g. limits on air emissions) established through the Pathway 2 process will continue to apply under Pathway 1 as part of standard guidelines and approval conditions for that technology. A technology would be regarded as being established (and thus eligible to transition to Pathway 1), once it has been lawfully operating under an environmental authority in Queensland for a period of time.

Requirements under Pathway 3 will allow proponents to demonstrate their technology's performance, and manage risks using clear, time-bound limitations on the scale, feedstock and siting and environmental emissions for Pathway 3 facilities. The demonstration conducted under Pathway 3 will create an evidence base which would enable an informed, case-by-case decision to be made on whether the technology should progress to Pathway 2.

The application of the BREF to Pathway 3 proposals would be determined on a case-by-case basis.

Question

8. Do you agree that the European BREF for Waste Incineration and BREF for Waste Treatment are appropriate guidance documents for Pathway 2 technologies? Why/why not?

Case study: Australian Paper - proposed EfW facility in Victoria

In November 2018, Australian Paper received a Works Approval from the Environment Protection Authority Victoria (VIC EPA) for a proposed EfW facility at its Maryvale site. The proposed facility is based on moving grate combustion technology and would process up to 650,000 tonnes per year of residual MSW as well as C&I waste. The project will require a series of further approvals, including an operating licence from the VIC EPA. However, the works approval is a significant step towards the establishment of a largescale EfW facility for mixed waste in Victoria.

The Australian Paper proposal made use of the BREF for Waste Incineration in their design, in order to demonstrate acceptable environmental performance. The VIC EPA also considered the proposed EfW facility against the BREF for Waste Incineration, and the European Union Industrial Emissions Directive. Alignment with these internationally accepted best practice guidelines gave the VIC EPA confidence to issue the works approval.

Planning approvals for EfW Facilities

Proposed principles

Principle 7. Queensland needs a clear, consistent and well-informed assessment process for new waste technologies.

Rationale

In Queensland, there are several assessment pathways and associated legislative frameworks for seeking planning and environmental approvals for waste and resource recovery infrastructure. Depending on the proposed activity, the assessment pathway can include a number of legislative requirements under different Acts, as well as a range of local and state planning instruments.

A significant EfW proposal, such as large-scale combustion of residual waste, could be approved under one of the following pathways:

- Assessment of development under the *Planning Act 2016* by local government under the local planning scheme and concurrent assessment by a state agency, likely to be the State Assessment and Referral Agency (SARA), of state interests triggered by the development.
- Assessment of development under the *Economic Development Act 2012* for projects located in a 'Priority Development Area'.
- Assessment of development under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) for projects located in a State Development Area.

In addition to obtaining development approval, an EfW project will also likely require other approvals including an environmental authority under the *Environmental Protection Act 1994*.

Under the SDPWO Act, an application may be made to the Coordinator-General to declare a 'coordinated project'. The Coordinator-General decides whether a proposal meets the criteria to be declared a coordinated project requiring an environmental impact statement or impact assessment report, and then issues an evaluation report, which serves to streamline the subsequent approvals processes identified in the scenarios above.

There are concerns from industry with respect to the various assessment pathways available, each requiring different processes, public consultation and involvement from different levels of government with varying understanding of EfW technologies. Lengthy assessment timeframes, uncertainty in obtaining approval and encroachment issues from sensitive land uses are significant deterrents for future investment in EfW projects and infrastructure.

The complexity and uncertainty surrounding the assessment pathways specific to EfW projects poses a deterrent to the development of an EfW industry in Queensland, and to Queensland's ability to effectively manage waste and recover resources during the transition to a circular economy. There is currently no clear guidance for proponents to identify the most appropriate assessment pathway for EfW projects.

The success or failure of major EfW proposals will have significant implications for the state-wide Waste and Resource Recovery Infrastructure Plan currently being developed as part of the waste strategy. In this context, greater state coordination and involvement in the assessment of significant EfW proposals under Pathway 2 would be beneficial. However, Queensland's planning legislation does not currently identify objective triggers for state coordination of the approval process for EfW facilities.

The waste strategy, and the Resource Recovery Industries 10-year Roadmap and Action Plan (the Roadmap) have both identified actions to review the Queensland planning and assessment framework to address the complexity and uncertainties for waste and resource recovery proponents (including EfW proponents). This broader review will determine whether any changes are required to the existing assessment pathways for EfW proposals. The EfW policy will aim to provide greater clarity and guidance around the existing planning and approvals processes for proposals under EfW Pathways 1 to 3, and will be updated if necessary to incorporate any recommendations from the broader review.

Questions

9. What aspects of the current planning and assessment framework do you think require clarification?
10. How can the planning process support effective community engagement?
11. What role should the government play in assessing significant EfW proposals?

Community engagement

Proposed principle

Principle 8. Proponents of EfW facilities must demonstrate that they have engaged appropriately and transparently with communities impacted by the proposed facilities.

Rationale

EfW can be a particularly contentious topic in communities and it is essential that the right stakeholders are involved in project decision-making appropriately, considerately and authentically. This is particularly critical for technologies under Pathway 2, which operate at a significant scale but are not yet well understood by the Queensland community. There is a very real risk that ineffective community consultation could result in technically-, and environmentally-sound EfW proposals being rejected, cancelled or delayed, resulting in missed opportunities for Queensland to recover resources and meet its ambitious landfill diversion targets.

Proposed principles of engagement

It is proposed that all EfW projects classed under all EfW pathways must undertake community consultation, following principles of engagement shown in Table 8.

Table 8: Proposed principles of engagement

Principle	What this means in practice
Community engagement will be authentic and transparent.	It will be clear which decisions can be influenced by community input and which cannot. The results of community engagement will be communicated back to the community – engagement will 'close the loop'. Information will be shared transparently with the community in a manner that encourages mutual trust.
Community engagement	Engagement activities will be as inclusive and accessible as possible and will take into account

will be inclusive.	any specific requirements of community groups with special needs, such as cultural and linguistic diversity, indigenous values or restricted mobility.
Community engagement will be respectful.	Stakeholders and the community can expect to have their concerns actively listened to. Engagement will acknowledge the expertise, perspective and needs of the community and stakeholders. Likewise, expectations of the community are that respect is mutual, and that stakeholders will be open, trustworthy and respectful when taking part in all engagement processes.
People have a right to participate in decisions about matters that affect them.	If a project is going to have an impact on the community, the community has a right to be informed about that project and for their opinions and feedback to be included in decision making. Engagement activities and information sharing will be done in a timely manner that allows appropriate time for consideration and contributions.

Responsibilities

All parties have a responsibility to ensure the engagement principles (Table 8) are adhered to at all stages of the project. Additional responsibilities for engagement are proposed in Table 9.

Table 9: Stakeholder responsibilities for community engagement

State Government agencies	Local government	Proponents
Provide relevant guidance on best-practice community engagement. Work collaborative with local government and community groups to help all stakeholders understand current policies for waste management, resource recovery, energy recovery and environmental protection. Work collaboratively with proponents to review and approve engagement plans, as appropriate for the overall project approval pathway. Facilitate identification and access to appropriate stakeholder groups (within the bounds of relevant privacy legislation).	Work collaboratively with proponents to review and approve engagement plans, as appropriate for the overall project approval pathway. Facilitate identification and access to appropriate stakeholder groups (within the bounds of relevant privacy legislation).	Plan and undertake consultation activities in line with the engagement principles. Ensure local and state government are informed throughout the engagement planning and execution process.

Questions

12. Do you agree with the proposed stakeholder engagement principles and responsibilities? Is there anything you would add or change?

13. How could proponents demonstrate that they have followed the proposed principles of engagement?

14. Should proponents of EfW facilities be required to demonstrate that they have obtained a social licence to operate the proposed facility? How would this be demonstrated?

Case study: Avertas Energy waste-to-energy facility, WA

Australia's first modern thermal waste-to-energy facility for mixed residual waste commenced construction in 2019, with expected completion by 2021.

The project reached financial close in October 2018. It was privately funded with \$275 million equity from Macquarie Capital and Dutch Infrastructure Fund and \$400 million debt including \$90 million from the Clean Energy Finance Corporation. The project reached financial close without a confirmed solution for bottom ash reuse, supported by a \$23 million grant funding from Australian Renewable Energy Agency to validate suitable bottom ash reuse opportunities which will be new for Australia. Confirmed waste supply contracts from four local councils were critical to the project reaching financial close.

The project will:

- Divert 400,000 tonnes per year of MSW and C&I waste from landfill, equivalent to approximately one quarter of Perth's residual waste
- Generate 36MW net electricity
- CO2 emissions reduction of approximately 400,000 tonnes per year compared to landfilling
- Increase investment and employment in the region
- Be sited in a major industrial precinct 40km south of the Perth CDB.



Photo 3: Artists impression of the Avertas Energy facility in Kwinana

Join the discussion

It is believed that EfW has a role to play in helping Queensland to achieve its ambitious landfill diversion targets of 90 percent of waste by 2050, during a broader transition to a circular economy. To provide clarity and certainty around EfW in Queensland, several high-level policy principles have been proposed to guide the development of EfW facilities in Queensland. The proposed principles will, among other things, minimise risks of harm to human health and the environment, and help to ensure that EfW does not undermine higher order reuse and recycling, and that proponents understand the importance of obtaining social licence to operate EfW facilities.

Your feedback is invited on the proposed policy principles, through the specific consultation questions summarised below.

Proposed principles

Principle 1: A risk-based approach will be used to guide and manage the development of EfW infrastructure.

Principle 2: The Queensland Government must consistently apply the waste hierarchy. Regulation and policy must ensure that energy recovery does not undermine recycling, and that disposal does not undermine appropriate energy recovery.

Principle 3: Energy recovery is only appropriate for residual wastes which it is not practically or economically viable to recycle.

Principle 4: The composition of residual waste will change over time as recycling improves and Queensland transitions to a circular economy. EfW facilities must be designed to accommodate this change.

Principle 5: To be considered genuine energy recovery, thermal EfW facilities must meet a minimum energy efficiency threshold that is consistent with international best practice.

Principle 6: Queensland should adopt international best practice standards and guidelines for managing the environmental impacts of EfW technologies.

Principle 7: Queensland needs a clear, consistent and well-informed assessment process for new waste technologies.

Principle 8: Proponents of EfW facilities must demonstrate that they have engaged appropriately and transparently with communities impacted by the proposed facilities.

Consultation questions

1. Do you agree that energy should be extracted from residual waste materials rather than disposing of those materials to landfill, if there are no other available alternatives for reusing or recycling the waste materials?
2. Does the proposed three-pathway framework for EfW technologies provide an appropriate, risk-based approach? What additional or alternative characteristics of EfW proposals should be considered?
3. How should a proposal or technology type transition from Pathway 3 (demonstration) to Pathway 2?
4. What role should facility operators, collection contractors and local councils be expected to play in ensuring that only appropriate residual waste is accepted for energy recovery?
5. What should the requirements be for safeguarding current and future resource recovery? Does the solution involve segregation, pre-processing or both?
6. Should the Queensland Government ban specific materials from landfill, or from both landfill and EfW facilities?
7. Should thermal EfW processes be required to meet the European R1 Criteria? Why/why not?
8. Do you agree that the European BREF for Waste Incineration and BREF for Waste Treatment are appropriate guidance documents for Pathway 2 technologies? Why/why not?
9. What aspects of the current planning and assessment framework do you think require clarification?
10. How can the planning process support effective community engagement?
11. What role should the government play in assessing significant EfW proposals?
12. Do you agree with the proposed stakeholder engagement principles and responsibilities? Is there anything you would add or change?
13. How could proponents demonstrate that they have followed the proposed principles of engagement?
14. Should proponents of EfW facilities be required to demonstrate that they have obtained a social licence to operate the proposed facility? How would this be demonstrated?

Make a submission

Submissions are encouraged from interested parties. You can provide your feedback on the consultation questions by:

Email: wastepolicy@des.qld.gov.au

Mail: Energy-from-waste paper
Office of Resource Recovery
Department of Environment and Science
GPO Box 2454, Brisbane QLD 4001

Submissions are due by 5pm on Monday 26 August 2019.

Appendix 1: Stakeholders consulted

Group	Stakeholder consulted
Environmental advocacy	Boomerang Alliance National Toxics Network
Peak bodies	Australian Organics Recyclers Association (AORA) Local Government Association of Queensland (LGAQ) Queensland Water Directorate Timber Queensland Tyre Stewardship Australia (TSA) Waste Management and Resource Recovery Association of Australia (WMRR) Waste and Recycling Industry Association of Queensland (WRIQ)
Waste management and resource recovery industry	Cleanaway Energy Developments Pty Ltd (EDL) JJ Richards & Sons REMONDIS ResourceCo
Energy industry	Energy Queensland
Federal Government	Australian Renewable Energy Agency (ARENA) Clean Energy Finance Corporation (CEFC) Commonwealth Scientific and Industrial Research Organisation (CSIRO) Department of Environment and Energy
State Governments	New South Wales Environment Protection Authority (NSW EPA) South Australia Environment Protection Authority (SA EPA) Environment Protection Authority Victoria (EPA VIC) Department of Environment, Land, Water and Planning (DELWP), Victoria
Local Government	Brisbane City Council Townsville City Council
Academia	University of Southern Queensland