Waste to Energy

Regulatory Impact Statement for Victoria's waste to energy cap and cap licensing

December 2023

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Abbreviations and Definitions

AEMO	Australian Energy Market Operator
ACCC	Australian Competition and Consumer Commission
BRV	Better Regulation Victoria
Cap Licensing Framework	Proposed cap licencing framework to be administered by Recycling Victoria
CBA	Cost-benefit analysis
CE	Circular Economy
Circular Economy Policy	*Recycling Victoria: A new economy* (Department of Environment, Land, Water and Planning, 2020)
C&I waste	Commercial and Industrial waste
C&D waste	Construction and Demolition waste
CE Act	*Circular Economy (Waste Reduction and Recycling) Act 2021*
CDS Vic	Victoria's Container Deposit Scheme
CO_2	Carbon Dioxide
DEECA	Department of Energy, Environment and Climate Action
DTP	Department of Transport and Planning
ELA Act 2022	*Environment Legislation Amendment (Circular Economy and Other Matters) Act 2022*
ELA Act 2023	*Environment Legislation Amendment (Circular Economy and Other Matters) Act 2023*
EO	Existing operator
EOI	Expression of Interest
EPA	Environment Protection Authority Victoria
EP Act	*Environment Protection Act 2017*
EPA permissions process	Regulatory licensing process administered by the EPA for high-risk activities (including waste to energy operations) provided under the *Environment Protection Act 2017*
EU	European Union
FOGO	Food Organics and Garden Organics, or green waste
GWP	Global warming potential
HDPE	High-density polyethylene, a plastic
LDPE	Low-density polyethylene, a plastic
MAV	Municipal Association of Victoria
MCA	Multicriteria Analysis
MSW	Municipal Solid Waste
MWh	Megawatt-hours
NPV	Net Present Value
NSW	New South Wales
PET	Polyethylene terephthalate, the most common thermoplastic polymer resin

PP	Polypropylene, a thermoplastic polymer
PS	Polystyrene, a synthetic polymer
PVC	Polyvinyl Chloride, a type of plastic
RIS	Regulatory Impact Statement, this document
RV	Recycling Victoria, (the Regulator)
SL Act	*Subordinate Legislation Act 1994*
SV	Sustainability Victoria
SV Act	*Sustainability Victoria Act 2005*
SWRRIP	Statewide Waste and Resource Recovery Infrastructure Plan
TEEP Test	Technically, environmentally and economically practicable Test
The existing Regulations	*Circular Economy (Waste Reduction and Recycling) (Waste to Energy Scheme) Regulations 2023*
The Framework	Victorian Waste to Energy Framework, 2021
The proposed Regulations	Circular Economy (Waste Reduction and Recycling) (Waste to Energy Scheme) Amendment Regulations 2023
The Regulator	Recycling Victoria
VWPM	Victoria's Waste Projection Model
VPA	Victorian Planning Authority
VRET	Victoria's Renewable Energy Targets
VRIP	Victorian Recycling Infrastructure Plan
WtE	Waste to Energy
WtE Scheme	Part 5A (Waste to Energy Scheme) in *Circular Economy (Waste Reduction and Recycling) Act 2021* (CE Act)

Executive summary

Victoria's Waste to Energy Scheme and the proposed Regulations

Victoria is in transition to a sustainable and thriving circular economy, where we maximise value extracted from material resources, minimise waste and encourage reuse, repair and recycling. In a circular economy waste to energy (WtE) is an opportunity to extract value from materials that would otherwise go to landfill. Under Victoria's Waste to Energy Scheme (WtE Scheme), only those wastes comprising permitted or exempt waste that cannot reasonably be further sorted or recycled are permitted for use in thermal WtE facilities. The WtE Scheme supports appropriate WtE investment that avoids risks to the circular economy transition and keeps Victoria on track towards its target of net zero emissions by 2045.

To prevent over-reliance on WtE as we move towards a circular economy, Victoria's WtE legislation provides for a cap on the amount of waste that can be thermally processed through new or expanded licensed WtE facilities. The cap complements strategies that reduce waste and increase recycling in the long term, enabling the right mix of investments and innovation in Victoria's transition to a circular economy. The Circular Economy (Waste Reduction and Recycling) (Waste to Energy Scheme) Amendment Regulations 2023 (the proposed Regulations), assessed in this document, will set the level of the cap and support licensing of thermal WtE facilities under the cap. The Victorian Government is setting the cap at one million tonnes per year, with the analysis in this document providing the rationale for the limit.

The proposed Regulations will be made under the *Circular Economy (Waste Reduction and Recycling) Act 2021* (CE Act). The proposed Regulations build on Circular Economy (Waste Reduction and Recycling) (Waste to Energy Scheme) Regulations 2023 (the existing Regulations) that support licensing of WtE facilities that had planning and/or environmental approvals in place prior to November 2021. The existing Regulations commenced on 1 June 2023.

Under the CE Act, thermal WtE operations processing permitted waste are required to hold a licence. The WtE Scheme provides for two types of WtE licences:

- Existing operator (EO) licences are reserved for thermal WtE operators that are either operating already or had appropriate approvals in place before November 2021. EO facilities are not required to fit within the WtE cap limit that is set in the proposed Regulations.
- Cap licences will be required for any new thermal WtE operators intending to process permitted waste in Victoria, including expansions to existing operations. Cap licence operations are required to fit within the cap limit.

The proposed regulations support the WtE Scheme cap licensing system by:

- setting a cap limit on the total amount of permitted waste that can be thermally processed through new or expanded WtE facilities each year
- setting out aspects of the Expression of Interest (EOI) and cap licence application processes
- setting the fees that are relevant for different application types, and
- specifying matters that the Head, Recycling Victoria (RV) must consider when determining whether to issue a cap licence.

The Regulatory Impact Statement assessment

Under the *Subordinate Legislation Act 1994* (SL Act), a Regulatory Impact Statement (RIS) must be prepared for any proposed regulations, unless criteria for an exemption are met, so that those potentially impacted by the proposed regulations have an opportunity to review and provide feedback on them.

This RIS has been prepared in accordance with the *Victorian Guide to Regulation* (2016), which provides a best-practice approach to analysing any proposed regulatory intervention. This RIS estimates the impact of the proposed Regulations on Victorian businesses, the community and environment.

Assessment of options for the cap limit

The key problem the WtE Scheme seeks to address is how to strike the right balance in support for appropriate WtE investment in Victoria and also long term circular economy and emissions reductions outcomes. Too little investment in thermal WtE miss opportunities to reduce our reliance on landfill and

generate value from our waste materials. Conversely, over-investment or over-reliance on thermal WtE in the short term has the potential to undermine long-term improvements in waste avoidance and recycling and could result in lost potential benefits for maintaining material value in the economy, reducing virgin material extraction and reducing emissions.

As such, the most significant impact of the proposed Regulations is likely to result from the investment which is simultaneously enabled and constrained by the level of the cap. The impact of the proposed Regulations has been estimated relative to a counter-factual base case scenario where no cap licences are issued – where the cap is effectively zero and only EO are licensed to operate under the WtE Scheme. The RIS explores the relative costs and benefits of three alternative cap levels noted below. Note that for the purpose of the analysis, EO licences in the base case are assumed to total one million tonnes of permitted waste and this processing capacity will be developed in the coming two financial years. This assumption is used for the purpose of the analysis only and does not predicate any licensing decisions that are yet to be made by the Head, Recycling Victoria

The three cap limit options assessed against the base case in this RIS are:

- Option 1: Cap of 500,000 tonnes
- Option 2: Cap of 1,000,000 tonnes
- Option 3: Cap of 2,000,000 tonnes.

The assessment focuses on five key impacts of a limit on the use of WtE to process permitted waste in Victoria, in line with how well they address the key problem and support the achievement of Victoria's circular economy and waste to energy policy objectives:

- increasing the value of waste managed in Victoria
- avoided use of virgin materials through increased material recovery and reuse/recycling
- avoided use of landfill
- net effect on greenhouse gas emissions
- financial, distributional and other impacts.

The quantitative and qualitative analysis in the RIS demonstrate that Option 2, a cap of 1,000,000 tonnes, achieves the best balance of outcomes against these five criteria. Option 2 maximises outcomes for waste flows in a circular economy resulting in a strong balance of incentives to facilitate future investment in recycling capacity, technology development and innovation, ensuring that this option aligns most closely with the objectives of the regulations and Victoria's circular economy policy.

The Department notes that there is significant uncertainty about future developments in the waste sector, especially in the long term. In addition, there are significant data limitations in the present which, require the use of a range of assumptions and which preclude the development of a precise and accurate model of impacts out to 2050. Therefore, the Department has endeavoured to estimate key impacts while acknowledging that the analysis is imprecise and should be considered indicative of the expected impacts, rather than a precise forecast of the expected impacts.

Figure B shows total permitted waste feedstocks available for use in thermal WtE facilities in Victoria under the three cap options over the period to 2050. It shows that in a scenario where resource recovery continues to improve at a modest rate, there is sufficient feedstock for Options 1 and 2, a 500,000 tonne and 1,000,000 tonne cap respectively, but insufficient feedstocks for a 2 million tonne cap under Option 3 over the period of the analysis.

To set a cap at that level would risk sending materials to WtE that could otherwise be used in higher order recovery in future years. This option could lock in a higher level of WtE infrastructure, which leads to a lack of commercial opportunity or incentive for other recycling infrastructure to be established that could have been established in the base case. In this way, in the Figure B, the gap between the 'Option 3, a 2m tonne cap' line and the 'Base case permitted and exempt feedstock' line could be interpreted as potential 'avoided recycling' or future 'lost opportunity for recycling'. This is shaded in black to illustrate the gap clearly.

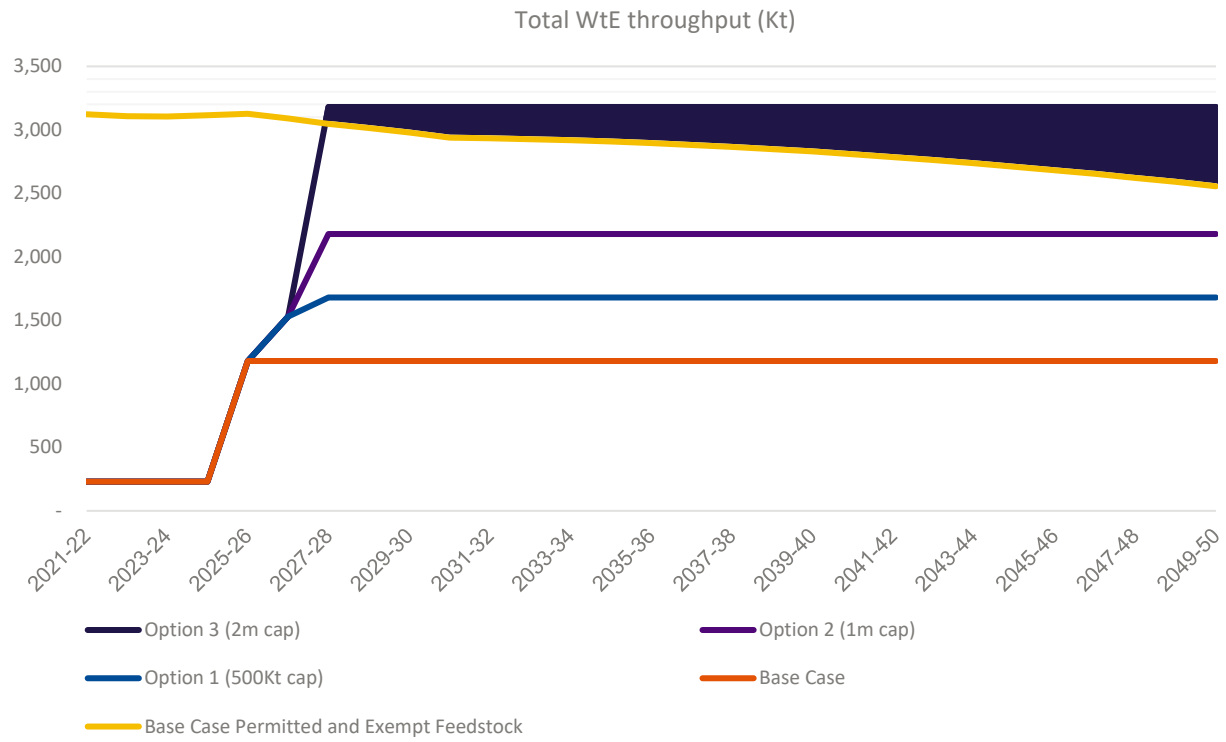

Figure EA: Available, suitable waste feedstocks for thermal WtE facilities compared to total Victorian thermal waste to energy processing capacity under the three cap options until 2050

That future lost opportunity for recycling carries economic and environmental impacts associated with the need to extract and manufacture virgin materials in place of recycled content. That includes impacts in greenhouse gas emissions, energy use, land use and degradation, and water use. The analysis finds that Option 3 is expected to result in 4,445km^2 of additional land use, and 82.6 GL of water use up to 2050 compared to the other two Options.

Options 1,2, and 3 are respectively expected to avoid about 7,900 m^3, 15,600 m^3, and 25,400 m^3 of landfill airspace up to 2050. However, due to the expectation that recovery rates increase over time, the landfill airspace savings of Option 3 decline over time, while remaining steady for Options 1 and 2. Sensitivity testing for this comparative analysis demonstrates that, under a scenario where recovery rates improve at only a slightly greater rate than forecast under the central assumption scenario, Option 2 and Option 3 may offer near equal benefits for landfill diversion in the latter years of the modelling.

The greenhouse gas emission impacts of waste to energy facilities relative to landfill or various forms of recycling depends on the waste material types, the processing technology, and the emissions of the alternative waste management or energy generation processes. The qualitative analysis in this RIS finds that all of those factors are subject to significant uncertainty given trends in innovation in both waste and energy sectors over the coming decades. The quantitative analysis estimates that Options 1, 2 and 3 are respectively expected to lead to avoided emissions of 5.2Mt, 10.2Mt, and 19.6Mt of CO_2-e respectively. The analysis indicates that these results are sensitive to the mix of feedstock used for WtE (primarily organics, paper and plastic), the alternative fate of the feedstock if it were not used for WtE (either landfill or recycling) and the technology used in processing.

Different sectors experience different impacts from different cap levels. A higher cap level leads to increased revenue for the WtE sector, but correspondingly lower revenue for the landfill and energy generation sectors. In addition, the greater the diversion from landfill, the less the Government receives in landfill levy; however it is the Government's policy to minimise the use of landfill as far as possible, due to the negative externalities and economic inefficiencies associated with landfill. Under Option 3 only, recycling facilities are expected to also lose out on some revenue.

Assessment of options for application fees

In addition to exploring impacts of the level of the cap, this RIS assesses fees applicable to cap licensing, which would enable RV to recover reasonable costs from WtE proponents, for regulatory services provided. The RIS assesses options for fees that partially cover regulatory costs associated with cap licensing, in line with the pricing principles in Victoria's *Pricing for Value* (2021) guide. Three options were identified for the fee structure for the cap licensing scheme, for assessment against the base case of no cap licensing and no prescribed fees. Across these three options, only one fee structure has been considered for the EOI and applications to decrease a cap allocation, whereas the fee structure for the cap licence application differs under each option as follows:

- Option 1: One flat fee would be prescribed for cap licence applications.
- Option 2: Fees for cap licence applications would be differentiated based on facility size. Two fee levels would be prescribed for cap licence applications – a lower fee for small facilities and a higher fee for large facilities.
- Option 3: Fees for cap licence applications would be applied as a percentage of the value of development costs up to a capped amount. Development costs would represent a proxy for scale and complexity of facilities and the corresponding higher level of effort and oversight required by RV to assess cap applications.

Table E1: Proposed fees

	Cap licence application	
	Fee units	*2023-24 fee*
Cap licence application	1,045 (small facility) 2,095 (large facility)	$16,615.50 $33,310.50
Expression of interest	780	$12,402
Application to decrease cap	390	$6,201

The analysis finds that the preferred option is for differentiated cap licence application fees between large and small applications, on an assessment three criteria of a fair distribution of costs, not unduly creating barriers to entry, and simplicity to implement and understand.

This RIS does not assess the proposed prescribed matters that the Head, Recycling Victoria must consider when making determinations. These mandatory considerations are detailed in the proposed Regulations and listed in Chapter 5. Specific requirements for proponents submitting EOIs or licence applications will be set by Recycling Victoria and will necessarily be informed by the final regulations; therefore assessment of associated impacts is out of scope of this RIS. However, feedback on the proposed mandatory considerations is welcome.

Implementation and evaluation

Implementation and evaluation phases will follow public consultation on this RIS. The implementation phase includes producing a consultation summary for public consumption, incorporating feedback into the regulations, and implementing in stages between February 2024 and quarter 3 in 2025. Evaluation is a requirement of all Regulations in Victoria. A two-step evaluation process is proposed, both qualitative and quantitative to better understand whether the proposed Regulations result in the impacts sought. The two-step evaluation process acknowledges that a mid-point impact evaluation may not result in any meaningful data given the likely lead time from WtE planning to operation.

Background

WtE can refer to any technology applied to waste to generate useful energy resources such as heat, electricity, gas and liquid fuels. It includes thermal treatments which can generate heat, steam, fuels and electricity from combustible waste, and biological technologies such as anaerobic digestion which create biogas and organic residues from organic wastes.

This RIS concerns thermal WtE, which is defined in section 74(M) of the CE Act (pp. 100-101) as a thermal process used:

- to recover energy from waste in the form of heat (which may be converted to steam or electricity), or
- to produce fuel from waste.

Waste to Energy in Victoria's waste system

WtE technologies can play a useful role in an integrated waste and resource recovery system. Recovering energy from residual waste contributes to a circular economy by reclaiming energy from materials that would otherwise be sent to landfill with limited benefit, and allowing businesses to generate more value from the materials they manage.

Victoria's landfill capacity is becoming more constrained, particularly in metropolitan Melbourne, as a result of population growth, greater demand for resources and an increase in waste generation. Increases to Victoria's landfill levies drive investment in innovative technologies and alternatives to landfill, such as recycling and waste to energy.

As Victoria shifts towards a circular economy, and as part of a comprehensive policy approach (described below), WtE facilities can support diversion of waste otherwise destined for landfill. Generating energy from waste can be better than sending waste to landfill, once valuable recyclable materials have been removed.

Thermal Waste to Energy technologies

There are a range of thermal WtE processes used to generate energy from waste.

The CE Act defines Thermal WtE as a process used to recover energy from waste in the form of heat, which may be converted to steam or electricity; or to produce a fuel from waste. This includes combustion, gasification and pyrolysis.

Combustion is the thermal oxidation of waste to produce heat, which may then be used to produce steam or electricity. It is important to note that combustion without energy recovery is not considered as thermal WtE under the Act.

Pyrolysis generally occurs at temperatures of between 400 and 1000 degrees Celsius, in the absence of oxygen. In a pyrolytic process, heat causes a thermochemical decomposition and chemical transformation of the waste product into a non-condensable gas, condensable liquid, or solid residual coproduct, such as biochar or charcoal.

Gasification generally occurs at higher levels than pyrolysis, at between 1000 to 1500 degrees Celsius. Gasification requires oxygen or steam to break down molecules into a syngas, a synthesis of hydrogen and carbon monoxide, which are principally used in the production of ammonia or methanol, liquid fuels, acetic acid and lubricants.

Waste to Energy in Victoria's energy market

WtE will play a small role in the overall Victorian energy system by providing an alternative source of electricity generation. One of the key advantages of WtE currently is its ability to generate electricity with a net lower carbon intensity than Victoria's grid. This means that, typically, for every kilowatt generated using power from

a WtE facility, there are fewer carbon emissions compared to if the electricity had been sourced from the grid, and the waste decomposed in landfill. The emissions benefits from offsetting grid electricity depends largely on the emissions intensity of the offset electricity and the counterfactual emissions associated with the same waste in landfill. For example, if thermal WtE offsets brown coal, the benefit would be more material than offsetting low emissions electricity.

While thermal WtE is expected to make a relatively modest contribution to the overall Victorian energy system, it can still play a role in supporting Victoria's electricity grid through additional generation capacity. WtE provides a dispatchable electricity supply that can completement increasing intermittent supply from other sources.

Some WtE facilities provide advantages behind the meter (e.g. be set up on site with industry to provide energy without having to be connected to Victoria's electricity or gas networks), allowing them to be strategically developed, particularly where gas is consumed for industrial processes. This localised development may reduce transmission losses in the energy system. Additionally, WtE facilities have the potential to produce fuels that can be utilised for transport, including applications in road freight, aviation and shipping.

The relative emissions benefits of generating electricity from WtE compared to other technologies in the grid will change over time. As the carbon intensity of the grid declines due to increased renewable energy adoption, the emissions advantage of WtE may decrease, depending on the nature of the WtE technologies deployed in Victoria. This is discussed in the following Problem chapter.

Existing waste to energy facilities in Victoria

There are a small number of EO's that, subject to applications being determined by the Head, Recycling Victoria, may operate under the WtE Scheme. Under the existing Regulations existing operators are thermal WtE facilities that have had appropriate approvals prior to 1 November 2021. This includes a licence or permit, however described, issued or granted under the *Environment Protection Act 2018* (EP Act) or the *Planning and Environment Act 1987* (P&E Act). Subject to issue of EO licences by Recycling Victoria under the existing regulations, these facilities would continue to operate, or commence operation, up to their approved volumes. In total, approximately 1,000,000 tonnes per annum may be included in EO licences. These volumes are not subject of the cap proposed in the proposed regulations.

There are several other facilities processing biomass to produce bioenergy in Victoria currently. These may be excluded from WtE Scheme licensing requirements either because the waste they process is treated as exempt waste under the CE Act, or the technology is not considered to be thermal WtE under the CE Act.

Processing of specific agricultural biomass or biosolids waste streams is often referred to as renewable bioenergy. In 2023, in an effort to extend bioenergy production, the Victorian Government granted $8 million dollars from the WtE - Bioenergy Fund to support twenty-four projects with the potential to add 6.82 megawatt-hours to Victoria's renewable energy capacity.

Social and environmental considerations for waste to energy

Community consultations on WtE policies and projects in Victoria show that some residents and community groups hold concerns that WtE facilities could bring local health and environment impacts and are strongly opposed to the development of WtE facilities. Some of these individuals and groups oppose all WtE developments in Victoria, while others oppose individual facility proposals in their communities, and seek government intervention to limit the development of WtE facilities.

Impacts to human health and the environment associated with WtE facilities are the primary consideration of the EPA when considering licence applications under the EP Act. The EPA engages the community to inform key decisions on permissions, including on development licenses. For WtE proponents to demonstrate a social licence to operate, this needs to be gained through building trust through consultation and engagement with the relevant community. Proponents should demonstrate international best-practice environment protection systems and explain the benefits of their facility compared to landfill.

Victoria's circular economy policy and objectives

In early 2020 the Victorian Government released *Recycling Victoria: A new economy* (Department of Environment, Land, Water and Planning, 2020) (circular economy policy), a 10-year circular economy policy and action plan. It contains a suite of complementary initiatives to reform Victoria's waste, recycling and resource management into a robust, innovative and progressive system. The Victorian Government has invested $380 million to deliver this policy and transform how Victoria's economy uses materials, designs out waste and provides avenues for new investment in the sector.

The circular economy policy commits to achieving 80% diversion of waste from landfill by 2030, and to reduce waste generation by 15% per capita by 2030, through prioritising activities in line with the waste hierarchy. This includes supporting communities and councils to reduce waste, such as through education and behaviour change campaigns. The policy recognises the role of WtE in complementing other outcomes under the waste hierarchy, reflecting the importance of waste minimisation and acknowledging the environmental benefits of recycling over converting WtE.

Through its circular economy policy, Victorian Government recognises a role for WtE investment, where projects:

- meet best-practice environment protection requirements including air pollution controls
- reduce the amount of waste sent to landfill and do not displace reuse or recycling
- do not inhibit innovation in reuse or recycling of materials
- meet best-practice energy efficiency standards
- reduce greenhouse gas emissions compared to the waste and energy services they displace
- have sustainable business models that create jobs and economic development, and
- work well with local communities in which they operate (Department of Environment, Land, Water and Planning, 2020; 2021).

The Circular Economy Hierarchy

Where waste does arise from the production and use of products and materials, it should be managed in the following order of preference—

(a) waste should be avoided

(b) waste should be minimised

(c) waste should be reused

(d) waste should be recycled

(e) energy and other resources should be recovered from waste

(f) waste should be treated so as to reduce the potential impacts of degradation,

(g) waste should be disposed of.

(CE Act, pp. 16-17, s. 8)

The policy identifies the risk of over-investment in WtE infrastructure in the short term, which could undermine higher order objectives enshrined in the circular economy hierarchy in the CE Act. The circular economy hierarchy acknowledges the importance of reducing reliance of virgin materials and, where appropriate, substituting virgin materials with recycled content to achieve better environmental outcomes.

WtE can play an important role in Victoria's circular economy, but should not displace waste avoidance, minimisation, reuse or recycling. To this end, the Victorian Government committed to develop a WtE Scheme, and to:

> *plan for waste to energy facilities as part of the Victorian Recycling Infrastructure Plan, to provide policy certainty for waste to energy facility proponents. This will include placing a cap of one million tonnes each year until 2040 on the amount of residual waste that can be used in thermal waste to energy facilities. The cap will be implemented through new rules which will be given effect by legislation or regulations* (Department of Environment, Land, Water and Planning, 2020, p. 36; Department of Environment, Land Water and Planning, 2021).

Victorian Recycling Infrastructure Plan (VRIP)

The CE Act establishes RV as the regulator for the WtE Scheme. One of RV's core functions is to undertake statewide infrastructure planning for the waste and recycling sector through the development and delivery of the Victorian Recycling Infrastructure Plan (VRIP).

RV is currently preparing the first VRIP to guide planning and investment in waste and resource recovery infrastructure for the next 30 years.

The VRIP will assess and recommend necessary infrastructure, including WtE infrastructure to:

- maximise the reuse, recovery, and recycling of materials
- align with risk management and mitigation initiatives for the waste and recycling system, and
- achieve sufficient waste and resource recovery sector capacity and capability to meet circular economy objectives.

Reforms to municipal waste collection and sorting

The Victorian Government is also reforming the way households recycle. Under the CE Act, Councils and Alpine Resorts Victoria have obligations to adopt a standardised four-stream household waste and recycling system. Services will need to be provided for the following waste streams:

- general rubbish
- mixed recycling
- glass recycling, and
- combined food organics and garden organics (FOGO).

These reforms have been designed to improve separation of materials at source, resulting in less contaminated and higher value resource streams. The system reform will help Victoria meet the diversion target of 80% of waste from landfill. Further, the introduction of separate FOGO services will assist to reduce the volume of organic material going to landfill between 2020 and 2030.

Under Victoria's WtE Scheme, household residual waste that is source separated and placed in the general rubbish or red lid bin is permitted waste that may be directly processed in thermal WtE facilities with an appropriate WtE licence. Mixed recycling, glass recycling and FOGO are all banned wastes that cannot be processed in thermal WtE facilities under the existing Regulations (pp. 6, reg. 8(2)). The one exception is where a thermal WtE process is used to sequester carbon from FOGO in biochar.

Container Deposit Scheme

Victoria's Container Deposit Scheme, (CDS Vic) began on 1 November 2023, fulfilling a key commitment under the circular economy policy.

A container deposit scheme is a form of product stewardship used across Australia and internationally. It places the costs of recovering and recycling beverage containers on the producers and purchasers. Like all Australian schemes, beverage first suppliers are funding Victoria's scheme, and consumers receive a financial incentive to encourage them to return used beverage containers for recycling. The scheme rewards Victorians with a 10-cent refund for every eligible can, carton and bottle they return.

Containers collected through the CDS Victorian refund network are banned from use in thermal WtE facilities in Victoria.

Circular economy contributes to Victoria's greenhouse gas emissions targets

Victoria's *Climate Change Act 2017* (Climate Change Act) establishes a long-term target of net-zero greenhouse gas emissions by 2050, and the Victorian Government has committed to bringing this forward by five years to 2045[1]. The Act requires the establishment of 5-yearly interim emissions reduction targets to keep Victoria on track to meet the Victorian Government's more ambitious long-term target of net zero by 2045. Victoria's interim targets are to have reduced greenhouse gas emissions 15-20% below 2005 levels by 2020, 28-33% by 2025, 45-50% by 2030 and 75-80% by 2035 (Department of Energy, Environment and Climate Change, 2023). To support these goals Victoria has set renewable energy targets (VRET) of 25% renewable electricity generation by 2020, which has been achieved, 40% by 2025, 65% by 2030 and 95% by 2035 (Department of Energy, Environment and Climate Action, 2023).

Achieving the net zero target is supported by sectoral targets for both the waste and energy sectors (Department of Energy, Environment and Climate Action, 2021; 2021). The circular economy policy and action plan is driving emissions reduction for the waste sector, while contributing to meeting the renewable energy target.

Victoria's Waste to Energy Framework

WtE facilities are often large and complex pieces of infrastructure, so their construction and operation are subject to multiple regulatory regimes that address matters including:

- Planning considerations, including appropriate land use, zoning, environmental and local social impacts and resident amenity and traffic are required to be addressed under applications under the Planning and Environment Act1987 (P&E Act).
- Environment, health impacts and social licence are considered as part of pilot or development and operational licence application processes under the Environment Protection Act 2017 (EP Act).
- Energy regulation, including market and network arrangements for the electricity grid, where relevant.

These regulatory frameworks do not adequately manage the complexity and risks associated with waste to energy facilities in the transition to a circular economy. These challenges are described in chapter 1 below. For this reason the Victorian Government developed the *Victorian Waste to Energy Framework* (The Framework, 2021).

The Framework was informed by extensive consultation with the community and industry, reaching more than 500 stakeholders, with 52 detailed submissions received. The Framework reiterated messages from the circular economy policy, including the intention to set a one million tonne cap to encourage investment that supports diversion of residual waste from landfill and avoids risks to recycling outcomes in the future.

The objectives of the Framework (p. 2) are to:

[1] The Climate Change and Energy Legislation Amendment (Renewable Energy and Storage Targets) Bill 2023 was introduced to Parliament on 29 November 2023. If that Bill passes, upon commencement of the relevant provisions the long-term target for net-zero greenhouse gas emissions by 2050 will be amended to 2045.

- encourage investment in facilities that help achieve the goals and targets of the circular economy policy
- support a diverse and competitive WtE market, and
- have a consistent, transparent and fair mechanism.

Circular Economy Act

Part 5A of the CE Act (pp. 98-131) provides the legislative framework for the WtE Scheme. It provides for the processing of permitted waste and exempt waste at thermal WtE facilities in Victoria. It also provides for a cap on new and expanded processing of permitted waste, enabled through a licensing system to be established through regulations. These legislative provisions commenced on 1 June 2023.

The WtE Scheme provides for two types of WtE licences:

- EO licences: reserved for thermal WtE operators that are either operating already or had appropriate approvals in place before November 2021, prior to the introduction of the Framework. EOs are not required to fit within the proposed WtE cap but must not exceed any limits imposed by their EPA permissions.
- Cap licences: will be required for any future thermal WtE facilities intending to process permitted waste in Victoria, or for any expansion of capacity of existing facilities. Cap licence facilities are required to fit within the cap.

Section 74(M) of the CE Act (p. 100) outlines which WtE process are included and excluded from the WtE Scheme. Section 74M(1) outlines that a thermal waste to energy process means a thermal process that:

- recovers energy from waste in the form of heat, which may be converted to steam or electricity, or
- produces fuel from waste, or
- is a thermal waste to energy process prescribed by the regulations.

For the purposes of the WtE Scheme, section 74(M)(2) (p. 100) provides that a thermal WtE process does not include either:

- an advanced recycling process
- a biological WtE process
- landfill gas collection and combustion
- the incineration of waste without energy recovery
- a process that recovers energy from a material other than waste, or
- a process prescribed not to a be a thermal WtE process.

Biological WtE processes create bioenergy, often in the form of gas, from two major waste streams: biosolids or solid organic residues from the biological process of treating wastewater and from treated sewage sludge; and waste biomass, or waste that is biological in origin, including animal and plant matter, wood waste, crop waste and biosolids. The often produce a digestate as a by-product that could be used as an input to other processes, such as composting.

The existing Regulations

The existing Regulations prescribe matters for the purpose of Part 5A of the CE Act (pp. 98-131), and address the issues identified through implementing the existing operator licensing process.

To do so, the legislation provides a basis for implementing the policy objectives from the Framework, including outlining the powers needed to licence WtE facilities in Victoria. The existing Regulations commenced on 1 June 2023, enabling the Head, Recycling Victoria to license EOs. The cap does not apply to these facilities.

The existing Regulations enable these functions by prescribing the:

- licensing process for EO licences, including certain aspects of the application process, issuing of licences and conditions on EO licences, defining thermal WtE process and what process will be exempted from the WtE Scheme
- definitions for:
  - permitted waste as waste that is subject to the WtE cap
  - exempt waste as waste that is not subject to the WtE cap
  - thermal WtE processes that are excluded from the WtE Scheme
- processes for amendment to, suspension and revocation of WtE licences, transfer of WtE licences between operators, and extension of a submission period in response to proposed revocations and suspensions of licences
- fees for regulatory services covered in these regulations, such as application fees for EO licences, and
- the existing Regulations also set out matters applicable to the administration of the WtE Scheme under the CE Act.

Processes that are exempt from the Waste to Energy Scheme

The CE Act and the existing Regulations exclude the following WtE processes for the purposes of the WtE Scheme:

- advanced recycling processes, defined as the conversion of a material or substance to monomer or chemicals intended for the production of polymer materials other than fuels by changing the chemical structure of a material or substance through cracking, gasification, pyrolysis or depolymerisation. For example, a facility processing post-consumer soft plastics back into industrial-quality soft plastics.
- a thermal waste to energy process in respect of which a pilot project licence has been issued and is in force, and
- a process that treats waste biomass through a pyrolysis process or gasification process to sequester carbon. For example, a process that produces biochar that is applied to land.

The CE Act and the existing regulations define and categorise waste that may be processed in thermal WtE facilities in Victoria, as shown in the table and diagram below.

Table 1: Definitions of eligible WtE waste

Permitted waste	Exempt waste	Banned waste
Waste permitted for use in a thermal WtE process in Victoria includes both: • waste permitted for use in thermal WtE process in Victoria is: waste prescribed to be permitted waste in regulations, and • waste that cannot reasonably be the subject of any further sorting or recycling.	Exempt waste does not require a licence to be used in a thermal WtE facility. Exempt waste includes: waste biomass; wood waste; straw, chaff and other waste from agricultural crops; nut hulls and shells; pips, pits and seeds from olives and other fruits; grape marc and other grape processing waste; poultry litter; paunch and abattoir wastes; fruit and vegetable processing waste; and residues from pulp and paper manufacturing and processing that	Banned waste must not be used in thermal WtE facilities in Victoria. It is all waste other than permitted waste or exempt waste, and includes eligible containers for the Container Deposit Scheme, recyclable waste, waste that needs further recycling or sorting, household recycling bin contents, FOGO and waste that has not undergone a proper assessment to determine whether it is recyclable.

	cannot be recycled into new paper products; biosolids and reportable priority waste as described in the EP Act.	

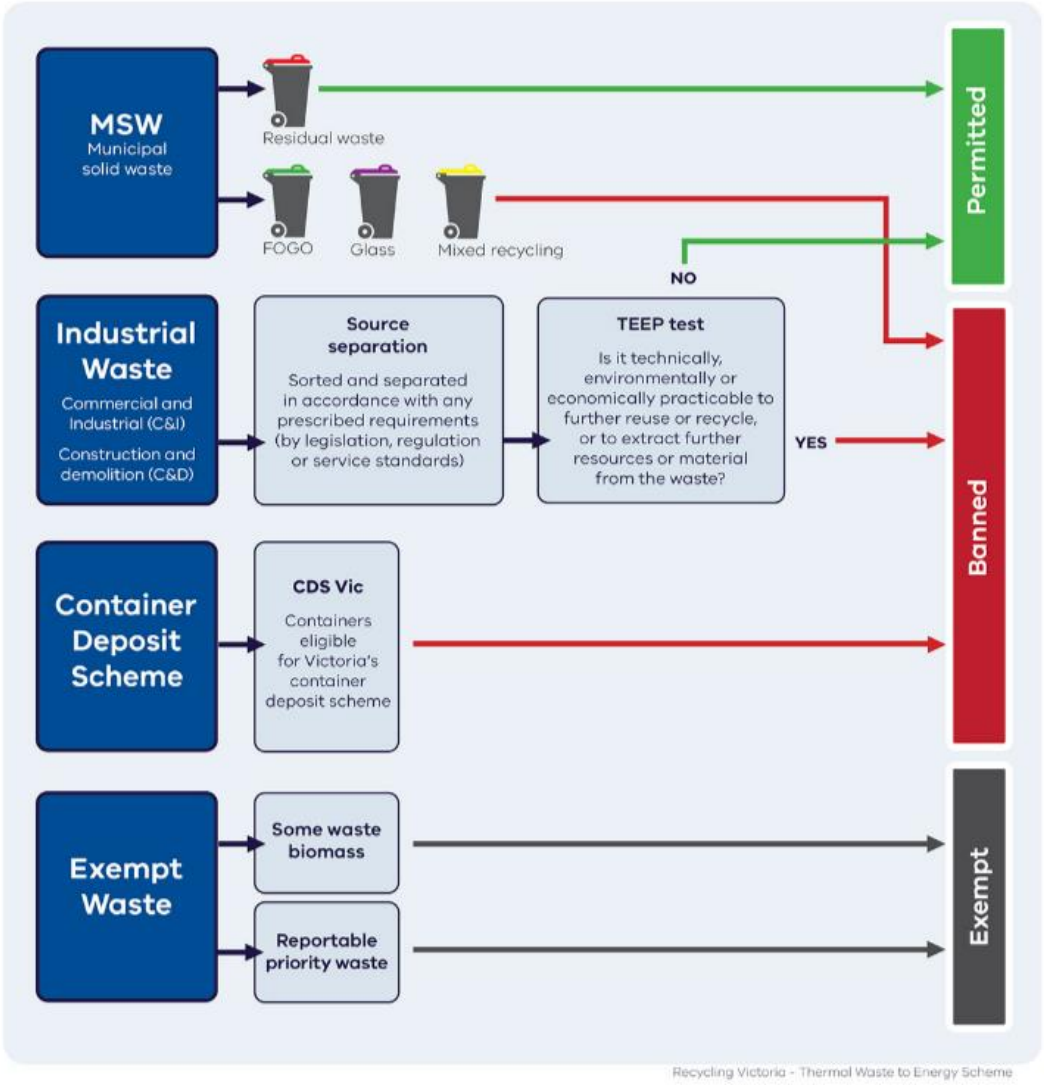

Figure A: Thermal Waste to Energy Scheme

Source: Recycling Victoria, 2023 'Banned' waste

Technical, environmental and economic practicability of recycling over time

Victoria's kerbside collection reforms separate residual waste, that is permitted waste, from recyclable materials, that are banned waste. Outside of the kerbside system, for waste to be permitted, it must be sorted and separated appropriately in line with any prescribed requirements. If no prescribed requirements apply, the operator must apply the 'TEEP test', that is to prove that it is not technically, environmentally, or economically practicable to reuse, recycle or extract further resources or materials from the waste. Alternatively, regulations can but currently do not prescribe when industrial waste is permitted waste.

As recycling technologies and end markets improve over time, it may become viable to recycle some wastes which can't be recycled today. The TEEP test provides an avenue to adapt to innovation and ensure we are reusing and recycling materials where possible, prior to directing them to WtE.

It is and will remain the responsibility of the WtE facility operator to demonstrate that their commercial and industrial (C&I) waste stream satisfies the TEEP test. Pathways for demonstrating that a waste stream satisfies the TEEP test will be included in guidance issued by RV.

The existing Regulations specify how operators may demonstrate that the TEEP test is satisfied. WtE facilities must demonstrate that it is not practicable to reuse, recycle or extract further value from the waste, for example by:

- demonstrating the absence of technology or process for sorting or recycling; or
- demonstrating that legislation prohibits the reuse or recycling of the waste; or
- performing an assessment that compares the environmental impacts of reuse or recycling the waste with the environmental costs of recovering thermal energy from waste, and
- performing an economic analysis that demonstrates that the financial disproportionate costs of available options to reuse or recycle the waste (including transportation costs) are disproportionate to the environmental, social and economic benefits of reusing or recycling the waste. As waste and recycling technologies, sorting processes and infrastructure develop over time, waste streams that currently meet definitions of 'permitted' waste may no longer meet those definitions and instead become 'banned' because they can be further recovered or recycled. This would mean that those waste streams would no longer be allowed to be processed in thermal WtE facilities.

For example, if a WtE facility had been processing waste from a particular waste producer, but then a new recycling facility were to be built with capacity to recycle that waste, then the waste may no longer meet the WtE Scheme's definition of 'permitted' waste and would instead be 'banned'. The WtE Scheme includes such provisions to ensure that WtE facilities do not hamper the development of higher value uses of waste.

WtE licence holders will need to carefully consider their compliance processes and feedstock contracts to ensure that they adequately manage the possibility that permitted waste streams may change to banned status, and to ensure their ongoing compliance with the CE Act.

RV will provide regulatory guidance to assist WtE licence holders to demonstrate that they have undertaken appropriate assessment of the permissibility of their feedstock, in accordance with the CE Act and the existing Regulations.

Chapter 1 Problem analysis

Across Australia and around the world, governments, businesses and communities are grappling with how to waste less and recycle more. Victoria is firmly on the pathway to a circular economy, but Victorian businesses and households will continue to generate significant volumes of waste, and those volumes will increase with population growth in coming decades. It is essential that Victoria maintains sufficient and appropriate disposal infrastructure to manage those wastes flows.

WtE facilities are an important alternative to landfills for waste that cannot be avoided, reused or recycled. WtE facilities can produce energy and other products from waste that would otherwise be sent to landfill. Victoria aims to ensure that WtE facilities support Victoria's transition to net zero emissions and a circular economy. Victoria aims to ensure investment in WtE does not undermine investment in lowering emissions, or in circular technologies used to manage waste streams. Finally, Victoria aims to ensure the WtE industry produces useful levels of energy.

Investments in WtE capacity are long-term propositions with the potential to influence Victoria's emissions and circular economy transition. While WtE investors make decisions based on information and incentives available to them, Victoria's net zero and circular economy transition is dynamic and complex, with investors potentially subject to imperfect information and incentives.

It is useful for government to guide and coordinate WtE investment decisions to some extent through the cap licensing system being established in the proposed Regulations, and through the VRIP scheduled for release in the second half of 2024.

Appropriate investment in Waste to Energy

Over-reliance on thermal WtE in the short term has the potential to undermine long-term commitments to waste avoidance and recycling. WtE is the final opportunity, after avoidance, reuse, and recycling, to extract value from materials which would otherwise go to landfill. As Victoria transitions to a more circular economy, rates of resource retention and recovery will increase, impacting on the quantity of available waste feedstock for WtE facilities.

In its advice to government, Infrastructure Victoria (2020), recommended that the Victorian Government's WtE policy should include ways to avoid overcommitting waste tonnages to WtE facilities. It advised, "long-term secure feedstock contracts are necessary for waste-to-energy projects to be financially viable, which risks creating perverse incentives to increase waste". This is in response to clear evidence from parts of Europe that the over-commitment of waste into thermal waste-to-energy facilities has undermined efforts to recycle materials, leading a number of international jurisdictions to regulate WtE through bans or caps (Papineschi, Hogg, Chowdhury, & Durrant, 2019).

As more jurisdictions consider the long-term impact of investment in thermal WtE, the need for strategic planning of waste and resource recovery infrastructure is clear if Victoria is to meet future waste management and energy needs, alongside emissions reduction and circular economy objectives.

International developments in WtE management

Although WtE facilities are well-established in Europe and parts of Asia, the industry is still establishing in Australia. In Europe, nations are taking a longer-term view on managing the interplay between recycling and WtE. Countries are increasingly seeking to align WtE policies with environmental directives by promoting sustainable waste management practices.

The Nordic Council of Ministers, the official body for inter-governmental co-operation in the Nordic Region, conducted an analysis of waste and recycling in the region's regulatory framework (Papineschi, Hogg, Chowdhury, & Durrant, 2019). This analysis noted the low cost of "incineration" a term used for standard combustion in the EU, compared to recycling in some countries may act as a disincentive in meeting recycling targets.

The report outlines that to reach the recycling targets set out by the EU waste directives, there must be a significant shift away from incineration of waste and towards recycling.

More recently, the Independent Review of the Role of Incineration in the Waste Hierarchy in Scotland (Church, Stop, Sort, Burn, Bury?, 2022) assessed the long-term impacts of further investment in WtE processes. Using existing evidence alongside commissioned additional capacity modelling, the assessment noted that excessive investment in WtE has the potential to discourage waste avoidance, reuse and recycling in the long term. The modelling demonstrated that the provision of additional thermal WtE capacity to address increasing waste volumes in the short-term resulted in long-term overcapacity.

It found that 'locking in' significant volumes of residual waste into long term WtE contracts (which often last at least 15 years), potentially excluded this waste from future higher value recycling technologies or markets in the long term. These contracts could also incentivise waste generators to maintain or increase waste generation rates to fulfill contractual obligations, undermining waste minimisation efforts.

The review recommended that Scotland restrict further development of thermal WtE infrastructure (2022, pp. 5, Recommendation 4), while also petitioning for the introduction of an indicative cap on the treatment of residual waste, which should decline over time as Scotland transitions to a circular economy (2022, pp. 5, Recommendation 5).

A subsequent report in the series (Church, Stop, Sort, Burn, Bury?, 2023) reaffirmed the value in managing investment in thermal WtE capacity. Key drivers for managing investment were the opportunities to decarbonise the residual waste treatment infrastructure sector.

Given the long-lived nature of energy infrastructure, a key challenge for government and industry is to estimate an appropriate level of thermal WtE capacity for Victoria. Addressing this is a complex problem because it depends not only on other components of Victoria's waste and recycling system, but on future technologies as well as activities that generate waste flows. There is uncertainty inherent in predicting appropriate long-term WtE capacity, so it is appropriate to take a conservative approach. Setting an appropriate level also needs to take into account WtE facilities outside the cap, including by licensed existing operators.

Changing net emissions impact of Waste to Energy

WtE proponents often highlight the greenhouse gas emissions benefits of processing waste using thermal WtE technologies. As this analysis demonstrates, the net emissions benefits of WtE facilities relative to the energy and waste management options likely to be used in their place are expected to reduce over time. Improvements in WtE technologies may also reduce emissions over time. However, there is a risk that unconstrained investment in thermal WtE facilities would create additional greenhouse gas emissions and make achievement of Victoria's net zero emissions target more difficult.

Frontier Economics' (2021) compared the emissions impacts of thermal WtE and landfilling of residual MSW. The comparison noted the risk of thermal WtE 'locking in' emissions. It noted three main drivers of decreasing net emissions benefits of thermal WtE, relative to landfill, over time:

- Direct emissions from burning fossil waste at thermal WtE facilities.

  Extraction of energy from the non-organics component of MSW is associated with greenhouse gas emissions comparable to coal powered electricity generation. As the organics share of residual MSW waste declines due to initiatives such as FOGO waste sorting and diversion through kerbside

collection reforms, emissions from thermal WtE will increase due to the emissions intensity of the remaining non-organics. Conversely, CO_2 produced by burning organic waste is treated as zero emissions under Australia's emissions accounting framework.

- The proportion of landfill methane captured and used for electricity generation.

  Landfill emissions depend on the landfill gas 'capture rate': the proportion of methane produced that is captured and flared or used to generate electricity. Historically, gas capture has been variable, particularly in rural areas. However, licensed landfills near metropolitan centres and modern landfills are designed to capture a high proportion of methane and generate electricity. Landfill gas energy generation has lower emissions than thermal WtE in some Australian regions already, and it is likely that this will increase as more landfills are built to contemporary construction requirements.

- The avoided emissions from offsetting grid electricity.

  The emissions benefits from offsetting grid electricity depends largely on the emissions intensity of the offset grid electricity. If thermal WtE offsets brown coal, the benefit can be material. If it offsets low emissions electricity there will be little benefit.

South East Metropolitan waste infrastructure gap

The Framework (2021, pp. 14-15 Part 3) outlined the Victorian Government's intention to prioritise allocation under the WtE cap to facilities that will meet a critical waste infrastructure need. The Framework identifies a critical need for additional waste processing to address the anticipated closure of landfill capacity in Melbourne's south east.

For many councils in this region, the closest landfill for the disposal of MSW is the Hampton Park landfill. It is anticipated that Hampton Park will close as early as 2028. Without new infrastructure, other landfills in Melbourne's north and west will be required to add this waste to their existing sources, which is likely to bring operational, environmental and amenity impacts. Without strategic intervention, this could lead to disruptions in the safe and efficient disposal of MSW in metropolitan Melbourne.

The South East Metropolitan Advanced Waste Processing (SEMAWP) project, which involves thermal WtE processing capacity, is designed to address this critical need for additional waste processing infrastructure through a collaborative procurement process. The procurement is being facilitated by the Victorian Government on behalf of participating south east metropolitan councils. The project is the largest collaborative procurement for new waste management infrastructure undertaken in Victoria.

To this end, the proposed Regulations call out the SEMAWP as a critical waste infrastructure project that meets the critical need caused by the closure of the Hampton Park Landfill. As one of the proposed mandatory considerations when issuing cap licences, the Head, Recycling Victoria must consider the desirability of the SEMAWP project meeting that critical need.

Allocating permitted Waste to Energy capacity

Once an appropriate level of thermal WtE capacity is identified, two key questions arise to be addressed:

- how to allocate capacity?

  Under the WtE Scheme, RV will be allocating capacity through cap licences. The proposed Regulations prescribe mandatory matters for the Head, Recycling Victoria to consider when making licensing decisions. These mandatory considerations support Victoria's policy objectives and are outlined in Chapter 5. However, the assessment and acquittal of these considerations is ultimately at the discretion of the Head, RV during the application assessment process. As such, this problem is not examined in this RIS.

- who should pay for the Scheme's administration?

  The proposed Regulations prescribe fees that must accompany different types of applications which are addressed in this RIS.

Chapter 2 Objectives

The objective of Victoria's waste to energy framework is to encourage investment that supports diversion of residual waste from landfill, while avoiding risks to recycling outcomes in the future. The principles for implementing the framework are:

- encourage investment in facilities that help achieve the goals and targets of Victoria's circular economy policy
- support a diverse and competitive waste to energy market, and
- have a consistent, transparent and fair mechanism.

Victoria's circular economy policy is guided by four goals spanning the life cycle of materials (make, use, recycle and manage). Each goal is designed to maximise value and minimise waste.

- Goal 1 - Design to last, repair and recycle.
  Generate less waste in businesses through innovation and design; use recycled materials in products and consider impacts across product life cycles; and support business to explore new circular economy business models.
- Goal 2 - Use products to create more value.
  Help people make smart purchasing decisions and extend the life of products and support the reuse economy; repair goods where possible.
- Goal 3 - Recycle more resources.
  Reform kerbside collections to generate more value from waste; improve the separation of recyclable materials; develop markets for recovered materials; plan for and boost investment in recycling infrastructure; embed the waste hierarchy in the management of materials; support the development of appropriate waste to energy facilities.
- Goal 4 - Reduce harm from waste and pollution.
  Protect communities and the environment from high-risk and hazardous wastes.

These goals align with the United Nations Sustainable Development Goals, including Goal 8 to 'promote sustained, inclusive and sustainable economic growth', and Goal 12 to 'ensure sustainable consumption and production patterns'.

Regulatory objectives

It is the objective of these regulations to:

- increase the value of waste managed in Victoria
- reduce the amount of virgin materials use in the economy
- reduce the amount of waste going to landfill
- minimise greenhouse gas emissions from waste processing and energy generation
- minimise disamenity resulting from waste processing, and
- achieve cost recovery for regulatory functions in an efficient and equitable manner.

The proposed Regulations are designed to achieve these objectives through:

- setting the cap and associated cap licencing process, and
- prescribing relevant fees and pricing.

Cap and cap licensing regulatory objectives

Consistent with the circular economy policy and the Framework, the cap limit and licensing process have been designed to:

- maximise the amount of waste diverted from landfill to waste to energy
- ensure that waste to energy operations do not displace reuse or recycling, and

- establish an effective and transparent regulatory cap licensing process that supports the achievement of the above objectives and ensures that waste to energy investment in Victoria:

> contributes efficiently to Victoria's waste and resource recovery infrastructure

> supports best practice facilities and processes

> has or will have well established engagement and connection with, and contributes to positive outcomes for Victorian communities.[2]

Fees and pricing objectives

The regulatory objectives of setting fees are to:

- distribute the costs of the licencing regime equitably amongst those who benefit from being considered for allocation under the cap
- not impose an unreasonable barrier to entry, competition or innovation, that may result in negative outcomes, and
- establish a fee structure which is based in actual costs of administering the scheme, is easy for applicants to understand, and simple for RV to administer.

[2] Responsibility for monitoring community engagement and the establishment of a project's social licence rests with the EPA. Effective engagement with communities will also be one relevant consideration among several for the Head, RV, when determining which projects should receive a licence under the cap limit.

Chapter 3 Options

This chapter outlines the courses of action considered and identifies feasible options to achieve the objectives set out in Chapter 2.

Part 5A of the CE Act establishes the WtE Scheme and enables a cap licensing system that:

- sets an appropriate limit on the amount of permitted waste to be processed in thermal WtE facilities, and
- allocates cap licences efficiently and effectively, including appropriate recovery of administrative costs through fees.

The EO licensing provisions in the CE Act and existing Regulations do not allow any new WtE operations beyond those that had appropriate planning and environment approvals before November 2021. Under the CE Act, EO licences are not subject to the cap limit, and the EO licensing process is not a competitive licensing process. There is a need to use the cap licensing provisions in the CE Act to enable issue of WtE licences beyond those that can be issued to EOs, and to implement these provisions, a new regulatory licensing framework for the competitive cap licensing process needs to be established.

For the CE Act cap licensing provisions to function as intended, regulations must prescribe a cap limit, elements of the cap allocation process and fees for the EOI and cap licence applications. Non-regulatory options would not be able to create a well-functioning cap system or recover regulatory costs, so would not achieve the Victorian Government's objectives. Therefore, no non-regulatory options to limit the amount of waste able to be processed or the fees to be charged have been considered.

Proposed Regulations

The existing Regulations do not currently cover the cap, or associated licensing processes. The cap limits the processing of permitted waste beyond that which had appropriate approvals before November 2021. The cap applies to specific types of facilities described in the CE Act.

The proposed Regulations:

- prescribe the cap limit
- create a cap licensing pathway, detailing processes for the Head, Recycling Victoria to invite an EOI and request applications for cap licences
- specify matters that the decision-making criteria that the Head, Recycling Victoria must consider take into account when making determinations regarding EOI and cap licence applications.
- establish the process for decreasing an allocation under the cap, and
- prescribe the fees for regulatory services covered in these regulations, such as the application fees for cap licences.

The proposed Regulations do not address:

- EO WtE facilities approved prior to 1 November 2021
- processes that are not thermal WtE processes
- waste that is not permitted waste, nor
- periodic licence fees.

Options for the cap limit

The WtE Scheme established in the CE Act provides for a cap limit to be prescribed in the proposed Regulations. The cap limit is a maximum aggregate amount of permitted waste that can be processed by thermal WtE facilities in Victoria each financial year, excluding facilities that had the necessary approvals before 1 November 2021.

Three cap limit options have been identified for assessment against the base case in Chapter 4. These options have been selected to test the trade-offs in the context of the Victorian Government's commitment to

a one million tonne cap in its circular economy policy which seeks to allow the operation of thermal WtE facilities to complement efforts to reduce or recycle waste, without inhibiting innovation.

These options are assessed against a base case in which no cap is specified. Not specifying a cap is not an option under consideration by government but is put forward as a reference point for the purposes of the assessment in the RIS.

Under all options, permitted waste amounts approved under the EO licences would not count towards the cap limit.[3] However, if an EO wanted to increase the amount of permitted waste they are authorised to process, they would need to obtain a cap licence, and the additional authorised amount of permitted waste would contribute to reaching the cap limit. There would be no limit on the amount of exempt waste all facilities are able to process under the WtE Scheme. Additionally, under all options, the allocated cap amount for individual facilities will be able to be decreased, either by the Head, Recycling Victoria if the licensee is consistently processing significantly less permitted waste than their allocated cap amount, or upon application by the licence holder themselves.

Base case

Under the base case, and for the purposes of a reference point in the analysis in the RIS, the proposed Regulations do not prescribe a cap limit. For the purposes of the analysis in this RIS, it is assumed that if no cap limit were prescribed, then the cap licensing scheme would not operate. New thermal WtE operators would not be authorised to process any permitted waste, and therefore, would only be able to process exempt waste. EOs would continue to operate but not be able to increase the amount of permitted waste they are currently authorised to process under existing approvals.

Option 1 – Cap of 500,000 tonnes

Under this option, a cap limit of 500,000 tonnes of permitted waste would be prescribed in the proposed Regulations. This option would likely allow only a small number of new WtE operators to process permitted waste.

Option 2 – Cap of one million tonnes

Under this option, a cap limit of one million tonnes of permitted waste would be prescribed in the proposed Regulations. This option aligns with the Victorian Government commitment in its circular economy policy. This option would allow a larger amount of thermal WtE capacity compared to Option 1.

Option 3 – Cap of two million tonnes

Under this option, a cap limit of two million tonnes of permitted waste would be prescribed in the proposed Regulations. This option would allow a larger amount of thermal WtE capacity compared to Option 1 and Option 2. This option is used to demonstrate a scenario in which substantial additional thermal WtE capacity is approved, which may be beyond the total amount of suitable permitted and exempt waste in the system.

Options for setting fees

Under the CE Act, fees can be prescribed in cap licensing Regulations for proponents:

- submitting an EOI to RV
- applying for a cap licence, following an EOI process, or
- applying to decrease an allocated cap amount.

Three options have been identified for the fee structure for the cap licensing scheme, for assessment against the base case in Chapter 4. Across these three options, only one fee structure has been considered for the EOI and applications to decrease a cap allocation, whereas the fee structure for the cap licence application differs under each option.

[3] EO licensing came into effect on 1 June 2023 for facilities that had relevant approvals before 1 November 2021.

Only one option was considered for the EOI stage as the activities associated with reviewing expressions of interest are expected to involve relatively lower administrative costs for RV compared to the cap licence application stage. Keeping the EOI fee relatively low and simple and recovering more costs through the application stage will also ensure that only those with a stronger prospect of being approved to operate a WtE facility will bear a greater proportion of RV's administrative costs.

Only one option was considered for the application to decrease an allocated cap amount due to this function requiring relatively low administrative costs for RV, with similar administration processes required across all licence-holders.

The CE Act was recently amended to provide for the setting of periodic fees, which would typically be used to recover RV costs related to ongoing monitoring and compliance activities. Those fees will be the subject of a future regulation and consultation process and are not considered here.

Cost base

The Victorian Government's *Pricing for Value* (2021) guide sets out the Pricing Principles which assist departments in determining relevant costs and appropriate levels of cost recovery. The relevant costs to recover through fees relate to administering the EOI, cap licensing and cap amendments functions and should not include costs associated with establishing RV's regulatory practices given it is a new regulator.

The fees should cover, at least in part, costs for activities related to:

- inviting EOIs and applications
- processing applications
- evaluating submissions against set criteria
- seeking expert advice and reports to substantiate claims with respect to applications
- determining licence conditions
- allocating cap amount,
- checking validity of any planning permits and EPA licences
- granting licences, and
- conducting fit and proper person checks.

It is intended that fees will cover RV costs, at least in part, as above. Future cost estimates have been considered in the setting of fees in the proposed Regulations and in the supporting analysis in this RIS. However, as RV is a new regulator and cap licensing is being introduced, the precise costs to RV of administering the scheme are currently unclear.

For EOI submissions it is appropriate that RV's costs are at least partially recovered from potential applicants, as it may not be considered fair to have full cost recovery for the EOI process due to uncertainty about whether an applicant will be invited to apply for a cap licence and authorised to operate a thermal WtE facility. Further, a prohibitively high fee could potentially result in a reduced pool of proposals for RV to choose from.

For the cap licence application**,** full cost recovery could be considered appropriate as operators allocated a cap licence will derive direct benefit from operating a WtE facility. However, as cap licensing is a competitive process with no guarantee that an applicant will receive a licence and given the broad system benefits WtE facilities can provide for the Victorian community, Pricing Principle 3 or partial cost recovery is also considered appropriate for cap licence applications.

Base case

Under the base case, the proposed Regulations would continue to prescribe no fees for the cap licensing scheme. Given the clear intent of the Victorian Government to prescribe a binding cap limit in regulations, there is a need to also prescribe fees under the proposed Regulations to accompany expressions of interest, applications for cap licences, or applications to decrease an allocated cap amount.

If fees are not prescribed, costs to RV for assessing expressions of interest, applications for a cap licence or applications to decrease an allocated cap amount would need to be funded by other sources.

Option 1 – Flat fee structure

Under this option, one fee would be prescribed for each of the different activities. Fees at the EOI stage would be less than the fee prescribed at the cap licence application stage. Fees for applications to decrease an allocated cap amount would incur the lowest fee.

Option 2 – Differentiated fee structure

Under this option, one fee would be prescribed for either submitting an EOI or applying to decrease a cap allocation. Fees for the cap licence application, however, would be differentiated based on facility size. Two fee levels would be prescribed for cap licence applications – a lower fee for small facilities and a higher fee for large facilities.

Option 3 – Sliding scale fee structure

Under this option, one fee would be prescribed for either submitting an EOI or applying to decrease a cap allocation. Fees for cap licence applications, however, would be applied as a percentage of the value of development costs up to a capped amount. Development costs would represent a proxy for scale and complexity of facilities and the corresponding higher level of effort and oversight required by RV to assess cap applications.

Proposed fees

The proposed fees under each option are outlined in Table 2, with detail on the rationale for each of the proposed fees outlined below.

Table 2: Fee options for the WtE cap licensing scheme

	Cap licence application		Expression of interest		Application to decrease cap	
	Fee units	*2023-24 fee*	*Fee units*	*2023-24 fee*	*Fee units*	*2023-24 fee*
Option 1 – Flat fee	2,095	$33,310.50	780	$12,402	390	$6,201
Option 2 – Differentiated fees	1,045 (small) 2,095 (large)	$16,615.50 $33,310.50	780	$12,402	390	$6,201
Option 3 – Sliding scale	Maximum 2,095	Maximum $33,310.50	780	$12,402	390	$6,201

Cap licence application fee

Cap licence application fees are proposed to be higher than expressions of interest and applications to decrease allocated cap amount, due to the significantly higher amount of administrative effort required by RV to assess applications and issue licences compared to the other types of applications. This higher amount of administrative effort is due to the need for RV to assess cap licence applications against consideration of evaluation criteria, which will also require a level of technical assessment, and to assess that the makeup of facilities that are licensed under the cap contribute to an efficient waste infrastructure system for Victoria.

The fee options for the cap licence application centre around a proposed fee of 2,095 fee units ($33,310.50 in 2023-24 fee units). Under Option 2 the fee for small facilities is proposed to be 1,045 fee units ($16,615,50 in 2023-24 fee units) or half of the proposed fee for large facilities. Under Option 3, the fees are proposed to scale with the development costs of the facility, up to a cap of 2,095 fee units. These lower fees for smaller facilities align with Pricing Principles 2 and 7, where a reduced fee for smaller facilities better aligns with the corresponding benefits the applicant may receive and seek to not unduly create a barrier to entry.

Given the uncertainty in RV's actual costs, the fee for large facility applications has also been considered in the context of benchmarking against licensing costs for WtE facilities in other Australian jurisdictions, as well as against EPA Victoria licensing costs for WtE facilities.

While Recycling Victoria will be considering, at least in part, different matters to the other jurisdictions noted below and the Victorian EPA in their licence assessment process, this benchmarking is a useful tool as the Recycling Victoria licence application and assessment process is expected to be of relative comparable complexity to these processes.

Benchmarking against licensing costs for WtE facilities in other Australian jurisdictions

WtE is regulated by the Environment Protection Authorities in both New South Wales (NSW) and Western Australia (WA). The quantum of fees for licence applications is similar in these two jurisdictions, approximately $32,000. While NSW and WA WtE regulatory schemes do not impose a cap on the amount of waste which can be processed through facilities, these schemes are regulating comparable facilities in Australia. Setting fees based on benchmarking with comparable Australian jurisdictions will also assist in establishing a competitive WtE industry in Victoria. For these reasons, a similar fee is proposed for WtE facilities in Victoria of 2,095 fee units ($33,310.50 in 2023-24 fee units).

Benchmarking against EPA Victoria licensing costs for WtE facilities

EPA development licences are required in Victoria for high-risk industrial or waste management activities, including for WtE facilities. The fees for EPA development licences are set at 1% of development costs, up to a maximum of 4,500 fee units ($71,550 in 2023-24 fee units). The development costs of WtE facilities are substantial, with a facility seeking to process 100,000 tonnes of waste per year typically costing in excess of $150 million, and so proposed WtE facilities will likely incur the maximum development licence fee. In comparison, the proposed WtE cap licence application fee is proposed at approximately only half the maximum cost of a development licence fee. This is considered reasonable, particularly given that the expected administrative effort for Recycling Victoria is expected to be less than that required by EPA Victoria to assess a development licence.

Operators of such a facility seeking to process 100,000 tonnes of waste per year will be required to obtain both an EPA development licence, planning permit and a WtE cap licence, so cap licence applicants would incur $120,925.50 from these licensing fees. This would be equivalent to 0.1% of typical development costs for an operator seeking to process 100,000 tonnes of waste.

Expression of interest fees

A single fee of 780 fee units ($12,402 in 2023-24 fee units) is proposed for the EOI application. Given this is a new licensing scheme, Recycling Victoria is in the process of establishing the cap licence application requirements and so associated administrative costs of assessing applications are currently unknown. It is anticipated that the administrative resources required of Recycling Victoria to assess expressions of interest will be similar to that required for EO applications under the existing Regulations. For these reasons, the fee for submitting an EOI is proposed to be set at the same level as the EO licence fee.

Application to decrease a cap allocation fees

A single fee of 390 fee units ($6,201 in 2023-24 fee units) is proposed for applications to decrease an allocated cap amount. This fee is lower than the proposed fee for expressions of interest and cap licence applications given Recycling Victoria is unlikely to need to revisit other information that would be part of these earlier application stages, and therefore will require less administrative resources to process[4].

[4] The fee associated with applications to decrease a cap licence amount is not designed to disincentivise prospective WtE operators from oversubscribing to a cap amount in their initial cap licence application. Section 74ZF of the CE Act (p. 121) allows the Head, Recycling Victoria to revoke a WtE licence in the case of a cap licence in a range of circumstances, including if they are satisfied the holder of the licence has demonstrated a pattern of processing an amount of permitted waste under the licence that is significantly less than the allocated cap amount specified in the licence.

Other matters

Given the proposed Regulations do not prescribe any information requirements, reporting requirements or other licence conditions which will impose direct costs on those submitting an application for an EOI, cap licence or cap decrease, no options for these matters are assessed in this RIS.

Instead, any information requirements, reporting requirements and licence conditions will be specified by RV, in line with the CE Act. This approach allows RV to establish a licensing scheme that is aligned with annual reporting through an outcomes-based framework.

While the proposed Regulations will not prescribe specific information requirements, they will prescribe matters that the Head, Recycling Victoria must take into account when determining whether to issue a cap licence. These matters, set out in Chapter 5 and the proposed regulations, include a variety of actors that will guide decisions about which facilities are likely to generate the greatest economic, environmental and social benefits, in line with the transition to a circular economy.

As is currently the case, prospective thermal WtE operators under the new licensing scheme will continue to be required to provide information to the EPA for the purposes of obtaining development and operating licences under the EP Act, and to the responsible authority under the P&E Act to obtain any required planning permits. Given RV must take the matters outlined above into account when issuing cap licences, RV may require information related to those matters in the cap application. However, detailed information relating to the types of waste to be processed and the thermal WtE technology to be utilised will be different to the information prospective operators are required to provide currently for licences and permissions in other regulatory schemes.

In addition, the CE Act and the proposed Regulations allow the Head, Recycling Victoria to request any further information they consider necessary to enable determination of whether to advance an applicant at EOI stage, or to issue or refuse a cap licence, in accordance with the CE Act.

This RIS does not attempt to assess any impacts associated with the provision of this information. RV is working with co-regulators to develop information sharing arrangements regulators to reduce the administrative burden and costs for proponents in providing information.

Chapter 4 Impact analysis

Chapter 3 of this RIS identified feasible options to achieve the objectives of the proposed Regulations. This chapter assesses the relative impacts of those options for setting the cap limit and licensing fees. Where possible, the analysis in this chapter is supported by quantitative modelling. Where it is not possible to meaningfully quantify option impacts, this chapter includes a qualitative discussion of option impacts.

DEECA commissioned Deloitte to support this impact analysis, including supporting the initial design of modelling of quantitative aspects and providing the Technical Appendices. The final analysis in this RIS reflects further additional modelling undertaken by the Victorian Government.

Cap limit options were selected to test the impacts of setting a one million tonne cap limit in line with the Victorian Government's commitment, and to consider the trade-offs of setting a cap limit below or above one million tonnes.

The qualitative and quantitative assessment of the five key impacts is presented in detail below. This assessment finds that Option 2 achieves the best balance of outcomes to achieve the objectives of the proposed Regulations and of Victoria's waste to energy policy described in the Background, Chapters 1 and 2.

The assessment focused on five significant impacts of a limit on the use of WtE to process permitted waste in Victoria, which would influence the flow of waste materials to landfill and higher order recovery options:

- increasing the value of waste managed in Victoria
- avoided use of virgin materials through increased material recovery and reuse/recycling
- avoided use of landfill
- net effect on greenhouse gas emissions, and
- financial, distributional and other impacts.

These five impacts do not carry equal weight or bearing on achieving the objectives of the proposed Regulations, or of the Victorian Government's circular economy and waste to energy policy (See Chapter 2), and thus inform the analysis to varying degrees. The four goals in Victoria's circular economy policy align strongly with the first two impacts: increasing the value of waste managed in Victoria and avoided use of virgin materials through increased material recovery, reuse and recycling. As such, the analysis considers these two impacts as having relatively greater importance compared to the later three. While the analysis does not assign specific weightings to each assessment criterion, it is crucial to recognise the relative importance and how these align with the primary objectives of the proposed Regulations.

Given the long-term nature of WtE investment, this RIS uses a time horizon of 2049-50 for options analysis.

It is not possible at this stage to predict the specifics of proponent proposals and subsequent regulatory decisions. As a result, this Chapter focuses on generalised trade-offs between landfill, WtE and recycling activity for any given scale of WtE investment. The analysis makes a number of broad assumptions about WtE facilities, including their business models, technologies, waste feedstocks and greenhouse gas emissions. Some of those assumptions will be more accurate for some proposed facilities than others.

The analysis in this RIS also relies on long term forecasts of waste flows in Victoria. It includes assumptions about the impact of known market trends and policy interventions. Beyond the current decade, the analysis assumes a modest continued improvement in recycling rates for materials that are suitable for use in WtE facilities, and that those materials that have poorest recovery today would see greater improvements than materials that are already well managed. The modelling methodology and list of assumptions can be found in Appendices A and B.

1. Increasing the value of waste by moving it up the waste hierarchy

A pillar of Victoria's circular economy policy is to ensure that waste resources are directed towards their best and highest use. The circular economy hierarchy, enshrined in the CE Act, guides the implementation of the WtE Scheme.

As Victoria transitions to a circular economy, new technologies and business models will be adopted. Some innovation will be driven by commercial interests, and some by government policy. For example, the

Victorian Government has introduced greater source separation of household wastes and will set standards for what may be included in separated streams to provide investment certainty, and scale to drive greater investment in recycling. Other programs, such as the Circular Economy Business Innovation Centre and the Recycled Markets Acceleration Package, have supported Victorian Businesses who were eager to innovate using circular economy principles, including for commercial reasons.

The value of waste is partially reflected in commercial considerations and market-based pricing. However, markets often do not reflect the environmental externalities of the waste materials and their potential alternative use in place of virgin materials, or the value of future innovation and development of waste markets and technologies, which may not be realised due to the efficiency and inertia of systems that facilitate disposal. Today's market pricing and commercial returns may not reflect the full value of different resources that are treated as waste.

While businesses can generate value from waste through WtE, there may be higher value uses for those waste streams that are not represented in current commercial markets.

WtE technologies can generate products other than energy and fuels. There are emerging technologies that can be used to conduct advanced recycling of problem materials for remanufacturing as new high value products. For example, a pyrolysis facility may take contaminated mixed plastics and return them to an oil that can be used to produce new plastics. To the extent that a facility is undertaking this kind of advanced recycling it is not subject to the WtE Scheme cap limit and does not require a cap licence. Other by-products of innovative WtE processes may have a high value, such as biochar or carbon black which can be used in asphalt, rubber manufacturing and chemical manufacturing, while by-products of a conventional thermal WtE facility, such as ash, typically have a low value.

The Victorian Government's focus on supporting an appropriate level of investment in WtE reflects the important role that WtE can play in Victoria's circular economy, without crowding out potential recycling activity. Over-investment in WtE may disincentivise investors to innovate and develop technologies that promote avoidance, reuse and recycling, if WtE is considered a more economically viable option in the short term.

The size of the cap limit is likely to have long-term impacts on Victoria's waste infrastructure. A cap that is too low will mean Victoria continues to rely heavily on landfilling residual waste, that is waste that is not recycled or exported for recycling, creating an inefficient reliance on this type of waste management infrastructure. Conversely, if the cap is too high, significant investment in long-lived WtE infrastructure may reduce incentives and commercial opportunity for technological innovation. In particular, this may be the case if WtE facilities commit waste streams as feedstock that could otherwise have become practicable to recover in the future with new investment in recycling infrastructure and technologies. If it becomes more difficult for recyclers to access these waste streams, they may choose not to invest in recycling facilities. Similarly, policy or behaviour change to drive waste higher up the hierarchy may also be disincentivised, resulting in poor outcomes for the circular economy. If efforts toward waste minimisation and recycling innovation do continue strongly, the flow of suitable source-separated feedstock could become insufficient to supply WtE facilities, and this may result in shortfalls in expected returns on investment in WtE, with the potential for WtE facilities to become stranded assets.

Victoria's waste system is dynamic and complex, with inherent uncertainty about what it will look like in the future. In order to preserve the possibility of higher value uses of waste, it is appropriate to take a conservative approach, based on best available information, when setting the cap limit. It would be open to future governments to set a higher cap level if future trends demonstrate additional capacity would be appropriate. It would not be practicable for future governments to reduce the cap once facilities have been licensed and built.

Although WtE proponents are rational actors, they do not have perfect information about future government circular economy or climate action policies that may influence market behaviour. Nor do they have perfect insight into how policy, consumer sentiment or economic drivers may influence any planned and future innovations of other participants in the economy. Those innovations may influence the scale and nature of waste feedstocks, including lightweighting and use of recovered materials by manufacturers, sharing, repairing and reusing by consumers, and innovative technologies and collection systems deployed by recyclers.

This has been considered in Chapter 3 in a quantitative sense, by projecting factors including future recovery rates, waste generation and population growth, and overlaying waste to energy processing capacity under the three cap limit options.

Figure C shows total permitted waste feedstocks available for use in thermal WtE facilities under the three cap options over the period to 2050. It shows that in a scenario where resource recovery continues to improve at a modest rate, there is sufficient feedstock for Options 1 and 2, a 500,000 tonne and 1,000,000 tonne cap respectively, but insufficient feedstocks for a 2 million tonne cap under Option 3 over the period of the analysis.

To set a cap at that level would risk sending materials to WtE that could otherwise be used in higher order recovery in future years. This option could lock in a higher level of WtE infrastructure, which leads to a lack of commercial opportunity or incentive for other recycling infrastructure to be established that could have been established in the base case. In this way, in the Figure B, the gap between the 'Option 3, a 2m tonne cap' line and the 'Base case permitted and exempt feedstock' line could be interpreted as potential 'avoided recycling' or future 'lost opportunity for recycling'. This is shaded in black to illustrate the gap clearly. The total tonnes impacted are presented in Figure C.

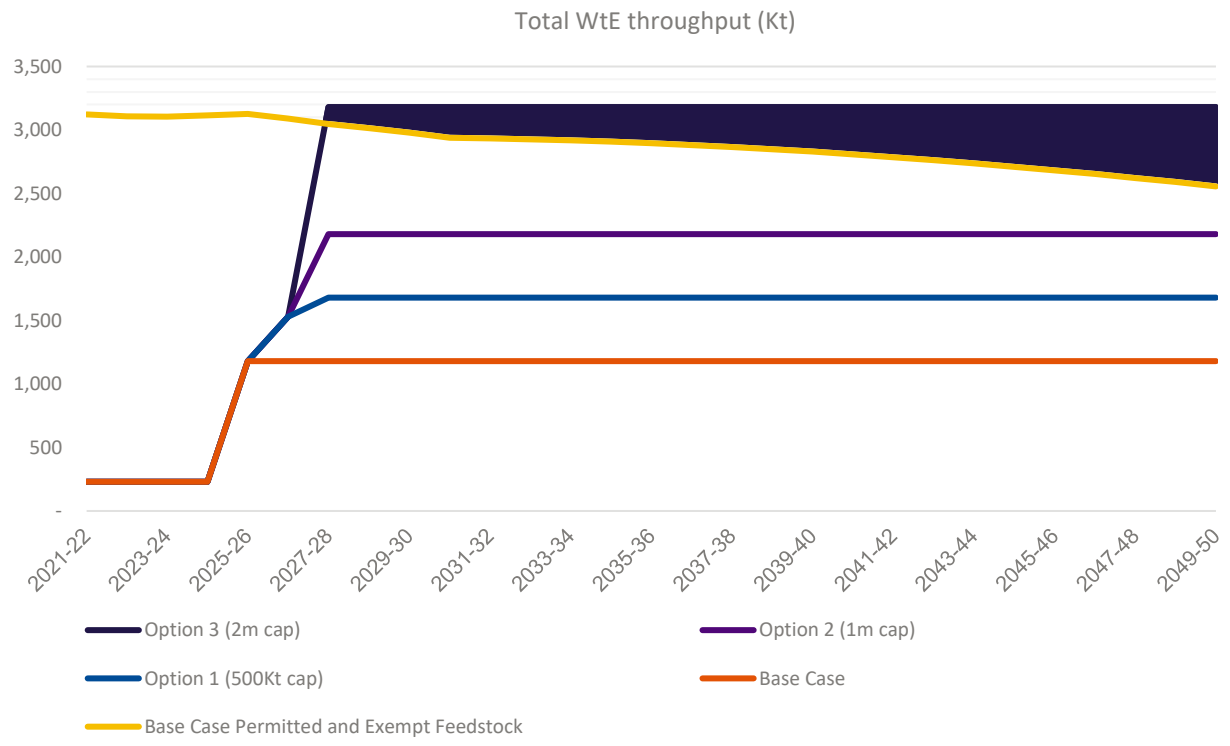

Figure B: Available, suitable waste feedstocks for thermal WtE facilities compared to total Victorian thermal waste to energy processing capacity under the three cap options until 2050

The model includes the assumed waste streams flowing to potential Existing Operator licensees in the total thermal waste to energy capacity under each of the three options.

The WtE Scheme places no limit on the amount of exempt waste that may be processed in thermal WtE facilities in Victoria. However, the model makes a conservative assumption that there is no further investment in exempt waste processing capacity from new or expanded WtE facilities. This means the analysis likely overestimates the suitable permitted and exempt feedstock that is available to licensed WtE facilities in future years, as any further investment in exempt waste processing capacity would use up some of the available feedstock.

Conversely, the model makes a simplifying assumption that material that is unsuitable for thermal WtE processing, such as metals and aggregates, is not processed by those facilities, even when collected with

other wastes, as in household residual bins. Some facilities may sort some of these materials, and others may not. Some metals may be recoverable and suitable for recycling after thermal processing. This likely means the analysis here may slightly underestimate the permitted feedstock that is available to licensed WtE facilities in future years. However, applying suitability lens to available permitted and exempt waste streams helps create more pragmatic assumptions about which non-household waste streams, including commercial and industrial and construction and demolition waste steams, will be sought out by waste to energy facilities.

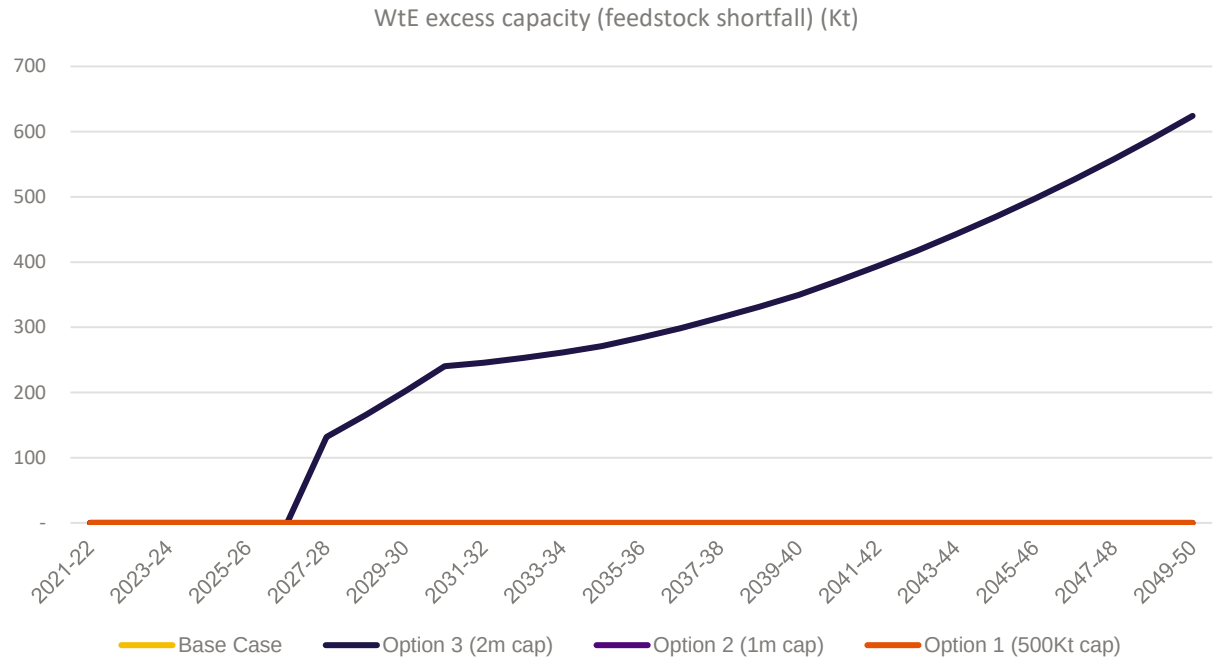

Figure C: Total volume of 'excess capacity' or 'feedstock shortfall' under the modelled assumptions for each option

a. Note the quantitative analysis for this RIS interprets this shortfall as 'lost opportunity for future recycling', but – alternatively – if this recycling is technically, environmentally and economically practicable in the future, an actual feedstock shortfall could eventuate for WtE facilities.

There is significant uncertainty about future recovery rates after 2030. However, sensitivity tests for this waste flow modelling, where assumptions about future recovery rates after 2030 are decreased and increased from the central scenario respectively, still demonstrate that Option 3 presents significant risks in terms of over-investment in waste to energy and lost opportunity for improvements in waste avoidance, reuse and recycling in the future.

The gap between recovery rates in 2030 and a theoretical perfect 100% recovery in 2049-50 were assumed to narrow by the percentages in the table below (at 25, 33 or 40%). For example, if the recovery rate for a particular material stream from a particular source has an expected recovery rate of 60% in 2030 for example aluminium in the MSW stream, then narrowing the gap by 25% would result in a 70% recovery rate in 2049-50; narrowing by 33% would result in an 73.2% recovery rate in 2049-50; and narrowing by 40% would result in an 76% recovery rate in 2049-50. This assumption results in the greatest improvement in the rate of recovery for materials that are currently recovered the least, for instance for plastics and textiles. Conversely, the assumption illustrates where there is the greatest opportunity, and modest improvements for materials that are already recovered at high rates, such as for metals and tyres.

Table 3: Sensitivity Analysis – aggregate WtE excess capacity (Kt) up to 2049-50

WtE excess capacity Recovery rate improvement from 2030-31 to 2049-50	Option 1	Option 2	Option 3
25	0	0	5,410

WtE excess capacity Recovery rate improvement from 2030-31 to 2049-50	Option 1	Option 2	Option 3
33	0	0	8,240
40	0	0	10,716

Table 4 outlines the total waste production data and projections for each sector in 2020-21 and 2049-50. A complete breakdown by material sub-type can be found in Table A-2 in Appendix 1.

Table 4: Annual waste production data and projections (Kt)

Sector	2020-21	2049-50
MSW	3304	5214
C&I	4510	6914
C&D	7533	19908

Figure D shows a high-level summary of the average feedstock material used by WtE facilities, coloured to represent what the alternative fate for that material would have been, either landfill or recovery. Options 1 and 2 utilise only waste that would otherwise have gone to landfill. These Options have similar feedstock proportions; about 40% organics, 25% plastic, 25% paper and cardboard, and 10% textiles. This reflects the proportion of these materials in the landfill waste stream after removing materials unsuitable for WtE, for example glass and metal. Option 3 draws 18% of its feedstock on average from material that would otherwise have been recovered. Because it draws on this material in proportion to the rate at which materials suitable for WtE are recovered, it has a different breakdown of feedstock: about 47% organics, 25% paper and cardboard; 20% plastic, 7% textiles and 1% tyres.

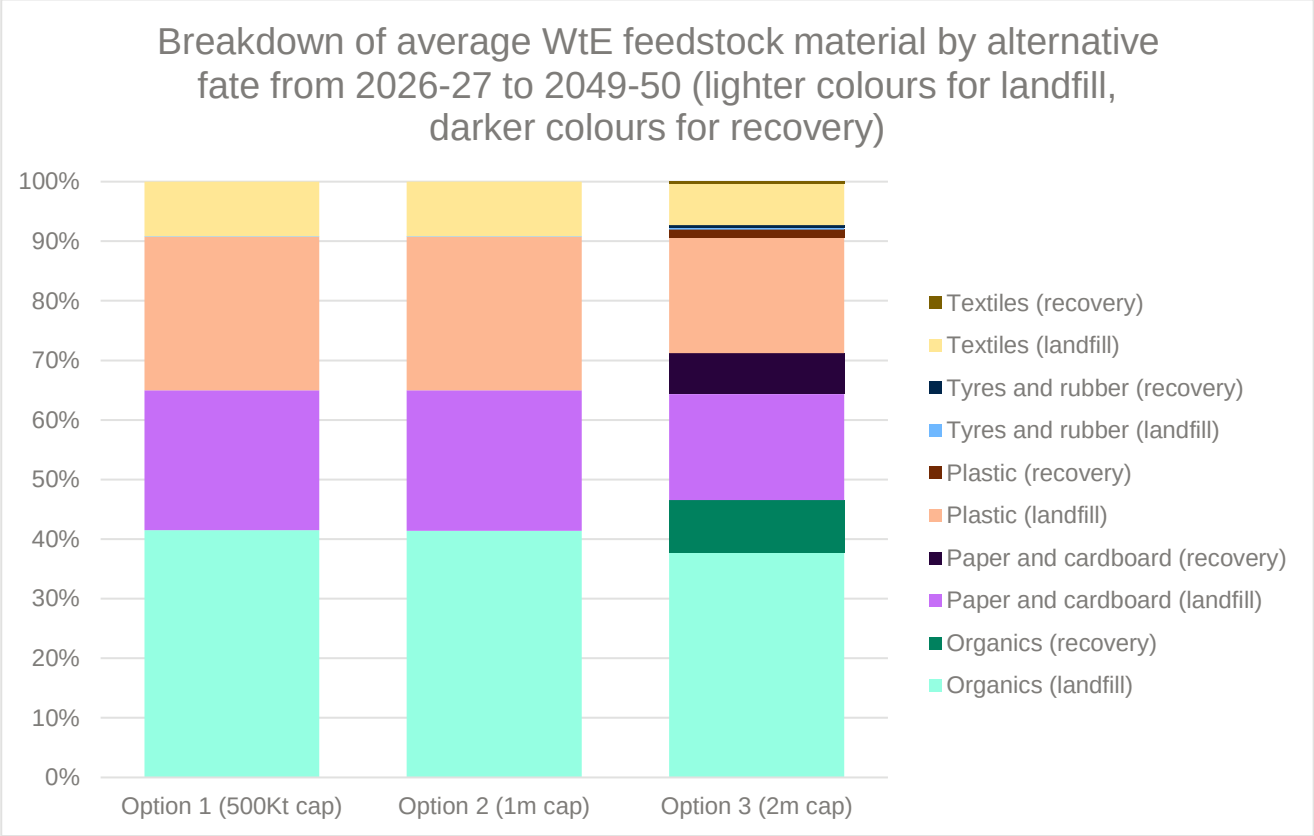

Figure D: Breakdown of average WtE feedstock material by alternative fate (lighter colours for landfill, darker colours for recovery)

2. Avoided use of virgin materials because of increased material recovery

As well as commercial benefits to WtE processors and other potential waste users, an important consideration when setting the cap limit is the externalities not represented in commercial transactions. One class of these externalities is the avoided use of virgin materials when waste is avoided or recovered. A sustainable, circular, low emissions economy prioritises resource efficiency, central to this is avoidance of extraction of new virgin materials, and maximising the value of materials that are extracted.

Greater reuse and recycling in place of extraction, and use of virgin materials in production, is likely to have significant environment and economic benefits including reduced greenhouse emissions, reduced energy use, reduced land use and degradation and reduced water demands. Conversely, in the long term, investing too much in WtE facilities rather than innovative recycling facilities may mean losing opportunities to reuse or recover those materials, and displace the extraction and production of products using new raw materials.

To demonstrate the relative quantitative land impacts and water impacts that result from the use of virgin materials, the analytical approach assumes that any scale of investment in waste to energy that could limit future waste avoidance, recovery and recycling would thereby increase the need for virgin material extraction, or conversely, reduce the opportunity to lessen virgin material extraction.

The relative impacts for each cap limit Option on land and water impacts are presented in the table below. These represent cumulative impacts over the period of the analysis to 2049-50. Given that energy use and emissions are analysed below, this is not included here.

Land use is primarily driven by new paper production. By recycling paper, the land area required to be occupied by forest plantations necessary to supply pulp-logs for paper production is reduced. Recycling materials, in almost all cases, save water use per tonne of material compared to virgin extraction. For example, by recycling food organics and garden organics into compost or other products and applying those to land in agriculture, the water needs of crops are reduced. Recycling materials such as plastics generate even higher benefits per tonne than organics (Carre, Crossin, & Clune, 2015).

Table 5: Relative land and water impacts of foregone recycling by option

Impact	Option 1	Option 2	Option 3
Land impacts	0	0	4,445 km^2
Water impacts	0	0	82.6 GL

3. Avoided use of landfill

In Victoria, all licenced landfill operators are obliged to charge a waste levy set by the Victorian Government. This creates a financial incentive to encourage waste generators to look for ways to reduce the amount of waste they generate and send to landfill. The levy reflects some of the externalities of waste disposal, however, it does not necessarily reflect the full upstream and downstream long-term costs of all environmental harms of waste, including greenhouse gas emissions, the exhaustion of finite resources and loss of material value associated with the disposal of materials in landfills. Landfills also have negative amenity impacts including noise, odour, and increased pest activity, and require large tracts of land including significant buffer zones, which are then rendered impractical for alternative, more productive purposes (Carre, Crossin, & Clune, 2015).

WtE facilities also have the potential for varied negative health and environmental outcomes, which, in turn, can negatively impact the amenity of people living close to these facilities. These impacts are contingent on a number of unknown factors, such as makeup of feedstock, location of facilities and the actions of operators to mitigate these impacts. The EPA regulates human and environmental health aspects of both landfill and WtE facilities.

While waste avoidance and recovery provide the benefits of avoided landfill use, the WtE sector also makes an important contribution in this regard, as WtE facilities can use materials that otherwise would have gone to landfill to generate energy, fuels and other products.

The impact of different cap amount options will have on use of landfill, or avoided use of landfill, relates to the amount suitable permitted and exempt waste feedstocks for waste to energy facilities. In the short term, a higher cap enables greater diversion of waste from landfill while recovery rates are modest. However, over the long term, as the amount of suitable feedstock declines through improvements in waste recovery, the relative benefits of a higher cap decline. This is demonstrated in Figure E, below, where the difference between Option 3 and 2 narrows over the years to 2049-50.

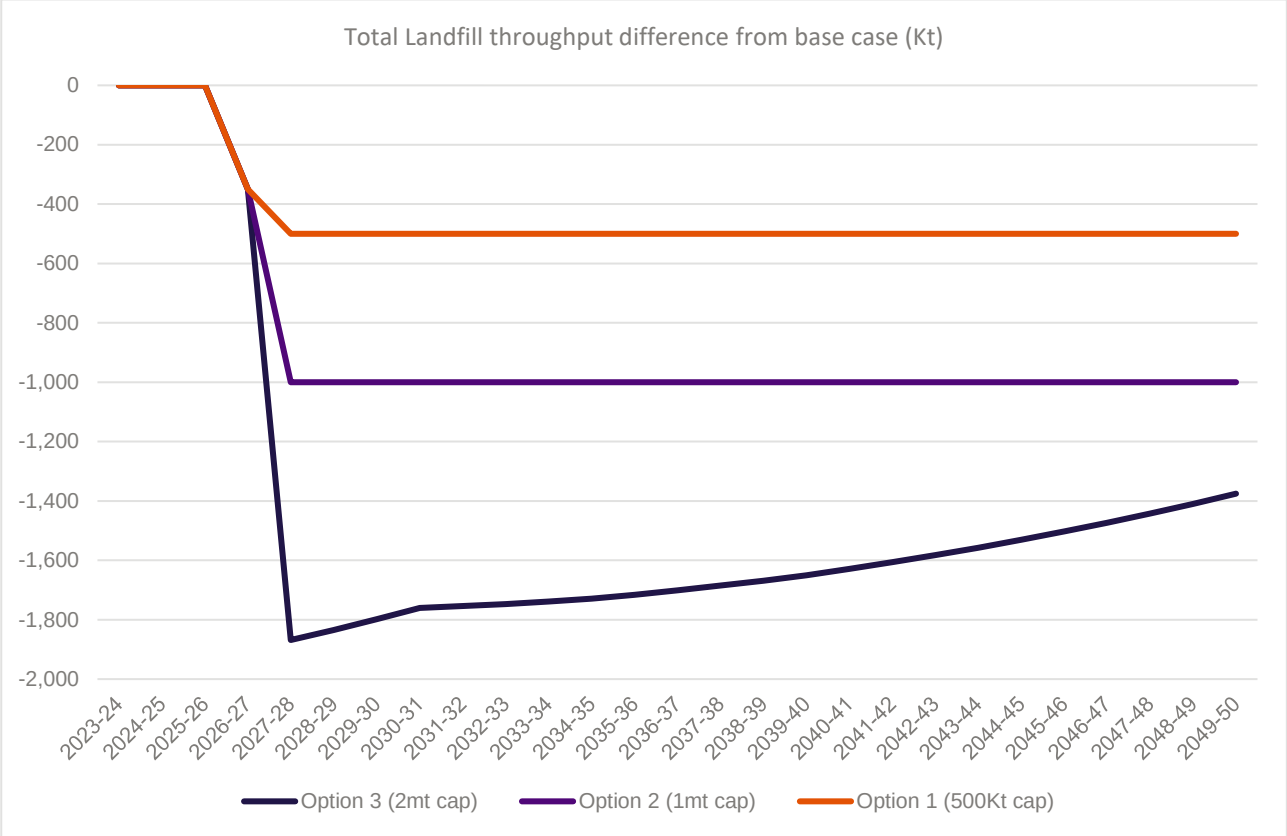

Figure E: **Total landfill throughput**

Sensitivity testing for this comparative analysis demonstrates that, under a scenario where recovery rates improve at only a slightly greater rate than forecast under the central assumption scenario, Option 2 and Option 3 may offer near equal benefits for landfill diversion in the latter years of the modelling.

The central scenario in the model currently assumes a recovery rate improvement of one third, or 33%, of the difference between expected recovery rates in 2030 and a 100% recovery rate in 2050 and is applied to different material types individually. For instance, if a material type had a 50% forecast recovery rate in 2030-31, the 33% improvement would take that to 66.5% in 2049-50. The aggregate effect of this assumption is around a 10 percentage point total improvement in recovery rate across all materials between 2030 and 2050.

Table 6 demonstrates how with relatively small increases to the general improvement in recovery rates between 2030-31 and 2049-50, and in addition to other improvements, Option 2 may offer equal benefits for landfill diversion in the final years of the model as Options 3. With an assumed improvement in recovery rates of 43%, which implies a total aggregate improvement of about 12 percentage points, there is no difference in landfill diversion between Option 2 and Option 3 in 2049-50. Under this scenario, this convergence occurs because the enhanced recovery rates reduce the amount of feedstock which would not have been recovered. That is, with an overall recovery rate improvement of 12 percentage points, the additional 1m in throughput under Option 3 would be entirely comprised of material that would be recycled under the base case and other Options.

Additionally, Table 8 presents a sensitivity test for each option, outlining the total landfill throughput avoided over the model's timeframe in Kt, from 2023-24 to 2049-50. This analysis provides a comprehensive picture of the long-term impact of varying recovery rates on landfill diversion for each option.

Table 6: Sensitivity Analysis – Total avoided landfill throughput (Kt) in 2049-50

Recovery rate improvement from 2030-31 to 2049-50	Option 1	Option 2	Option 3
25	500	1,000	1,681
33	500	1,000	1,376
40	500	1,000	1,109

Assuming a conversion of 1.5 tonnes per cubic meter will result in the following avoided use of landfill capacity. Table 7 displays the aggregate of total landfill throughput avoided. For reference Hanson's Wollert landfill has an annual capacity of 450 Kt.

Table 7: Sensitivity Analysis – aggregate of total landfill throughput avoided (Kt) from 2023-24 to 2049-50

Recovery rate improvement from 2030-31 to 2049-50	Option 1	Option 2	Option 3
25	11,850	23,350	40,940
33	11,850	23,350	38,110
40	11,850	23,350	35,634

Table 8: Sensitivity Analysis – Total aggregate avoided landfill throughput (m^3) from 2023-24 to 2049-50

Recovery rate improvement from 2030-31 to 2049-50	Option 1	Option 2	Option 3
25	7,900	15,567	23,756
33	7,900	15,567	25,407
40	7,900	15,567	27,293

4. Emissions

This RIS assesses greenhouse gas emissions impacts of the different cap options. Given significant, ongoing innovation in both WtE and recycling technologies, and also improvements in methane capture and use in landfills, there is a level of uncertainty about the emissions impacts of different infrastructure and waste management scenarios over the next few decades. This analysis makes several simplifying assumptions to assist in understanding the impact that different cap levels might have on waste flows and therefore on emissions.

Thermal WtE produces GHG emissions through the transformation of waste via combustion or other thermal treatment process such as gasification or pyrolysis, and consumption of stationary fuels, such as gas, to maintain required operating conditions. The amount of emissions depends on the composition of the waste and the thermal technology in use. The waste composition is a key sensitivity, as under the international emissions accounting rules for the national greenhouse gas accounts, carbon dioxide from biogenic carbon, such as. paper, garden, wood and food, and fossil carbons such as plastic carry different global warming potentials (GWP). Biogenic carbon dioxide including from organic waste is assumed to experience uptake and release within 100 years through photosynthesis and carries a neutral GWP, that is the emissions are not counted in the national greenhouse gas accounts. Whereas GHG emissions from fossil carbon such as plastic have a higher GWP and are counted in the national greenhouse gas accounts.

When WtE plants generate electricity, they reduce the need for electricity to be generated from other sources and they avoid the GHG emissions associated with that alternative generation. The generator that would

have produced electricity in the absence of the WtE plant(s) is referred to as the 'marginal generator'. It is not necessarily the generator that produces *most* of the electricity at a given time, but the generator that bids into the wholesale market at the highest price at which the market clears to meet demand, that is it provides the 'final' bit of electricity. Being the generator that determines the wholesale market price at a given time is called 'generating on the margin'.

While the 'average' electricity generated in Victoria and in the National Electricity Market typically comes from coal-fired power stations, the marginal generators are a mixture of coal, renewable energy, and gas plants. This means that, currently, the GHG emissions associated with marginal electricity generation, the emissions that are 'displaced' by WtE plants, are lower than the GHG emissions from the 'average' electricity generator.

In future, as coal-fired power stations close, the importance gas-fired power stations in meeting the 'final' bits of electricity demand will increase in addition to the growing importance of renewable energy. This means that, while the average GHG emissions in a renewables-dominated electricity system will be close to zero, marginal electricity GHG emissions will remain higher. Further information is provided in Appendix B.

The extent to which any thermal WtE facility can offer net emissions benefits depends on what would have happened in the absence of that facility, that is, the emissions that would have been generated by the landfill or recovery facility that would have processed the same waste, and the energy generating facility that would have provided the same amount of energy. Further information for energy generation assumptions is found in Appendix B. Chapter 1 explores some of the trends in the waste and energy sectors that make it more difficult to predict the net emissions impact of WtE facilities in Victoria over the next few decades, including an increase in renewable energy and a decrease in organic waste to landfill.

Table 9: Total avoided greenhouse gas emission (millions of tonnes of CO_2e) from 2023-24 to 2049-50

Impact	Option 1	Option 2	Option 3
Greenhouse gas emissions avoided (mt CO_2e)	5.2	10.2	19.6

The model compared WtE emissions with alternative waste and energy solutions using simplifying assumptions over a time horizon to 2049-50. It shows that, while per-tonne emissions from landfill hold relatively steady, the per-tonne net emissions of processing waste in thermal WtE facilities increases more significantly over time, or emissions reductions would decrease over time, as the electricity grid decarbonises. For example, plastic processed in a thermal WtE facility using mature technologies would generate a net increase of emissions of 1.63 tonnes of CO_2-e for each tonne of waste processed in 2024-25, and by 2049-50 that figure would be 2.45 tonnes. This compares with zero emissions associated with plastic in landfill, as it is inert over periods exceeding 100 years, and with net emissions reductions of recycling of -0.36 tonnes of CO_2-e per tonne of plastic recycled in 2024-25, which falls to -0.17 tonnes in 2049-50.

Similarly, the net emissions benefit of processing food in the same thermal WtE facility would reduce, from -0.71 tonnes of CO_2-e for each tonne of waste in 2024-25 to -0.43 in 2049-50. This compares with net increased emissions of food in landfill of 0.71 tonnes of CO_2-e per tonne of waste disposed of in 2024-25, increasing to 0.84 tonnes in 2049-50, due to the release of methane as the food decomposes, which is a more potent greenhouse gas than CO_2. Food that is recovered by commercial composting is associated with a small increase in carbon emissions, of 0.06 tonnes CO_2-e per tonnes of food composting, declining to 0.04 tonnes in 2049-50; this positive value is due to the energy required to warm commercial in-vessel composting units being slightly more emissions intensive per tonne than the amount of carbon sequestered for 100 years or more in the compost.

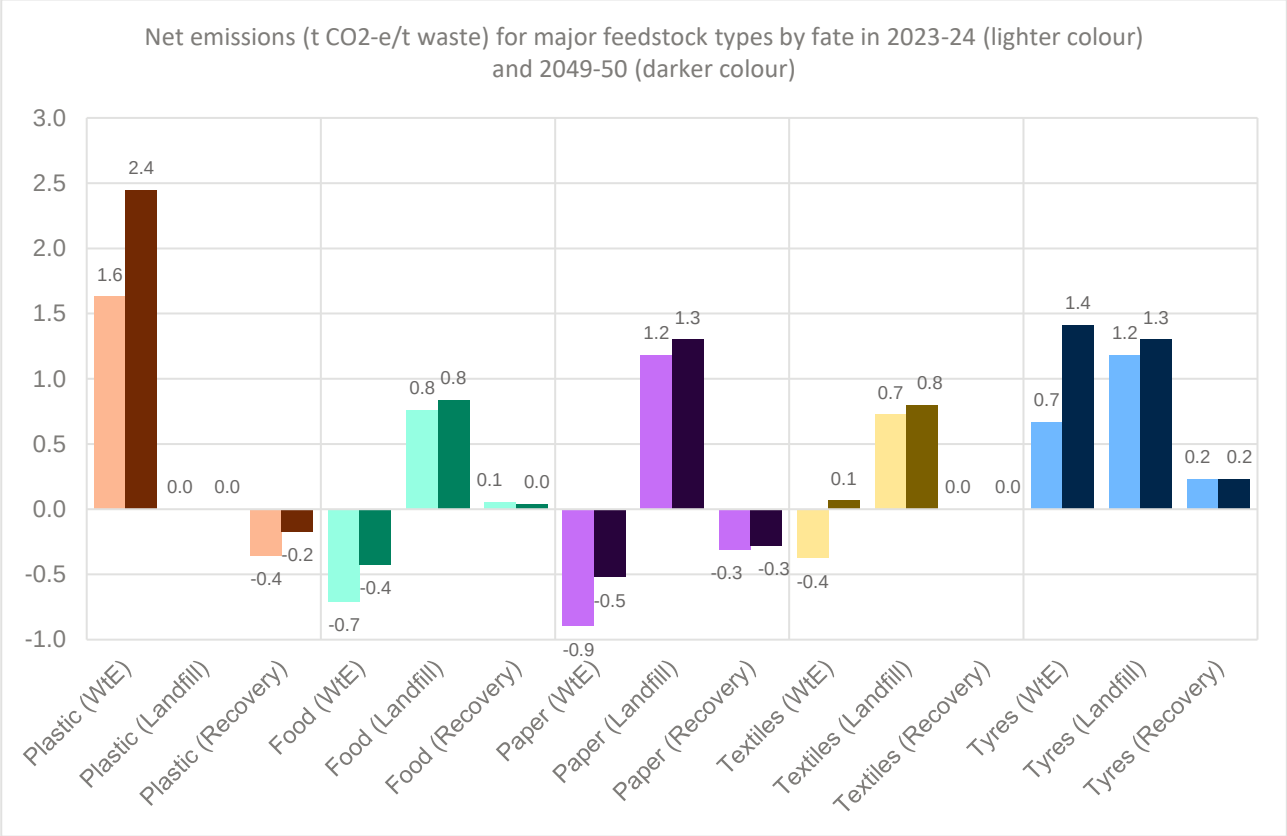

Figure F: Net emissions (t CO_2-e/t waste) for major feedstock types by fate in 2023-24 (lighter colour) and 2049-50 (darker colour)

(a) There was no reliable data available to estimate the per tonne emissions of textile recycling, due to the infancy of the technology. Therefore, to be conservative a value of zero emissions was assumed. It is expected that this technology, once mature, would likely help avoid carbon emissions.
(b) There was no reliable data on the avoided emissions associated with tyre recycling, but there was evidence for the direct emissions of tyre recycling. Similar to textiles, it was conservatively assumed in the model that the avoided emissions associated with tyre recycling are zero. Again, it is expected that the avoided emissions associated with tyre recycling would be greater than zero.

The value placed on the GHG emissions produced or avoided are based on international projections of the costs of reducing GHG emissions to meet Victoria's climate action targets: decreasing GHG emissions through WtE makes it easier to meet Victoria's targets, and avoids abatement costs elsewhere, while increasing GHG emissions through WtE makes it more difficult to meet Victoria's targets and would add abatement costs in other areas of the economy. Further information is provided in Appendix B.

The shape of the net present value of emissions benefits presented in the figure below is driven by:

- The total amount of waste used as feedstock by WtE facilities
- The material composition of the feedstock used
- The relative greenhouse gas emission factors of those materials depending on their fate
- The marginal greenhouse gas emissions associated with a MWh of grid electricity
- The increasing value of emissions over time, and
- The social discount rate of 4% used in this RIS, which reduces the value of future costs and benefits relative to present costs and benefits.

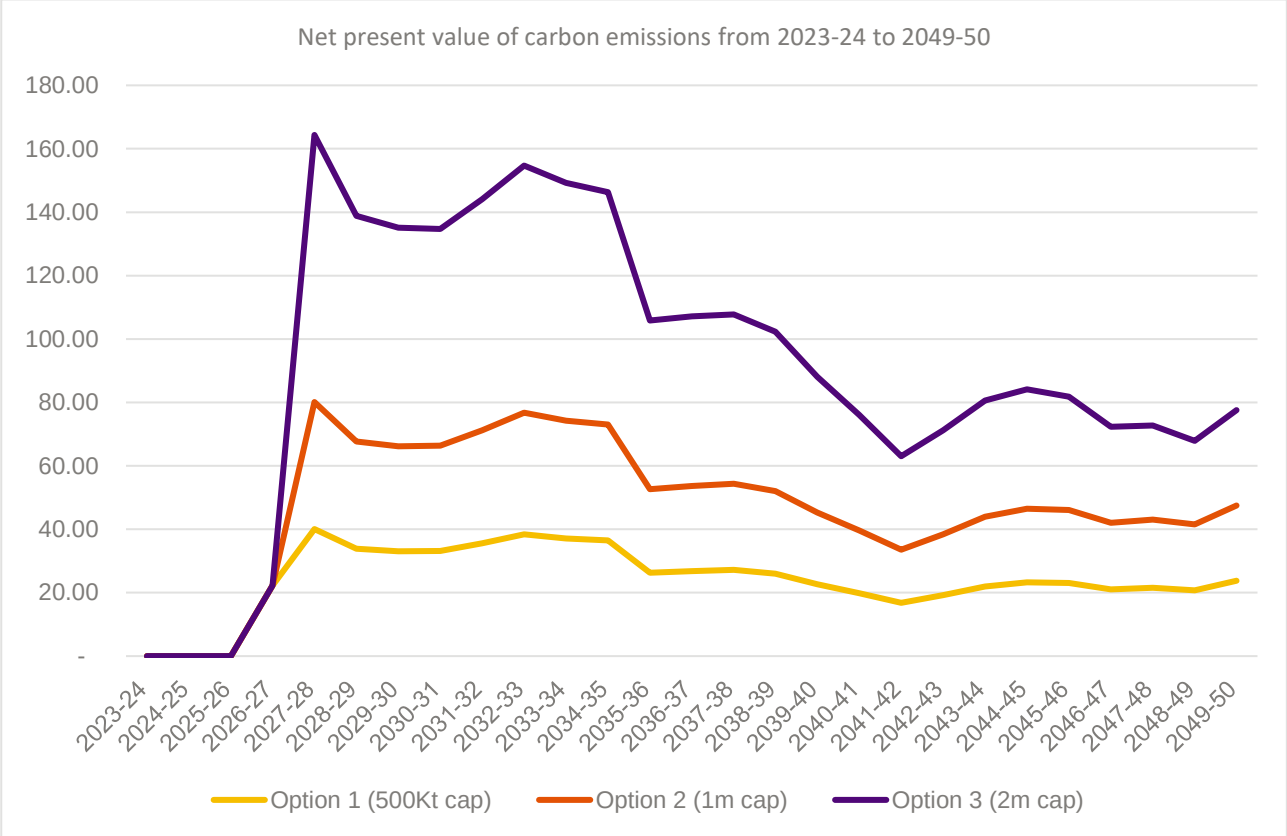

Figure G: Net present value of carbon emissions from 2023-24 to 2049-50

Transport emissions are not included in this analysis, because the relative impacts of WtE facilities compared with landfills or other recycling facilities cannot be known until the location of the waste generation and processing facility. This analysis uses a simplifying assumption that transport emissions will be similar for all facilities.

Table 10: Emissions costs and benefits associated with thermal waste to energy facilities

Category	Description
Cost	Increased greenhouse gas emissions from WtE facilities
	Increased greenhouse gas emissions from electricity sourced from the grid which would otherwise have been sourced from landfill-generated electricity
	Decreased emissions notionally offset through recovery activity.
Benefit	Avoided greenhouse gas emissions from landfill
	Avoided greenhouse gas emissions from WtE substituting electricity sourced from the grid
	Decreased emissions from fuel use and electricity in recovery activity

Table 11: Sensitivity analysis of net present value of total avoided greenhouse gas emissions from 2023-24 to 2049-50 ($m)

Emissions valuation sensitivity analysis	Option 1	Option 2	Option 3
Low	469	923	1,764
Central	650	1,278	2,448
High	1,031	2,027	3,889

5. Financial and distributional impacts

Financial impacts on landfill operators, WtE operators and government have been estimated in terms of changes in revenue associated with any shift from landfill activity to WtE activity.

From the point of view of an operator, whether WtE or landfill, profit calculated as revenue minus costs denotes the economic value received by that operator. However, profit does not capture the complete economic impact, as it excludes the secondary impacts to labour, capital and impacts on upstream and downstream industries.

For every tonne of waste transferred from landfill or recovery in the base case to WtE under each option, there is a transfer of value encompassing landfill or recovery revenue and waste levy receipts lost and WtE revenue gained. In addition, WtE production displaces both landfill energy generation from methane capture and grid generators of electricity, which causes an additional transfer from landfill operators and electricity grid generators at the electricity market rate. It is important to note that, since second and third-order market impacts are not in-scope, industry impacts are treated as a transfer of wealth from four sectors; landfill operators, recyclers, electricity grid generators and the government, to WtE operators.

The magnitude of these transfers depends heavily on assumptions relating to the landfill, recovery, electricity and WtE sectors. To begin with, it is assumed that all revenue earned by operators based in Victoria stays in Victoria. Embedded in this explicit assumption is the implicit set of assumptions that all employees of, investors in, and suppliers to both landfill and WtE operators are based in Victoria. Furthermore, a simplifying assumption is made around gate fees, keeping them constant in real terms at $185 per tonne of waste processed for landfill, recovery and WtE. For landfill, this gate fee includes a constant $129.27 per tonne waste levy in real terms. While over time gate fees may increase, it is likely that these movements will be roughly proportional. Comparable gate fees for landfill and WtE is a reasonable assumption, given the competition for residual waste between the two sectors. The assumption of a similar gate fee for recyclers was used for simplicity; in reality these gate fees are likely to depend on, amongst other factors, the degree of source separation, commodity market prices, and the extent of competition in a particular material category. It is difficult to make any assumptions around how gate fees might change year-on-year, but it is likely that these distributive effects will stay in roughly the same proportions.

The Department notes that, while the government's waste levy revenues would be reduced by building additional WtE capacity, it is the policy of the government to increase diversion from landfill, with a target of 80% diversion by 2030. The meeting of this target entails lower waste levy revenues, which in the absence of these proposed Regulations would have to be met by alternative means, so this should not be considered an additional loss to government as a result of these proposed Regulations. They are nonetheless included for completeness.

In addition to the financial impact of waste allocation, there are also transfers that occur between the landfill sector, the WtE sector and grid generators. The electricity that is produced by WtE and landfill substitutes electricity that would otherwise be generated for the grid. Assuming a constant spot price of electricity of $70 per MWh, a sense of the scale of the transfer can be determined. The transfer is positive for the waste to electricity sector as it produces more electricity, negative for the landfill sector as it produces less electricity, and negative for other grid generators as the electricity they would otherwise produce is being substituted. In addition to the electricity market impacts, WtE can also produce gas or other fuels, which can offset gas and fuel production from other sources, leading to a similar transfer from gas and other fuel producers to the WtE sector. In addition, the model assumes that WtE facilities capture the waste heat from processing and utilise it for industrial processes requiring heating. If facilities do not utilise the heat in this way, then the emissions offsets would be about 27% lower than modelled.[5].

Table 12 shows the present value over the 27-year period of these transfers to each key stakeholder: the landfill sector, the recycling sector, the energy generation sector, the WtE sector, and the Victorian Government.

[5] The model only accounts for thermal waste to energy being used for industrial processes directly, that is waste heat of generators, rather than the generation of gas.

Table 12: Financial transfers, present value

Financial transfers ($m NPV)	Option 1 (500Kt cap)	Option 2 (1m cap)	Option 3 (2m cap)
COSTS			
Decrease in landfill operator revenue	473	923	1,521
Decrease in recycler operator revenue	-	-	774
Decrease in Government waste levy revenue	874	1,708	2,836
Decrease in grid generator energy export revenue	610	1,194	2,322
TOTAL COSTS	**1,957**	**3,825**	**7,453**
BENEFITS			
Increase in WtE operator revenue	1,957	3,825	7,453
TOTAL BENEFITS	**1,957**	**3,825**	**7,453**
NET TOTAL	**0**	**0**	**0**

Table 13 shows the average annual changes to generation by each source, and Table 12 shows the value of these transfers over the period.

Table 13: Electricity generation impact

	Option 1	Option 2	Option 3
Average annual (GWh)			
Change in electricity produced through WtE	733	1,446	2,749
Change in electricity produced through landfill	- 97	- 191	- 299
Change in electricity produced through grid generation	- 636	- 1,255	- 2,450

The total generating capacity of thermal WtE represents between roughly 1.5% and 6% of total electricity consumed in Victoria per annum, depending on the option. No broader market impacts, such as changes to electricity prices as a result of additional WtE facilities, are factored into the analysis. This assumption has been made because WtE facilities represent a small part of the energy system. As a result, the revenue generated by WtE operators from the sale of electricity into the grid, or avoided costs for behind-the-meter use of energy, is treated as a transfer from other electricity generators including landfill operators..

Other impacts

In addition to the five impacts above, the analysis for this RIS considered a suite of other impacts. Table 14 summarises the full list of impacts considered in the RIS analysis.

Table 14: Summary of other impacts associated with thermal waste to energy facilities, and treatment

Description	Included in analysis
Health, environmental and amenity costs from by-products beyond greenhouse gas emissions of landfill, recovery facilities, WtE facilities, and alternative	Qualitatively Each of landfill, recovery facilities, WtE facilities, and alternative electricity generation have the potential to bring varied negative health and environmental outcomes, which, in turn, can negatively impact the amenity of people living close to these facilities. However, the nature and magnitude of these impacts and, hence, the net impact of WtE versus recovery facilities, and landfill is contingent on a number of unknown factors, such as the makeup of WtE feedstock, the technology

Description	Included in analysis
electricity generation avenues[6]	used in the WtE facility or landfill to reduce air emissions or odor, the placement of new WtE facilities and the actions taken by regulators, including the EPA. This impact is also partially covered in section '3: avoided use of landfill'.
Administrative costs to government	Qualitatively The scale and potential impacts of WtE facilities necessitates regulation. Where there are administrative costs to government, cost recovery guidelines are followed. This is explored further in the section 'Impact analysis of options for fees structure'.
Change in waste transport costs	Qualitatively as follows: Impacts associated with the transportation of waste, either to landfill, WtE facilities, or future recovery facilities depends in large part on the placement of new WtE facilities, and the agreements reached between waste producers such as local councils and individual facilities. These factors are dependent on the decisions made by RV in approving facilities. In the absence of specific information, waste processing facilities of any type are assumed to be established in the same general areas and transportation costs are not factored further into this analysis.
Job creation	Qualitatively as follows: It is unclear the extent to which the WtE industry in Victoria will create new jobs, or lead to the transfer of jobs from other industries, particularly in the construction phase, given the construction industry is currently constrained. There is not considered to be a significant difference in the FTE required per tonne of waste processed to operate landfill compared to that required to operate a WtE facility. WtE facilities will likely directly create permanent jobs in the operation and maintenance of new or expanded facilities, as well as in waste collection which will likely be offset by a reduction in jobs transporting waste to landfill, depending on facility locations. There are also likely to be indirect jobs created in service and support industries such as maintenance contractors and suppliers, as well as downstream secondary industries such as metals recycling or civil construction using bottom ash aggregates.
Social and economic development	Qualitatively WtE provides compelling social and economic development benefits over landfill disposal methods. These include essential support for secondary industries through utilisation of recovered products such as bottom ash in brick making or civil construction applications, contributing to circular economy aspirations. By efficiently recycling these materials, WtE may itself mitigate the demand for virgin resources, reducing the environmental impact associated with extracting and processing raw materials.

Impact analysis of options for fees structure

The total impact of the proposed fees is expected to be small in terms of aggregate fee revenue, given the low number of applicants likely to apply to operate a WtE facility. The expected fee revenue is relatively small, but falls on a small number of stakeholders, and thus merits a proportional analysis in this RIS. The following analysis is used to set out DEECA's consideration of possible fee structures and the rationale for selecting the preferred structure.

A multicriteria analysis (MCA) is used to assess the options identified in Chapter 3 in relation to the fee structure for the WtE licensing scheme.

As outlined in Chapter 3, the three options to be considered are:

[6] Note that Victoria's EPA regulates waste to energy facilities to protect human health and the environment. The EPA will continue to undertake this role alongside the new role for Recycling Victoria as regulator of the Waste to Energy Scheme under the CE Act.

- Option 1 – Flat fee structure
- Option 2 – Differentiated fee structure, and
- Option 3 – Sliding scale fee structure.

The proposed fees under each option are outlined in Table 15.

All options set the same fee and structure for expressions of interest and applications to decrease a cap allocation. This is because the relative effort required from the regulator, Recycling Victoria, to administer these processes is not expected to vary significantly between facility sizes or complexity, and the proposed fee quantum is relatively small compared to the proposed cap licensing fees. Therefore, the MCA considers only the differences in impacts associated with the cap licence application fee.

Table 15: Fee options for the waste to energy cap licensing scheme

	Cap licence application		Expression of interest		Application to decrease cap	
	Fee units	*2023-24 fee*	*Fee units*	*2023-24 fee*	*Fee units*	*2023-24 fee*
Option 1 – Flat fee	2,095	$33,310.50	780	$12,402	390	$6,201
Option 2 – Differentiated fees	1,045 (small) 2,095 (large)	$16,615.50 $33,310.50	780	$12,402	390	$6,201
Option 3 – Sliding scale	82 – 2,095	$1,303.80 - $33,310.50	780	$12,402	390	$6,201

Multicriteria analysis framework to assess options for fees structure

The intention in setting WtE licensing fees is to enable partial cost recovery for RV's relevant resourcing, in a manner that also aligns with:

- Distributing costs of service provision fairly among those who benefit from the service (Principle 2)
- Not unduly creating a barrier to entry, competition or innovation (Principle 7), and
- Being simple to understand and administer (Principle 11).

On this basis, the criteria outlined in Table 16 have been defined to assess the options in the MCA. The criteria have also been weighted according to their relative importance to achieving the intent of the licensing scheme. In this instance, all criteria have been weighted equally.

Table 16: MCA criteria and weights

Criteria	Description	Weight
Fair distribution of costs	The extent to which an option results in a fee structure which distributes the costs of the service amongst those who benefit from being considered for allocation of the permitted waste cap. This criterion aligns with Pricing Principle 2.	33%
Barrier to entry, competition or innovation	The extent to which an option imposes an undue barrier which would result in negative outcomes, such as creating a barrier to entry, competition or innovation. This criterion aligns with Pricing Principle 7.	33%
Simplicity	The extent to which an option results in a fee structure which is easy for applicants to understand, and simple for RV to administer. This criterion aligns with Pricing Principle 11.	33%

Scoring of options

A score has been assigned according to the impact of the option against each of the criteria, measured relative to the base case. A rating scale from -10 to +10 (Table 17) has been applied against each criterion listing in Table 16 above. The base case is given a zero score on all criteria.

Table 17: MCA scoring scale

Score	Description
-5 to -10	Much worse than the base case
-1 to -4	Somewhat worse than the base case
0	No change from the base case
1 to 4	Somewhat better than the base case
7 to 10	Much better than the base case

Each option has been assessed against the criteria defined above. An option is preferred where it receives the highest net score after assessment of each criterion.

Table 18 provides a summary of the MCA results, showing **Option 2 – Differentiated fee structure as the preferred option**. A detailed analysis of the scoring of each option against each criterion follows the summary table.

Table 18: Summary of MCA scores for all fee structure options

	Weight	Option 1 – Flat fee	Option 2 – Differentiated fees	Option 3 – Sliding scale
Fair distribution of costs	33%	6	8	9
Barrier to entry, competition or innovation	33%	-3	-2	-1.5
Simplicity	33%	-1	-1.5	-5
Total weighted score		0.66	1.49	0.83

Criterion 1: Fair distribution of costs

Option 1 – Flat fee

Option 1 receives a score of 6 against this criterion, as compared to the base case where no fee is prescribed, this option distributes the costs of regulatory services amongst those who benefit from being considered for allocation of the permitted waste cap, rather than these costs being covered by the broader Victorian community.

Option 2 – Differentiated fees

Option 2 receives a score of 8 against this criterion. Similar to Option 1, compared to the base case this option does distribute the costs of regulatory services amongst those who benefit from being considered for allocation of the permitted waste cap, rather than the broader Victorian community.

This option scores better compared to Option 1, given this fee structure allows for differentiation between applications to operate small or large facilities, better aligning the fees with the benefits operators may receive given greater potential for revenue benefits associated with operating a larger facility. This also aligns better with the expected increased relative regulatory effort in the assessment of larger, more complex facilities.

Option 3 – Sliding scale

Option 3 receives a score of 9 against this criterion. Similar to Options 1 and 2, compared to the base case this option does distribute the costs of regulatory services amongst those who benefit from being considered for allocation of the permitted waste cap, rather than the broader Victorian community.

This option scores better compared to Option 2, as this fee structure allows for the fee payable to scale directly with facility size, ensuring that the largest facilities will pay the highest fee, relative to other applicants. This option only scores slightly better compared to Option 2 however, given there is a capped fee limit, so applications for facilities on the larger end of the scale will all pay the same fee.

Criterion 2: Barrier to entry, competition or innovation

Option 1 – Flat fee

Option 1 receives a score of -3 against this criterion. Compared to the base case where no fee is prescribed, this option does impose a fee, which has the potential to create a barrier to entry, competition or innovation. The imposition of a fee may unduly deter some prospective operators from applying, particularly smaller operators who might face challenges in securing funding which would likely be dependent on receiving licence to operate.

Option 2 – Differentiated fees

Option 2 receives a score of -2 against this criterion. Similar to Option 1, compared to the base case where no fee is prescribed, this option does impose a fee which has the potential to create a barrier to entry, competition or innovation.

This option however, scores marginally better than Option 1, as the differentiated fee structure will prescribe a lower fee for prospective smaller operators, creating a lower barrier to entry, competition or innovation than under Option 1.

Option 3 – Sliding scale

Option 3 receives a score of -1.5 against this criterion. Similar to Options 1 and 2, compared to the base case where no fee is prescribed, this option does impose a fee which has the potential to create a barrier to entry, competition or innovation.

While the sliding fee scale under this option will allow the barrier for entry to scale directly with operator size, this option scores only slightly worse than Option 2, as the cap on the fee amount will not enable differentiation between mid to large size facilities and very large-scale facilities. It will see these very large operators being required to pay the same fee as some operators on a relatively smaller, but still sizeable, scale.

In some cases, a fee that scales with cost of development may create a disincentive for prospective operators to invest in technologies which may have higher up-front costs be more efficient in the long term.

Criterion 3: Simplicity

Option 1 – Flat fee

Option 1 receives a score of -1 against this criterion. Compared to the base case where there is no fee structure to understand, applicants will need to be conscious a fee is required to be paid when submitting their application. This option only scores slightly worse than the base case, as given only one fee will be prescribed, understanding this would not be too burdensome for applicants to understand and RV would only need to establish processes to administer and track payment of only one fee level.

Option 2 – Differentiated fees

Option 2 receives a score of -1.5 against this criterion. Compared to the base case where there is no fee structure to understand, applicants will need to be conscious a fee is required to be paid when submitting their application.

Under this option the differentiated fee structure will mean applicants will need to determine whether they are considered a small or large facility, and the corresponding fee they must pay. Given facility size is proposed to be defined based on the throughput of permitted waste in tonnes applied for in the application, this information will be easily identifiable by applicants as it forms a key component of the cap licence application and therefore, this option does not receive a lower score compared to Option 1 on this basis.

This option will, however, require RV to establish processes to administer and track payments of two different fee levels, so this option receives a marginally worse score than Option 1.

Option 3 – Sliding scale

Option 3 receives a score of -5 against this criterion. Compared to the base case where there is no fee structure to understand, applicants will need to be conscious a fee is required to be paid when submitting their application.

Under this option, the sliding scale fee structure will require applicants to calculate the fee they are required to pay based upon the value of development costs. This will require minimal effort on applicants to calculate, and so only impacts the scoring of this option marginally.

This option will, however, require RV to establish processes to administer and track numerous different payment amounts from different applicants, and will create uncertainty for RV in determining likely revenue flows. Therefore, this option receives a worse score compared to Option 1 and 2.

Summary of preferred fee structure option

As shown in the MCA results in Table 19 Proposed Fees, the preferred option for setting the fee structure for cap licence applications is Option 2, a differentiated fee structure. Under this option, fees for the cap licence application will be differentiated based on facility size, with a lower fee for small facilities and a higher fee for large facilities.

Table 19: Proposed fees

	Cap licence application	
	Fee units	*2023-24 fee*
Cap licence application	1,045 (small facility) 2,095 (large facility)	$16,615.50 $33,310.50
Expression of interest	780	$12,402
Application to decrease cap	390	$6,201

The proposed Regulations will set the threshold for small facilities at those seeking to process less than 30,000 tonnes of permitted waste per annum. In determining this threshold, DEECA and RV considered a number of alternative options, including:

- permitted waste throughput in tonnes proposed
- total throughput in tonnes
- MW output, and
- monetary value of proposed project.

Permitted waste throughput was selected as the recommended threshold, given alignment with the WtE framework's focus on waste inputs, rather than outputs. There was also considered a risk that if the threshold was determined based on MW output, there may be incentive for applicants to reduce their MW output.

The threshold of 30,000 tonnes considers the policy settings in Victoria, provides opportunities for small pyrolysis and gasification plants, and aligns with the relative size of facilities in the Victorian context.

The proposed facility size threshold seeks to ensure a fair fee structure while considering the capacity constraints of the WtE cap, allowing operators seeking to apply for up to only 3% of the total cap limit in Victoria an opportunity to do so through a lower fee.

The proposed threshold also acknowledges the operational characteristics of small pyrolysis and gasification WtE plants. These technologies provide valuable alternatives for sustainable waste management, especially in regional locations. Setting this threshold ensures that these small-scale pyrolysis and gasification plants are not disproportionately burdened by excessive fees that could impede their viability.

In the Victorian context, a 30,000 tonne facility is considered small relative to other waste management and energy facilities. When compared to larger-scale facilities in the region, which have capacities in the hundreds of thousands of tonnes per year, a 30,000 tonne facility is modest in size. Categorising facilities below this threshold as small, will ensure a fair distribution of fees based on facility operational scale and alignment with industry standards and benchmarks established in the region.

Partial cost recovery

Option 2 will most likely result in a partial cost recovery, the rationale for adopting this approach for as a fee structure for WtE licences is multifaceted. WtE offers benefits to the government, the broader community, and WtE operators. It plays a crucial role in reducing reliance on landfills, aligning with the government's circular economy policy objectives.

The choice of partial cost recovery is a pragmatic compromise that is more beneficial to applicants compared to full cost recovery. A partial cost recovery is considered fair for the EOI process due to uncertainty about whether an applicant will be invited to apply for a cap licence and, subsequently, authorised to operate a thermal waste to energy facility. Further, a prohibitively high fee could result in a reduced pool of proposals.

For the cap licence application fee, partial cost recovery could be considered appropriate as operators allocated a cap licence will derive direct benefit from operating a waste to energy facility. However, as cap licensing is a competitive process, with no guarantee that an applicant will receive a licence, with identified broad system benefits that WtE facilities can provide for the Victorian community.

For the purpose of analysis in this RIS, we have assumed 15 applications, consisting of 12 large and 3 small scale proposals. This estimate is derived from engagements with industry stakeholders concerning the cap implementation.

Table 23 outlines cap license administering costs for RV, estimated at $760,000. With 15 expected applicants, the cost per applicant is approximately $635,602.50. The proposed fee structure would represent an estimated 83% proportion of cost recovery.

Administrative costs are expected to be incurred by applicants. These administrative costs can be estimated using assumptions: cost of time valued at $51 per hour, covering on costs and margins, with an estimated 500 hours required for a license and expression of interest application. These assumptions lead to likely actual costs beyond the RV fee amounting to approximately $25,500 per application.

Chapter 5 Summary of preferred option

This chapter summarises the preferred options as identified following analysis outlined in chapter 4. It covers the options' key characteristics, likely impact on stakeholders relative to existing arrangements, and impacts to competition and small business.

Cap of one million tonnes

In line with the preferred option, the proposed Regulations prescribe a cap limit of one million tonnes per financial year. This means that the Head, Recycling Victoria would not issue a cap licence if the issue of that licence would have the effect of specifying an aggregate amount of permitted waste in cap licences that exceeds one million tonnes per financial year (CE Act, s. 74U). This aligns with the Victorian Government commitment in its circular economy policy, and reiterated in the Framework.

The CE Act and proposed Regulations provide further detail regarding how cap licences will be allocated within this cap limit – for example, proposed Regulations provide that the Head, Recycling Victoria must take into account information provided in the:

- applicant's expression of interest to apply for a cap licence or an increase in the allocated cap amount specified in a cap licence
- application for a cap licence
- if the application relates to a critical waste infrastructure project specified in column 2 of the table in Schedule 1 (Table 20), the desirability of that project meeting the corresponding critical need specified in column 3 of the table in Schedule 1 through the operation of waste to energy facilities related to that project

Table 20: Schedule 1 – Critical waste infrastructure projects

Column 1	*Column 2*	*Column 3*
Item	*Critical waste infrastructure project*	*Critical need*
1	The project procured by South East Metropolitan Advanced Waste Processing Pty Ltd ACN 654 660 438 that is known by the name "South East Metropolitan Advanced Waste Processing project" or by any subsequent name	Additional processing of waste due to closure of the Hampton Park Landfill

- any advice or information provided to the Head, Recycling Victoria by the Authority that indicates, or may indicate, environmental or compliance risks posed by the facility
- the extent to which the distribution of WtE facilities across Victoria, including their proximity to any waste feedstocks and offtake destinations for energy and other output products, enables the facility to contribute to an efficient waste infrastructure system
- the source, composition, material type and weight of permitted waste and exempt waste in metric tonnes proposed to be processed over the projected lifetime of the facility, including the extent to which the facility can accept changing feedstocks
- the commercial and technical viability of the energy recovery process or technology proposed to be used at the facility
- any information provided to the Head, Recycling Victoria regarding whether the applicant has obtained environmental, planning, safety and other permits or licences associated with operating the facility
- any planned, completed or ongoing engagement activity with:
  - the local community
  - any relevant traditional owners
- any economic, social and environmental costs and benefits associated with the facility, including—
  - any employment opportunities created by the construction and operation of the facility; and

- the energy products that the facility will produce.

RV will implement these provisions, and provide further guidance for potential cap licence applicants – regarding both expressions of interest and cap licences applications.

While the proposed Regulations will require that the Head, Recycling Victoria take into account the considerations above, they are not direct costs or conditions on licence applicants. As outlined in chapter 3, specific information and a level of detail will be required for expressions of interest and cap licence applications to RV. The information and detail sought through this process will necessarily be informed by the final regulations, after consultation has concluded, and will specified by RV prior to the commencement of each step in the licensing process. While it is reasonable to assume that this will require some input and therefore effort from WtE proponents, this RIS does not quantify this effort because specific information requirements are not yet prescribed or known.

To the extent that RV is able, and consistent with the requirements of its role under regulations, it will seek to share information with other regulators reduce regulatory burden in line with Victorian Government policy, including Towards Best Practice, a guide for regulators (Better Regulation Victoria, 2022).

Impact of the cap limit on stakeholders relative to existing arrangements

Specifying this cap limit in the proposed Regulations provides greater certainty to industries and communities about the role and scale of WtE in Victoria's circular economy. Head RV is unable to issue a cap licence without the proposed Regulations. The proposed Regulations only allow permitted waste processing cap licenced operators up to one million tonnes per financial year.

The cap will not affect the issue or use of EO licences under the WtE Scheme, nor the quantity of permitted waste to be processed under those licences. The cap will also not affect the ability of existing or new operators to process either:

- exempt waste using thermal WtE, or
- waste using processes that are not classed as thermal WtE under the WtE Scheme.

Impacts of the cap limit to competition and small business

Table 21: Assessment of impacts of the cap limit on competition and small business

Competition impact	Answer	Explanation
Is the proposed measure likely to limit the number of producers or suppliers to: • only one producer? • only one buyer? • less than four producers?	Uncertain.	Given the level of business interest in WtE investment in Victoria, the proposed one million tonne cap limit is expected to limit the number of thermal WtE facilities operating in Victoria. However, given the significant variety in WtE facility sizes, it's not possible to predict how many facilities could be approved within a one million tonne cap – particularly when each of those facilities could theoretically process a significant volume of exempt waste in additional to the capped amount of permitted waste. The cap is not expected to limit the number of waste producers, those businesses upstream of WtE, nor the number of energy users, those businesses downstream of WtE. The cap limit is expected to encourage the presence of alternative processors for example, recyclers of permitted waste.
Would the proposed measure discourage entry into the industry by new firms/individuals or encourage EO to exit the market?	Yes.	The proposed cap limit is likely to discourage entry for some new WtE proponents. Industry stakeholders have noted that the uncertainty organisations face regarding the likelihood of being granted a cap licence increases investment risk, and therefore may deter applicants.
Would the proposed measure impose higher costs on a	Not significantly.	The cap limit itself does not impose costs on businesses or services. However, licence conditions will constrain

Competition impact	Answer	Explanation
particular class of business, for example small business or type of service?		businesses to a specified limit on waste that can be processed, which may limit a business' ability to achieve greater economies of scale over time.
Would the proposed measure affect the ability of businesses to innovate, adopt new technology or respond to the changing demands of consumers?	No.	The cap does not materially limit innovation in thermal WtE facilities. By limiting the amount of permitted waste processed using thermal WtE, the cap limit encourages innovation in alternatives to thermal WtE.

A cap limit of one million tonnes enables processing of permitted waste in Victoria by thermal WtE facilities within that constraint. The implementation of the cap alongside the proposed regulations to give effect to the cap licensing scheme will help inform investment decisions for WtE facilities in Victoria.

WtE facilities interact with upstream and downstream industries, by providing both:

- an alternative destination for waste that would otherwise have gone to landfill, and
- energy or fuel outputs.

WtE facilities face price competition from other waste disposal and energy suppliers in the area. Competition between WtE operators and feedstock supply is limited by the cap and planning restrictions that impact the number of operators that can service a given geographical area.

Differentiated fee structure

The preferred option for the proposed Regulations differentiates cap licence fees according to facility size. This approach recognises the increased complexity and effort required to assess applications for larger facilities, compared to smaller ones. These fees are summarised in the table below.

Table 22: Fees in the proposed Regulations

Cap licence application		Expression of interest		Application to decrease cap	
Fee units	*2023-24 fee*	*Fee units*	*2023-24 fee*	*Fee units*	*2023-24 fee*
1,045 (small[a]) 2,095 (large[b])	$16,615.50 $33,310.50	780	$12,402	390	$6,201

a. The "small" fee applies to an application that indicates that the facility will thermally process less than 30,000 tonnes of waste each financial year.

b. The "large" fee applies to an application that indicates that the facility will thermally process at least 30,000 tonnes of waste each financial year.

Net impact of fees on stakeholders

The proposed fees are designed to recover, at least in part, costs associated with administering these regulatory functions, in accordance with *Pricing for Value* (Department of Treasury and Finance, 2021) principles. As such, they represent costs for RV's regulatory services that will be paid by WtE proponents when submitting an EOI, cap licence application, or application to decrease an allocated cap amount. These same costs represent benefits for Victorian taxpayers, in that the costs of administration would otherwise have needed to be funded through another avenue, such as taxation.

The cost estimate in Table 23 includes estimated salary and program costs only during 2024, when cap licence applications will be considered for the first time. However, it is important to note that these estimated figures may change as RV finalises its waste to energy regulatory cap licensing framework and could change further with any regulatory alterations arising from consultation.

Table 23: Cap licence administering cost for Recycling Victoria

Cap licencing framework finalisation ($ Thousand)	Cap licencing process (incl. EOI) ($ Thousand)	Total ($ Thousand)
138	622	760

Impacts of the proposed fees to competition and small business

Table 24: Competition test to assess impact of the proposed fees to competition and small business

Competition test	Answer	Explanation
Is the proposed measure likely to limit the number of producers or suppliers to: • only one producer? • only one buyer? • less than four producers?	No.	Relative to the scale of capital investment in the average WtE facility, the proposed fees are not material to investment decisions and are not expected to limit the number of facilities in Victoria.
Would the proposed measure discourage entry into the industry by new firms/individuals or encourage existing providers to exit the market?	Yes (minimal).	The proposed fees would apply equally to new WtE proponents and EO's who seek to apply for a cap licence. Differentiation in cap licence application fee would be based only on tonnage applied for. WtE facilities are significant investments, subject to uncertainty. Given the planning approvals and the regulatory approvals required from EPA and RV, amongst other regulators, there may be a cumulative disincentive to apply for a cap allocation, with the proposed fees adding to this on the margin. However, given the size of the investment and potential revenues, the Department expects this effect to be minimal.
Would the proposed measure impose higher costs on a particular class of business such as small business or type of service?	Yes (minimal).	The proposed fees would impose costs on WtE proponents: those expressing interest in cap licences, applying for cap licences, and licence holders applying to decrease their cap allocation. This is an appropriate alternative to those amounts being paid for through general Government revenue, to cover the costs of regulatory services for WtE. While WtE operators are not anticipated be small businesses, the differentiated cap licence application fees are designed to level the playing field across smaller and larger operators, and support different business models – including smaller, modular, WtE facilities.
Would the proposed measure affect the ability of businesses to innovate, adopt new technology or respond to the changing demands of consumers?	No.	Relative to the scale of capital investment in WtE projects, the application fees proposed are not material to project technology or service delivery choices.

The proposed fees are unlikely to have a substantive impact on the number of expressions of interest or cap licence applications received, and are not expected to adversely affect the quality or quantity of WtE projects to which cap licences may eventually be issued. While the existence of fees may in theory prevent marginally commercially viable proponents from submitting expressions of interest or applications, the fees are low compared to the overall scale of investment required to build a WtE facility.

Given that the fees represent real costs of government administering the WtE Scheme, it is appropriate that the applicants who benefit from the opportunity to seek a licence bear those costs, rather than taxpayers generally, through other revenue sources.

The proposed fees are not expected to influence the eventual quality or quantity of WtE facilities in Victoria or to have significant upstream or downstream effects on competition or small businesses.

Chapter 6 Implementation plan

Consultation on Proposed Regulations

Prior to release of this RIS, policy and technical specialists from a number of Government departments including Better Regulation Victoria, Investment Victoria, Recycling Victoria, Sustainability Victoria have been consulted and contributed data and views to the development of the Regulations and this RIS. Additionally, a number of technical experts in areas including economic analysis, business investment and climate forecasting have contributed expertise to the development of the RIS to date.

Relevant government departments and technical specialists will be forwarded a copy of the RIS to encourage any formal contribution as part of the formal consultation process.

The Waste to Energy Team manages an inbox and mailing list comprising local government, lobbyists, waste industry specialists, consultants, and prospective WtE facility owners. All correspondents to date have been added to the waste to energy mailing list, will be sent a link to the formal consultation page on Engage Victoria's website, and encouraged to contribute to the consultation. This mailing list has generated large audiences for two industry briefings held in the second half of 2023. All persons who registered for these events will be provided a link to the Engage Victoria website and encouraged to contribute to the consultation.

Following receipt of consultation collateral, data and submissions will be analysed and a formal response to the consultation will be published on the Engage Victoria website. This response will inform the final form of the proposed Regulations.

Implementing the proposed Regulations

Table 25 outlines the stages and expected implementation timeframe for the WtE Scheme. Expected timings are based on an assumption that the regulations are made in early 2024, following promptly after consultation on this RIS.

The Cap Licensing framework for the WtE Scheme will be implemented over three stages:

- framework finalised through the proposed regulations.
- expression of interest – The Head, Recycling Victoria will call for an EOI for cap licences. EOIs for cap licences will be open to new operators as well as EO's who wish to increase the volume of permitted waste processed by their facility.
- cap licence application – Successful EOI respondents will be invited to apply for a cap licence. The Head, Recycling Victoria will then decide whether to issue a licence for a particular allocation of the cap to their thermal WtE facility.

Table 25 provides an overview of the tasks under each of these areas of work. The timing of these tasks is dependent on when the proposed Regulations are finalised and come into effect, and the detailed design of the two-stage cap licensing process. Note that the two licensing stages will be conducted sequentially – EOI first, and then cap licence application. EO's will also have an opportunity to apply for a cap licence to increase their tonnages through this process.

Table 25: Implementation Plan Staging

Implementation stage	Action	Expected timing
Before Regulations are proclaimed	Consultation Report developed and published	Q1 of 2024 (following consultation on the proposed Regulations)
Before framework commences	Cap Licensing Framework	End Q2 of 2024 (following consultation on the proposed Regulations).
EOI	Industry briefing on EOI process	Q3 2024
	Invite EOI from new proponents and EO's	Q3 of 2024 Open 2 months.

	Assess EOI responses	Q4 of 2024 Expected to require 2-3 months, but time required is dependent on the number and quality of EOIs submitted.
	Approve suitable applicants and invite to apply for Cap Licence	End Q4
Cap Licence application	Open application period	Q1 of 2025 Open for minimum 4 months
	Assess applications	Q2 2025 Time required to complete the assessment will depend on the number, quality and complexity of applications received, and details of final regulations.
	Finalise Cap Licences and approvals	Q3 2025.
	Issue licences to Cap Licence holders	Q3 2025

Stakeholder Communications and Engagement

Following the making of the proposed regulations, DEECA and RV will work with project proponents to explain the arrangements and inform participation in the cap licence scheme. Communication and engagement objectives are to:

- build stakeholder, industry, and community awareness of the operation of the WtE Scheme in Victoria's transition to a circular economy.
- inform industry understanding of and participation in the cap licensing process by:

– clarifying the EOI, application, and approval stages of cap licensing, and RV expectations around the requirements and timelines of each

– providing access to accurate and timely information to support project planning and investment decisions.

- maximise the likelihood of success of the WtE Scheme by communicating in a consistent, timely and transparent manner, using best practice methodologies.

Stakeholder groups identified as having a particular interest in the WtE Scheme are:

- WtE project proponents
- local governments
- waste and resource recovery peak bodies, consultants and advisers
- environment groups
- communities in which WtE facilities are proposed.

Chapter 7 Evaluation strategy

Background

This evaluation strategy delivers on the Victorian government's commitment in the circular economy policy to review the progress of the WtE sector to ensure it assists in meeting Victoria's waste reduction and resource recovery targets. Although initially scheduled for 2023, this commitment will now be undertaken following proclamation of the proposed Regulations and implementation of the WtE Scheme.

The evaluation will assess how efficient and effective the proposed Regulations were in delivering on the objectives of the scheme by independently verifying:

- the proposed and actual inputs, activities and outputs
- whether the proposed inputs, activities and outputs resulted in the outcomes that were sought from the proposed Regulations, and based on these inputs.

The evaluation scope has been designed specifically to assess the effectiveness of the proposed Regulations and the implementation of the WtE Scheme. This can inform any broader evaluation of Victoria's circular economy policy.

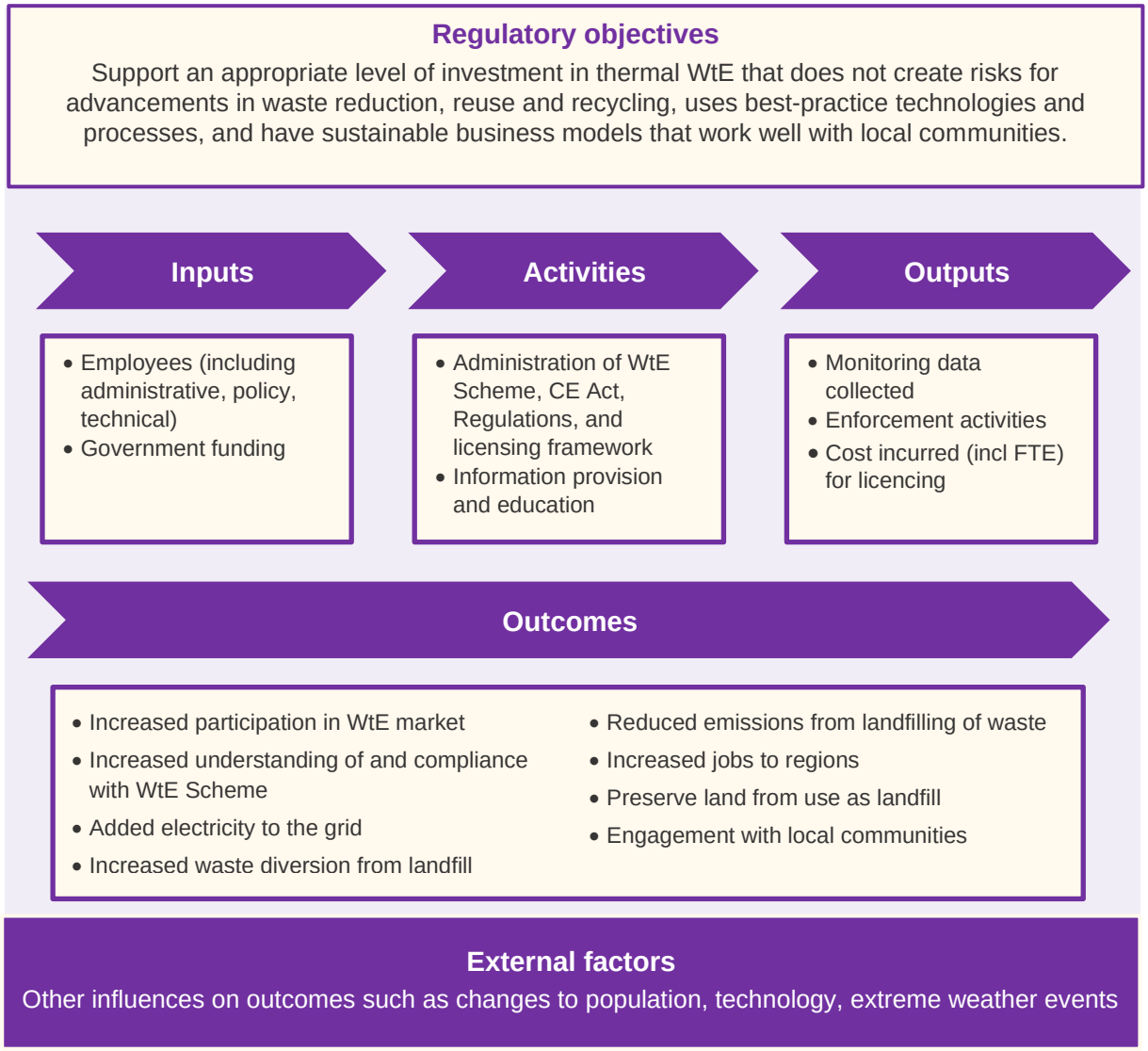

Figure H: Evaluation logic map

Evaluation questions

The evaluation seeks to better understand three key questions:

- how effective and efficient have the proposed Regulations been in achieving their objectives
- are there any improvements that could or should be made to ensure more efficient and effective regulation of WtE in Victoria, and
- to what extent does the WtE Scheme contribute to Victoria's circular economy transition?

Creating a baseline

Both quantitative data and qualitative information will be collated to develop a baseline, or reference dataset, from:

- data already developed for and included in the RIS
- data sets already collected by RV, and
- information provided in the consultation process for development of this RIS.

This data will provide a picture of what occurred prior to the introduction of the WtE scheme. Table 26 sets out data to be collected to form the baseline for later analysis.

Table 26: Baseline data

Type of Data	Output or Outcome	Unit	Frequency	Data collected by where
Number of licensed thermal WtE facilities	Outcome	Count	As at 30 June 2024	RV
Total processing capacity of licensed thermal WtE facilities	Outcome	Tonnes	As at 30 June 2024	RV
Cost of licencing, monitoring and enforcement activities	Output	$	As at 30 June 2024	RV
Current waste processed through licensed waste to energy facilities	Outcome	Tonnes	As at 30 June 2024	RV
Energy generated from licensed WtE facilities	Outcome	KWh, litres	As at 30 June 2024	RV

The WtE Scheme evaluation will be supported by the routine collection of qualitative information and quantitative data, including through regular reporting by licensees to RV.

Qualitative information

Qualitative data techniques will be deployed in a variety of ways, designed to better understand the Scheme's effectiveness and stakeholders' perspectives on the WtE scheme's operation and impact.

Qualitative data collection proposed for the evaluation is itemised in Table 27.

Table 27: Qualitative data for evaluation

Type of data	Output or Outcome	Purpose – to understand	Technique	Frequency	Stakeholder
Costs of compliance and effectiveness of WtE Scheme implementation	Outcome	Any changes in perception of scheme compliance and effectives over time	Survey	5 years	Regulator and license holders
Impact of the Scheme on innovation in the waste and recycling industry	Outcome	Changing perception of impact of scheme on	Survey	5 years	Waste industry bodies Regulator

Type of data	Output or Outcome	Purpose – to understand	Technique	Frequency	Stakeholder
		innovation over time			Scheme license holders

Quantitative data

Quantitative datasets will be collected and plotted to develop meaningful indicators of change over time from the implementation of the WtE Scheme across a suite of indicators. Quantitative data identified for the evaluation include the datasets identified in Table 27.

Table 28: Quantitative data for evaluation

Issue	Output or Outcome	Purpose – to understand	Measure	Date	Frequency	Data source
Number of applications under the cap	Output	Level of interest in being an operator under the Scheme	Count	30 June	Annual, financial year	RV
Number of licences issued	Output	Total number of licensees and conversion rate of applications to licences	Count	30 June	Annual, financial year	RV
Cumulative tonnes of licences issued	Output	Proportion of WtE cap licenced	Tonnes	30 June	Annual, financial year	RV
Number of licensees operating in the market	Output	Time frame from licence issue to operation	Count	30 June	Annual, financial year	RV
Number and type of enforcement activities	Output	Type of enforcement activities undertaken to inform future information, education, compliance and enforcement activities	Count	30 June	Annual, financial year	RV, EPA
Volume and composition of permitted and exempt waste processed by licensed WtE facilities	Outcome	Comparative proportion of waste in landfill to WtE over time	Tonnes	30 June	Annual, financial year	RV, operators
Total energy generated from WtE facilities	Outcome	Contribution of WtE to the grid	MWh, litres	30 June	Annual, financial year	RV, operators
CO_2-e emitted by WtE generation	Outcome	Net Emissions impact	Tonnes	30 June	Annual, financial year	RV, operators

Issue	Output or Outcome	Purpose – to understand	Measure	Date	Frequency	Data source
Total number of people employed in licensed facilities, by region	Outcome	Regional employment outcomes	Number	30 June	Annual, financial year	Operators

Evaluation timeframe

It is proposed that the evaluation occur in two tranches. The first is designed to better understand the operation of the regulatory cap licensing scheme, the second to understand the contribution of the scheme to delivery of broader circular economy goals.

To support the evaluation, quantitative data will be collected annually, so that even in the absence of an earlier evaluation, it will be possible to track progress towards broader circular economy goals over time.

Table 29: Timeframe for evaluation

Timing	Timing	Component
Baseline	June 2024	Compilation of baseline
Compilation of Data	Annual / 5 yearly	Compilation of data sets
Partial evaluation once licences are issued but before all licensees are operational	June 2026	Qualitative and quantitative (where relevant)
Full evaluation once licences are issued and all licensees are operational	~June 2029	Both Qualitative and Quantitative to understand operation and impact of the scheme

Reviews of Victoria's Waste to Energy Framework and Victoria's policy settings

Recycling Victoria: A new economy committed to a review of Victoria's waste to energy policy settings in 2023. The intention is to conduct this review of policy settings after the WtE Scheme has commenced implementation, so that such a review can be informed by both quantitative and qualitative data.

Future review may consider matters such as the cap amount and effectiveness of this in reference to Victoria's waste and recycling infrastructure needs and relatedly, the effects of WtE infrastructure on current and future waste flows and recycling.

Appendix A – Technical Appendix

This appendix lends greater detail to the model methodology underpinning the impact analysis.

Modelling waste generation

The model uses RV projections of Victorian waste generation. This data provides estimates of tonnes of Victorian waste generation out to 2049-50, segmented both by sector: MSW, C&I or C&D, and by material sub-type, with the same sub-types of waste across all sectors (Table A-2).

Additionally, RV data provides estimates of the recovery rate of generated waste for the year 2020-21, by sector and material sub-type (Table A-1). The recovery rate refers to the proportion of waste which is recycled domestically, or exported interstate or internationally for recycling and so is removed from the waste stream before the point at which it may be destined for landfill or WtE.RV's dataset does not forecast future recovery rates changes.

The remaining waste which is not recovered is then assumed to be going to landfill, some of which may be eligible for WtE processing, subject to consideration of waste sources and types that are permitted for use in WtE within the regulatory framework, as well as consideration of whether the waste type is practically suitable for use in WtE processing.

RV's waste generation data provides a 'business as usual' baseline projection of Victorian waste generation. Changes in both waste generation over time, as well as the recovery rate, drive the amount of available feedstock for WtE over the analysis period. The RV 2020-21 recovery rates have been adjusted to account for and assume achievement of three of the four currently stated Victorian Government targets regarding waste recovery (Table A-1).

Table A-1: Waste material types, sub-types and recovery rates

Type	Sub-type	Recovery rate (2020-21)		
		MSW	C&I	C&D
Aggregate, masonry and soil	Asphalt	96.2%	65.4%	99.8%
	Bricks	0.5%	5.3%	97.2%
	Concrete	95.6%	18.8%	99.1%
	Plaster	0.0%	54.7%	3.5%
	Rubble	95.9%	43.7%	98.1%
	Soil and natural materials	45.4%	10.9%	59.8%
Metals	Aluminium	58.7%	78.6%	65.1%
	Ferrous	91.0%	89.4%	89.7%
	Other metals	100.0%	100.0%	100.0%
Organics	Food organics	12.0%	10.4%	3.4%
	Garden organics	82.0%	54.7%	32.0%
	Other organics	33.0%	77.9%	59.9%
	Wood/timber	38.4%	24.4%	42.9%
Paper and cardboard	Cardboard	31.3%	88.9%	79.3%
	Liquid paper	0.0%	6.8%	0.0%
	Newsprint and magazines	100.0%	100.0%	100.0%

Type	Sub-type	Recovery rate (2020-21)		
	Other paper	51.0%	51.7%	1.1%
	Printing and writing paper	0.0%	54.6%	0.0%
Glass	Container glass	86.0%	26.9%	57.7%
	Other glass	0.0%	18.0%	21.6%
Plastic	HDPE	31.0%	10.9%	11.9%
	LDPE	17.3%	28.7%	8.5%
	Other plastics	0.6%	18.2%	7.1%
	PET	31.4%	24.3%	0.0%
	PP	29.4%	17.9%	6.0%
	PS	26.6%	14.3%	59.0%
	PVC	4.3%	6.2%	20.7%
Tyres and rubber	Offroad tyres	0.0%	100.0%	0.0%
	Other rubber	47.0%	63.3%	0.0%
	Passenger tyres	100.0%	95.0%	0.0%
	Truck tyres	0.0%	100.0%	0.0%
Textiles	Clothing	0.4%	0.0%	0.0%
	Other textiles	1.2%	30.6%	0.0%

a. Source: Recycling Victoria

Table A-2: Annual waste production data and projections (Kt)

Sector	Material Type	Material Sub-type	2020-21	2049-50
MSW	Aggregate, masonry and soils	Rubble	73.376	200.051
		Soil and natural materials	28.491	77.676
		Asphalt	19.650	53.573
		Bricks	49.234	134.230
		Concrete	8.990	24.509
		Plaster	4.416	12.041
	Metals	Ferrous	384.939	553.301
		Aluminium	49.971	71.827
		Other metals	17.633	25.345
	Organics	Food organics	714.891	1049.876
		Garden organics	545.126	812.542
		Other organics	148.265	217.740
		Wood/timber	45.176	66.344
	Paper and cardboard	Printing and writing paper	61.960	26.937

Sector	Material Type	Material Sub-type	2020-21	2049-50
		Cardboard	53.713	76.935
		Liquid paper	28.276	48.668
		Newsprint and magazines	14.879	5.687
		Other paper	258.887	541.647
	Glass	Container glass	273.784	448.006
		Other glass	37.955	55.740
	Plastic	PET	69.029	101.374
		PP	51.431	75.531
		PS	12.882	18.918
		PVC	24.919	36.595
		HDPE	102.895	151.110
		LDPE	40.945	60.131
		Other plastics	84.221	123.685
	Tyres and rubber	Passenger tyres	10.879	15.976
		Truck tyres	0.000	0.000
		Offroad tyres	0.000	0.000
		Other rubber	4.582	6.730
	Textiles	Clothing	62.116	91.223
		Other textiles	20.511	30.122
C&I	Aggregate, masonry and soils	Rubble	31.562	86.050
		Soil and natural materials	151.666	413.498
		Asphalt	11.499	31.352
		Bricks	35.988	98.117
		Concrete	49.585	135.188
		Plaster	62.041	169.147
	Metals	Ferrous	657.732	945.407
		Aluminium	100.739	144.799
		Other metals	270.473	388.771
	Organics	Food organics	355.812	522.540
		Garden organics	167.601	249.819
		Other organics	172.624	253.512
		Wood/timber	394.215	578.938
	Paper and cardboard	Printing and writing paper	168.682	73.332
		Cardboard	903.989	1294.804
		Liquid paper	39.252	67.558
		Newsprint and magazines	57.890	22.125

Sector	Material Type	Material Sub-type	2020-21	2049-50
		Other paper	225.674	472.158
	Glass	Container glass	47.680	78.020
		Other glass	20.829	30.589
	Plastic	PET	37.374	54.887
		PP	66.804	98.108
		PS	16.678	24.494
		PVC	38.408	56.405
		HDPE	76.614	112.515
		LDPE	71.765	105.393
		Other plastics	46.913	68.895
	Tyres and rubber	Passenger tyres	22.232	32.649
		Truck tyres	12.079	17.739
		Offroad tyres	13.801	20.267
		Other rubber	28.099	41.266
	Textiles	Clothing	47.950	70.418
		Other textiles	106.153	155.895
C&D	Aggregate, masonry and soils	Rubble	530.748	1447.017
		Soil and natural materials	1864.035	5082.052
		Asphalt	646.105	1761.523
		Bricks	1026.914	2799.749
		Concrete	2953.458	8052.224
		Plaster	16.358	44.599
	Metals	Ferrous	163.214	234.600
		Aluminium	11.217	16.124
		Other metals	12.392	17.812
	Organics	Food organics	3.139	4.610
		Garden organics	31.569	47.056
		Other organics	1.322	1.942
		Wood/timber	208.488	306.182
	Paper and cardboard	Printing and writing paper	1.256	0.546
		Cardboard	21.277	30.475
		Liquid paper	0.552	0.951
		Newsprint and magazines	1.256	0.480
		Other paper	1.699	3.554
	Glass	Container glass	1.611	2.637
		Other glass	4.235	6.220

Sector	Material Type	Material Sub-type	2020-21	2049-50
	Plastic	PET	1.829	2.686
		PP	3.775	5.543
		PS	2.255	3.312
		PVC	2.937	4.314
		HDPE	5.012	7.361
		LDPE	3.613	5.307
		Other plastics	2.548	3.742
	Tyres and rubber	Passenger tyres	0.130	0.191
		Truck tyres	0.000	0.000
		Offroad tyres	0.000	0.000
		Other rubber	0.181	0.266
	Textiles	Clothing	3.740	5.492
		Other textiles	6.666	9.790

Adjusting recovery rates over time

The Victorian Government has committed to improve future waste generation and recovery rates in its circular economy policy and action plan. Given the significant reforms being delivered under this policy, the modelling accounts for assumed improvements in MSW source separation and assumes achievement of the circular economy's policy's target to achieve diversion of 80% of waste from landfill by 2030, with an interim target of 72% by 2025.

Assumed improvements in MSW source separation are incorporated in the model through exogenous improvements to the recovery rates of certain material sub-types and sectors associated with planned and ongoing Victorian waste reforms. It is assumed that the recovery rate for all MSW high-density polyethylene (HDPE) and low-density polyethylene (LDPE) plastics increases linearly by a total of ten percentage points between 2026-27 and 2030-31, which aims to capture the removal of soft plastics from the waste stream, as well as the implementation of Victoria's container deposit scheme from late 2023, and the removal of glass from the mixed recycling bin. These latter two policies are also captured by the glass and polyethylene terephthalate (PET) recovery rates, which are both modelled to increase by 5 percentage points, from 86.0 to 91.0%, and from 31.3 to 36.3% respectively. Additionally, the removal of glass from the mixed recycling bin is captured by a general 10 percentage point rise in MSW paper and cardboard recovery rates. Table A-3 summarises the recovery rate improvements below.

Table A-3: improvements to recovery rates of material sub-type (MSW)

Material sub-type	2026-27	2030-31
HDPE	31%	41%
LDPE	17%	27%
Paper and cardboard	+10 linear increase between 2026-27 to 2030-31	
Glass	86%	91%
PET	31.3%	36.3%

The modelling also accounts for achievement of the target to halve the amount of organic material going to landfill between 2020 and 2030, with an interim target of 20% reduction by 2025. To reflect the

implementation of the Victorian Government's commitment to rolling out FOGO recycling services across the state, the recovery rate for MSW food organics is modelled to increase by 42 percentage points, from 12.0 to 54.0% between 2021-22 and 2030-31. Similarly, the recovery rate for MSW garden organics is modelled to increase by 8 percentage points, from 82.0 to 90.0% between 2026-27 and 2030-31. Also contributing to achievement of the organics target is the expected introduction of source separation requirements for C&I waste, which in the analysis are assumed to be introduced in 2025/26. This is modelled by a general increase in C&I organic waste recovery by 15 percentage points. These assumptions lead to an increase in the aggregate recovery rate for all materials increasing from 71.3% in 2023-24 to 74.9% in 2030-31.

In addition to the adjustments described above to account for the impact of the Victorian Government's circular economy commitments up to 2030, a general recovery rate improvement assumption has been adopted for the years 2030-31 to 2049-50. There is significant uncertainty about long-term future changes in consumption patterns, recycling technology, investment in recycling infrastructure, changes in consumer behaviour and government policies. Nonetheless, it is expected that there will be continued improvement in recovery rates over time. To account for this, the gap between recovery rates in 2030 and perfect, 100%, recovery in 2049-50 were assumed to narrow by a specific percentage. The central estimate is for a 33% narrowing of this gap, with a lower bound at 25% and an upper bound at 40%. The aggregate effect of these improvements are to increase the recovery rate from 74.9% in 2030-31 to either 82.6%, 84.5%, or 86.1% for the lower bound, central, and upper bound estimates respectively.

For example, if the recovery rate for a particular material stream from a particular source has an expected recovery rate of 60% in 2030, then narrowing the gap by 25% would result in a 70% recovery rate in 2049-50; narrowing by 33% would result in an 73.2% recovery rate in 2049-50; and narrowing by 40% would result in an 76% recovery rate in 2049-50.

This assumption increases the rate of recovery for all material streams. It increases recovery rates the most for materials that are currently recovered the least, for example. plastics and textiles, and where there is the greatest opportunity, while leading to modest increases for materials that are already recovered at high rates, for example metals and tyres).

Determining available feedstock for thermal waste to energy facilities

Following the above method yields estimates of residual waste for disposal, a proportion of which may be processed through WtE facilities if the waste is:

- residual MSW, as permitted under the CE Act and Regulations[7]
- C&I or C&D waste which it is not viable or practicable to recycle[8]
- in addition to the above, also practically suitable as a source of feedstock for WtE facilities, that is a type of waste that can be processed by thermal WtE technology.

MSW is treated separately in the model from C&I and C&D. In the model, all unrecovered MSW is assumed to be placed in residential general waste bins, and is assumed to be permitted to be used as feedstock by thermal WtE facilities, provided the council responsible for waste services has a three-bin system in place. The transition to a four-bin system, consistent with Victoria's household recycling reforms, is modelled through exogenous improvements in recovery rates for these materials. While all residual MSW will be permitted to be used by thermal WtE operators once the reformed four-stream system is in place, the model incorporates DEECA assumptions on the types of waste which are deemed suitable feedstock for facilities to process (Table A-4). The final amount of available residual MSW feedstock for WtE facilities in the model consists only of suitable feedstock, one which for example excludes metals, glass as well as aggregates, masonry and soils.

[7] Residual MSW is only permitted in local government areas with at least a three-bin system in place. For the purpose of modelling waste flows for viable waste to energy feedstock, all residual MSW is included, recognising that all relevant local government areas will have a three-bin system by 2030, with most expected sooner than this, broadly in line with the timing of waste to energy facilities coming online.

[8] Any C&I and C&D waste which is sorted and separated in accordance with any requirements prescribed by legislation, regulation or service standards or which can be demonstrated to not be technically, environmentally or economically practicable (TEEP) for further reuse or recycling, can be processed by thermal waste to energy facilities under the existing Regulations.

The amount of available C&I and C&D waste is subject to the same suitability of waste for processing filter. Available C&I and C&D waste is driven by consideration of whether it is viable or practicable to recycle the waste, and is therefore subject to prescribed sorting and separation requirements or the TEEP test. For the purposes of the model, waste that is recovered from the C&I and C&D streams are therefore unavailable to be used by WtE operators. That is, only waste that would otherwise be sent to landfill would be able to be used as WtE feedstock. In practice, operators will be required to demonstrate that any C&I and C&D waste they are processing is not able to be recycled. All C&I and C&D waste that is suitable for WtE facilities includes any C&I and C&D waste that is classified as exempt under the proposed Regulations, with any processing of exempt waste not contributing to their cap limit.[9]

Table A-4: Suitability for waste to energy processing assumptions

Type	Sub-types	Suitability for waste to energy processing
Aggregate, masonry and soil	Rubble, soil and natural materials, asphalt, bricks, concrete, plaster	Not suitable
Metals	Ferrous, aluminium, other metals	Not suitable
Organics	Food organics, garden organics, other organics, wood/timber	Suitable[a.]
Paper and cardboard	Printing and writing paper, cardboard, liquid paper, newsprint and magazines, other paper	Suitable
Glass	Container glass, other glass	Not suitable
Plastic	PET, PP, PS, PVC, HDPE, LDPE, other plastics	Suitable
Tyres and rubber	Passenger tyres, truck tyres, offroad tyres, other rubber	Suitable
Textiles	Clothing, other textiles	Suitable

a. 75% of other organics and wood/timber are assumed to meet the definition of exempt waste in the model, and so are eligible to be used as WtE feedstock, but do not contribute to WtE processing under the cap licence.

b. Source: DEECA assumptions

Investment in waste to energy

Up to this point, the model has considered only the supply of waste available for processing. How much of that waste goes to WtE depends on the total productive capacity of these facilities, which is, in turn, impacted by the cap limit under each of the options.

The model considers the capacity of WtE facilities with existing works approval under the base case, and capacity from new facilities developed as a result of the cap. It is assumed that, while individual facilities may not be able to process all types of feedstock, Victoria's WtE sector as a whole will be able to process all available feedstock that is suitable for WtE processing, if they have the capacity to do so. This assumption is made because the technology make-up of the individual facilities under cap depends on future decisions made by RV.

Additionally, it is assumed that no new investment in WtE occurs outside of what is permitted under the cap, that is, no additional facilities processing only exempt waste start operating.

WtE facilities are considered separately based both on whether they are allowed to process permitted waste, and on whether they will fall under the cap. The total WtE capacity is made up of facilities only permitted to process exempt waste, EO processing permitted waste outside the cap in accordance with limits to be

[9] The existing Regulations (pp. 4-5, reg. 6) prescribe exempt waste to be certain types of waste biomass and reportable priority waste.

specified by anticipated EO licences, and facilities permitted to process waste inside the cap[10]. Table A-5 below details these capacities, and how they change under each option.

Table A-5: Total Waste to Energy capacity under different cap limit options

Capacity (Kt)	Base Case	Option 1	Option 2	Option 3
Exempt-only capacity	180	180	180	180
EO outside of cap	1,000	1,000	1,000	1,000
Cap licence capacity	0	500	1,000	2,000
Total capacity	1,180	1,680	2,180	3,180

a. Source: DEECA

b. Note: Rows are summed before rounding, so rounded costs and benefits may not sum to rounded totals.

There is also assumed to be a four-year lag between the introduction of the cap licence scheme and cap licensing facilities becoming operational with all facilities operational in the 2027-28 financial year. This is in line with conservative estimates of the time taken to construct WtE facilities of a similar size to those already operating or under construction in Victoria. The figures in table A-5 includes total known existing exempt waste processing capacity, including smaller on farm thermal waste to energy facilities.

Distributing waste flows

After the amount of viable feedstock for WtE is calculated, waste is then distributed between landfill, recovery and WtE, contingent on the latter's capacity to process waste. WtE is assumed to take priority over landfill, with all available feedstock first going to these facilities, until their productive capacity is exhausted. Any waste that is not recycled and is unsuitable for processing through WtE, as well as viable waste that exceeds the cap, is assumed to be processed by landfill.

Facilities that only process exempt waste receive as much waste as they are able to process, provided the feedstock exists. The modelling assumes all facilities that are able to process permitted waste, whether within the cap or outside of it, prioritise processing all available potentially permitted waste. If there is not enough potentially permitted waste to exhaust the capacity, these facilities will also process exempt waste to make up the shortfall. Any waste that is not processed through WtE is processed by landfill.

However, if the processing capacity of WtE exceeds the amount of viable feedstock, these facilities are assumed to include material that would be recovered in the base case in their feedstock, reducing the amount of waste being recovered compared to the base case. This reflects the fact that WtE facilities may 'lock in' waste streams, which would make it unfeasible or unprofitable to establish recycling facilities that would have been feasible and profitable in the base case.

All costs and benefits in this impact analysis are downstream of the distribution of waste flows between landfill, recovery and WtE. As a tonne of waste is diverted from landfill or recovery to WtE, the model considers the relative lifetime emissions associated with those fates. Future costs and benefits are discounted back to the base year using a social discount rate of 4%. Further assumptions that underpin the conversion from waste flows to quantifiable costs and benefits are found in Appendix B.

Over-investment in waste to energy and the processing of waste that might otherwise have been recovered

Where the available feedstock in the base case is insufficient to meet the demand of WtE facilities, these facilities are faced with surplus capacity. In reality, this may be managed by WtE facilities processing less than their capacity, allowing WtE operators to excavate landfill to gather feedstock and maintain

[10] Modelled EO licence amounts are based on the indicative amount of waste to energy facilities with prior works approval. EO licences have yet to be granted and are contingent on applications received and assessment and approval conducted by Recycling Victoria.

operationality, or a myriad of other potential outcomes, each of which presents different costs to processors. These scenarios are not captured in the model but may present alternative or additional costs to over-investment in WtE beyond those that are quantified.

For the purposes of the model, the analytical approach taken is to assume that surplus capacity in WtE relative to the available feedstock in the base case is assumed to come from the market for recoverable waste. This reflects that overinvestment in WtE would disincentivise the construction of more recycling capacity or the development of alternative, higher value uses for recovering and recycling waste.

As noted above, while this may not represent what would happen in the instance of excess capacity in WtE, this approach was adopted to demonstrate one possible outcome, and reflect the broader risk of over-investment in WtE, and the necessity to find an appropriate cap licence amount which balances these risks. Other Victorian waste reforms will impact the level of feedstock available for WtE, if investment in WtE capacity is too high and the supply of viable feedstock too low, the impetus to invest in waste recovery technologies and projects will diminish. As such, it is feasible that over-investment in WtE could lead to a decline in recovery outcomes, which is captured in the model.

Emissions impacts

Financially quantified costs and benefits in the model are driven by differences in the emissions generated and avoided under the options, compared to the base case. The model uses a set of inputs in which emissions are calculated as a multiplier of the tonnes of waste processed, with the multiplier depending both on fate whether recycling, landfill or energy recovery, and on material sub-type. Emissions are split into scope 1 & 2 emissions associated with the processing of the waste, and mitigation resulting from substituting electricity sourced from the grid for electricity generated through WtE or landfill.[11] Since these emissions are calculated at a material sub-type level, and relative to marginal grid emissions, the emissions profile of waste processors changes over time in line with shifts in the make-up of feedstock, and Australia's grid decarbonisation.

Assumptions around the amount of electricity produced per tonne of waste processed, grid emissions intensity, and carbon values are available in Appendix B.

Financial transfers

The model considers changes to the throughput of landfill, recovery and WtE. However, this model does not consider second- and third-order market effects that may emerge from an expansion of WtE capacity. Gate fees charged by landfill, recovery and WtE facilities, as well as the landfill levy, are assumed not to change between options or over time. These assumptions are found in Table B-2. Notional gate fees for landfill include the waste levy. While the former is considered a transfer of wealth from waste producers to landfill operators, the latter is considered a transfer from landfill operators to the Victorian Government. Since both transactions are transfers, neither have an impact on NPV. However, estimates of landfill gate fees and the waste levy determine the size of the transfer, and its split between the landfill industry and the government. Similarly, for simplicity, it is assumed that recyclers charge the same gate fees as both landfill and WtE, so that any WtE feedstock that would have otherwise been recycled constitutes a transfer of value from recyclers to WtE operators.

Revenue for both landfill net of the landfill levy and WtE is calculated as a multiple of the number of tonnes processed and the gate fees charged per tonne. This revenue is then used as an indicator of the total revenue associated with the two possible fates for waste, with revenue generated either by WtE or landfill distributed between wages paid to employees, dividends paid to investors, input costs paid to suppliers and retained earnings for the facility itself. Where the per-tonne revenue differs between landfill and WtE, waste producers such as local councils and waste-producing industry, bear that difference, either as a saving if WtE is cheaper than landfill, or as a cost.

[11] Scope 1 emissions account for emissions released as a direct result of waste processing activities, and scope 2 emissions account for the indirect emissions associated with waste processing, such as grid-generated electricity used by facilities. WtE facilities do not generate scope 2 emissions, as they produce the electricity associated with their own operation. However, for consistency, the term "scope 1 & 2 emissions" is used to capture scope 1 emissions under WtE, and scope 1 & 2 emissions for landfill and recycling.

The result of taking such a broad approach to attributing costs and benefits, as well as the assumed lack of market impacts, means that, in practice, the industry impact ends up being a large transfer of economic value from the landfill industry and Victorian Government to the WtE industry. In Option 3, there is also a transfer of value from recyclers to WtE operators. However, due to the assumption there is no change to the per-tonne gate fee paid, and the lack of second- and third-order market effects estimated in the modelling, this is a pure transfer of financial value and does not reflect any additional value to the economy outside of this transfer. This means that the net result of these financial transfers is zero.

Market value of electricity generated through waste to energy

The model also considers the electricity produced by both WtE processors and landfill, and the commercial value of that electricity. An assumption is made that the electricity produced, either by WtE or landfill, displaces electricity that would otherwise have been sourced from the grid. No broader market impacts are factored into the analysis, such as changes to the spot price of electricity as a result of additional WtE plant; energy prices, assumed to be unchanged between options. This assumption has been made because thermal WtE facilities represent a small part of the energy system, producing between 1.5% and 6% of total Victorian electricity consumption[12].

Under these assumptions, the net impact of more WtE is zero, with losses experienced by landfill operators, who now produce less electricity by virtue of receiving less methane-producing waste which could be combusted, and grid generators who export less energy to the electricity, with these losses offset by revenue for WtE operators for exporting energy to the electricity grid.

Using the assumptions provided by Sustainability Victoria (SV) and updated by DEECA, electricity generated is calculated as a multiplier of the tonnes of waste processed, with the multiplier depending on fate type, WtE versus methane capture, and on material sub-type. As with emissions, the total electricity generated is calculated at a material sub-type level, meaning electricity generated changes over time, in line with shifts in the make-up of feedstock. These multipliers by sub-type and fate stay constant over time, with shifts in the electricity generated dependent entirely on feedstock composition and total waste processed. A constant electricity spot price of $70 per MWh is assumed. While the spot price of electricity is subject to a high degree of volatility, this assumption is in line with a 12-month average for Victorian electricity spot prices.

[12] Based on modelling for this RIS and 2021-22 Victorian energy consumption figures (Department of Climate Change, Energy and Environment, 2023)

Appendix B – Model inputs and assumptions

This appendix outlines all modelling inputs (Table B-1) and assumptions (Table B-2) underpinning the impact analysis. It also includes further explanation of the approach to greenhouse gas emissions introduced in Appendix A.

Table B-1: Modelling inputs

Input	Value	Source
Discount rate	4%	Victorian Government
WtE gate fee	$185/tonne	DEECA assumption
Landfill gate fee excluding waste levy*	$55.73/tonne	Infrastructure Victoria – Recycling and resource recovery infrastructure: Evidence base report
Waste levy 2023-24	$129.27/tonne	EPA
Emissions multipliers**	See “Greenhouse gas emissions analysis in this RIS” section below	SV and DEECA
Victorian electricity grid emissions intensity	See “Greenhouse gas emissions analysis in this RIS” section below	DEECA
Targets based value of carbon emissions	See “Greenhouse gas emissions analysis in this RIS” section below	DEECA analysis, based on IPCC Sixth Assessment Report
Land use	See “Land and water use analysis in this RIS” section below	DEECA analysis, based on RMIT LCA of Kerbside Recycling in Victoria report
Water use	See “Land and water use analysis in this RIS” section below	DEECA analysis, based on RMIT LCA of Kerbside Recycling in Victoria report

a. The landfill gate fee is inclusive of the $129.27/tonne landfill waste levy for 2023-24 set out in the EP Act, which is paid by landfill operators to the Victorian Government. Additionally, it is noteworthy that the combined cost of waste levy and landfill gate fees amounts to $185/tonne, aligning with the gate fees for WtE.

b. The emissions multipliers represent the emissions produced per tonne of waste processed for each material sub-type. These multipliers are segmented by landfill and WtE processing and provide estimates of emissions generated directly through scope 1 and 2 activities, as well as grid emissions avoided by electricity generated.

Table B-2: Modelling assumptions

Variable	Assumption
Amount of waste generated	Waste generation does not differ between options, and follows RV’s projections.
Amount of recovered waste	The capacity for waste to be recovered, either recycled domestically or exported interstate or internationally for recycling is unconstrained, both in aggregate and at a material sub-type level. This also means that all recovered materials will have an end market, and that recoverable waste will not be stockpiled between periods.
Investment in recycling technology	Investment in existing recycling technologies does not differ between options.
Amount of waste to landfill	Landfill capacity is unconstrained. Note that this is a simplifying assumption for modelling, so output does not quantify any extra utility of WtE that may arise in situations where landfill capacity is constrained.
Recovery rates	Recovery rates (both for individual sectors and sub-types, and in aggregate) do not differ between options.
MSW food organics recovery rate	The recovery rate for MSW food organics is assumed to increase linearly from 12.0% in 2020-21 to 54.0% in 2030-31, in line with Victoria’s planned waste reforms.

Variable	Assumption
MSW garden organics recovery rate	The recovery rate for MSW garden organics is assumed to increase linearly from 82.0% in 2025-26 to 90.0% in 2030-31, in line with Victoria's planned waste reforms.
MSW HDPE recovery rate	The recovery rate for MSW HDPE is assumed to increase linearly from 31.0% in 2025-26 to 41.0% in 2030-31, in line with Victoria's planned waste reforms.
MSW LPDE recovery rate	The recovery rate for MSW LDPE is assumed to increase linearly from 17.3% in 2025-26 to 27.0% in 2030-31, in line with Victoria's planned waste reforms.
MSW container glass recovery rate	The recovery rate for MSW container glass is assumed to increase linearly from 86.0% in 2022-23 to 91.0% in 2027-28, in line with Victoria's planned waste reforms.
MSW PET recovery rate	The recovery rate for MSW PET is assumed to increase linearly from 31.4% in 2025-26 to 36.3% in 2030-31, in line with Victoria's planned waste reforms.
C&I organics recovery rates	The recovery rates for C&I organics are assumed to increase linearly by 15 percentage points between 2026-27 and 2030-31, in line with Victoria's planned waste reforms.
MSW paper and cardboard recovery rates	The recovery rates for MSW paper and cardboard are assumed to increase linearly by 10 percentage points between 2023-24 and 2027-28, in line with Victoria's planned waste reforms.
General improvement in recovery rates (additive to other improvements) from 2030-31 to 2049-50	From 2030-31 to the end of the analysis period in 2049-50, the model incorporates a general improvement in recovery rates for all materials. This is calculated as 33% of the percentage point gap between the recovery rate in 2030-31 and 100% recovery, calculated by material sub-type.
Material sub-type recovery rates	Increases in aggregate recovery rates are distributed among material sub-type and sector recovery rates proportionally to the amount of unrecovered waste in each material sub-type and sector.
Unrecovered MSW	All unrecovered MSW is assumed to be permitted under the cap licence but must still be material suitable for WtE processing in order to be used as feedstock.
Unrecovered C&I and C&D waste	All unrecovered C&I and C&D waste is assumed to be permitted under the cap licence but must still be material suitable for WtE processing in order to be used as feedstock
Suitability test	Materials are deemed to be suitable or not suitable for WtE processing in line with Table A-2.
Exempt waste	75% of C&I and C&D wood/timber and other organics are assumed to be exempt. 100% of C&I and C&D tyres and rubber are assumed to be exempt.
Exempt WtE processing capacity	The capacity for exempt WtE processing does not grow over time or change between options. In the modelling, it is assumed licence holders will process exempt waste if the amount of available permitted feedstock falls short of their aggregate licensed amount.
WtE processing capacity	All suitable waste is able to be processed through WtE, regardless of the material make-up of the feedstock, if the capacity is available.
WtE EO investment timing	500Kt of WtE processing capacity for permitted wasteexcluding exempt waste, is currently available, with 950Kt of processing capacity becoming operational in 2025-26.
WtE cap licence investment timing	For each Option, 350Kt of WtE processing capacity becomes operational in 2026-27. The residual capacity (150Kt under Option 1, 650Kt under Option 2 and 1,650Kt under Option 3) becomes operational in 2027-28.
Waste distribution prioritisation	In line with the Victorian waste hierarchy, suitable waste is prioritised for use as WtE feedstock before it is processed by landfill. When suitable waste is split between WtE and landfill, no sub-type takes precedence over any other, meaning the proportion of individual sub-types allocated to each fate are equal to the ratio of that material source stream to the aggregate waste stream.
Emissions multipliers	Scope 1 & 2 emissions produced by both landfill and WtE are constant over time and between facilities using a technology-agnostic lens.

Variable	Assumption
Landfill and waste to electricity generation	Electricity generated by landfill and WtE effectively reduces the amount of electricity demand from the rest of the electricity grid (the National Electricity Market; NEM) and therefore causes a reduction in electricity generated by other generators in the NEM. It is assumed that the effect on demand and generation has no material impacts on the broader electricity market such as on electricity prices, investment in network infrastructure, or closure dates of coal-fired power stations.
Revenue attribution	All employees of, investors in, and suppliers to both **WtE** facilities and landfill facilities are located in Victoria, and so costs and benefits accruing to these stakeholders are in-scope for the CBA.
Gate fees	Gate fees for both landfill and **WtE** facilities do not change over time, or between options.
Landfill levy	The landfill levy value does not change over time, or between options.
Investor opportunity cost	Investors in **WtE** facilities would otherwise invest their money in an asset that earns a comparable return to that expected from their investment in **WtE**. This asset always yields its expected return.

Table B-3 outlines the energy generation per material sub-type for landfill and waste to energy generation that underpin the impact analysis.

Table B-3: Energy generation per kilotonne of waste processed for landfill and WtE assumptions (MWh/Kt)

Material type	Material sub-type	Landfill generation (methane gas capture) Electricity yield (MWh/Kt)	Waste to Energy generation Electricity yield (MWh/Kt)
Aggregate, masonry and soils	Rubble	-	-
	Soil and natural materials	-	-
	Asphalt	-	-
	Bricks	-	-
	Concrete	-	-
	Plaster	-	-
Metals	Ferrous	-	-
	Aluminium	-	-
	Other metals	-	-
Organics	Food organics	249.75	915.00
	Garden organics	186.32	915.00
	Other organics	49.55	915.00
	Wood/timber	85.23	1215.00
Paper and cardboard	Printing and writing paper	388.50	1200.00
	Cardboard	388.50	1200.00
	Liquid paper	388.50	1200.00
	Newsprint and magazines	388.50	1200.00
	Other paper	388.50	1200.00
Glass	Container glass	-	-
	Other glass	-	-

Material type	Material sub-type	Landfill generation (methane gas capture) Electricity yield (MWh/Kt)	Waste to Energy generation Electricity yield (MWh/Kt)
Plastic	PET	-	2625.00
	PP	-	2625.00
	PS	-	2625.00
	PVC	-	2625.00
	HDPE	-	2625.00
	LDPE	-	2625.00
	Other plastics	-	2625.00
Tyres and rubber	Passenger tyres	386.52	2400.00
	Truck tyres	386.52	2400.00
	Offroad tyres	386.52	2400.00
	Other rubber	386.52	2400.00
Textiles	Clothing	237.86	1425.00
	Other textiles	237.86	1425.00

a. The following sources have been used as inputs to inform the assumptions for landfill generation and waste to energy generation:

b. Carre, Crossin, & Clune, (2015)National Greenhouse Accounts Factors (Department of Climate Change, Energy and Environment, 2023)

c. ISWA Guidelines: Waste to Energy in Low and Middle Income Countries (International Solid Waste Association, 2013).

Greenhouse gas emissions analysis in this RIS

Emissions are relevant for assessing WtE in Victoria, because WtE may replace either landfill or recovery avenues for waste materials streams, and each of these avenues has different emissions impacts.

Emissions multipliers

The emissions multipliers used in this RIS represent the emissions produced per tonne of waste processed for each material sub-type. Different multipliers are used, according to whether waste is going to landfill, WtE processing or recovery in the modelled scenarios. The multipliers are used – in combination with modelled waste tonnages – to calculate estimates of emissions generated directly through scope 1 and 2 activities, as well as marginal grid emissions avoided by, for example, replacing electricity grid emissions with WtE – or landfill gas – energy generation.

Emissions produced by landfill, WtE and recovery are partially dependent on emissions associated with using electricity sourced from the grid. Therefore, landfill, WtE and recovery net emissions change over time depending on expected marginal electricity grid emissions. The analysis in this RIS is technology-agnostic regarding WtE and recovery technologies, and any variability in emissions between them.

Table B-4 shows the emissions multipliers – by material sub-type and destination – applied in 2023-24. Note that only material types deemed suitable for WtE processing are included in this table, as emissions factors for materials not suitable for waste to energy processing do not affect the results of analysis in this RIS. These landfill and WtE multipliers are adjusted over time in line with the electricity emissions intensity factors in Table B-5.

As well as electricity emissions intensity, the multipliers used in this RIS are based on varied data sources. DEECA adapted these figures using input from SV. The figures are based on modelling intended to support the estimation of greenhouse emissions and should not be relied on for purposes beyond this RIS. Data sources that inform the emissions multipliers include:

- LCA of Kerbside Recycling in Victoria (Carre, Crossin, & Clune, 2015)

- National Greenhouse Accounts Factors 2022 (Department of Climate Change, Energy and Environment, 2023).
- ISWA Guidelines: Waste to Energy in Low and Middle Income Countries (International Solid Waste Association, 2013).

Table B-4: Waste material types, sub-types and associated emissions factor used in base year 2023-24

Type	Sub-type	Emissions factor t CO_2-e/t (2023-24)					
		Landfill		Recovery		Waste to Energy	
		Scope 1 & 2	Avoided emissions	Scope 1 & 2	Avoided emissions	Scope 1 & 2	Avoided emissions
Organics	Food organics	0.90	-0.14	0.08	-0.02	0.00	-0.71
	Garden organics	0.67	-0.10	0.089	-0.03	0.00	-0.71
	Other organics	0.86	-0.03	0.089	-0.01	0.00	-0.71
	Wood/timber	0.31	-0.05	0.089	-0.06	0.00	-0.94
Paper and cardboard	Cardboard	1.40	-0.22	0.63	-0.94	0.04	-0.93
	Liquid paper	1.40	-0.22	0.63	0.94	0.04	-0.93
	Newsprint and magazines	1.40	-0.22	0.63	0.94	0.04	-0.93
	Other paper	1.40	-0.22	0.63	0.94	0.04	-0.93
	Printing and writing paper	1.40	-0.22	0.63	0.94	0.04	-0.93
Plastic	HDPE	0.00	0.00	0.51	0.69	3.67	-2.04
	LDPE	0.00	0.00	0.51	0.69	3.67	-2.04
	Other plastics	0.00	0.00	0.51	0.69	3.67	-2.04
	PET	0.00	0.00	0.51	0.69	3.67	-2.04
	PP	0.00	0.00	0.51	0.69	3.67	-2.04
	PS	0.00	0.00	0.51	-1.29	3.67	-2.04
	PVC	0.00	0.00	0.51	-1.29	3.67	-2.04
Tyres and rubber	Offroad tyres	1.40	-0.22	0.23	0.00*	2.53	1.86
	Other rubber	1.40	-0.22	0.23	0.00*	2.53	1.86
	Passenger tyres	1.40	-0.22	0.23	0.00*	2.53	1.86
	Truck tyres	1.40	-0.22	0.23	0.00*	2.53	1.86
Textiles	Clothing	0.86	-0.13	0.00*	0.00*	0.73	-1.11
	Other textiles	0.86	-0.13	0.00*	0.00*	0.73	-1.11

a. Source: SV and DEECA calculations, based on various sources including (Carre, Crossin, & Clune, 2015). Note: DEECA and Sustainability Victoria accept no liability for any loss or damage purportedly sustained or incurred as a result of reliance being placed on these figures. DEECA and Sustainability Victoria make no representation or warranty as to the accuracy, currency or completeness of these figures or any information extrapolated or calculated from these figures.

b. Note: Where no data is available so assumed to be zero. It is expected that these values if estimated would likely lead to greater net emissions reductions from recovery than from WtE and from landfill.

Emissions avoided from electricity generation

Electricity generated by landfill and WtE reduce greenhouse gas emissions at the expected marginal emissions intensity of electricity sourced from the grid, in line with DEECA analysis. The marginal generator is the final generator dispatched; the price-setting generator. Marginal generators are often gas plants, which have materially different emissions intensities to the technologies that currently supply most electricity (coal plants) and the technologies expected to supply most electricity in the future (renewable energy plants). Marginal emissions are lower than current average emissions, but are likely to be higher than future average emissions in a renewables-dominated NEM.

The marginal grid emissions intensity factors used in this RIS are presented in Table B-5.

Table B-5: Electricity grid emissions intensity scaling factors

Units	NEM emissions (tCO_2-e/MWh)
2024	0.56
2025	0.56
2026	0.56
2027	0.40
2028	0.53
2029	0.44
2030	0.44
2031	0.44
2032	0.46
2033	0.47
2034	0.44
2035	0.42
2036	0.29
2037	0.29
2038	0.29
2039	0.28
2040	0.23
2041	0.20
2042	0.17
2043	0.19
2044	0.22
2045	0.24
2046	0.24
2047	0.22
2048	0.22
2049	0.22
2050	0.25

a. Source: DEECA analysis

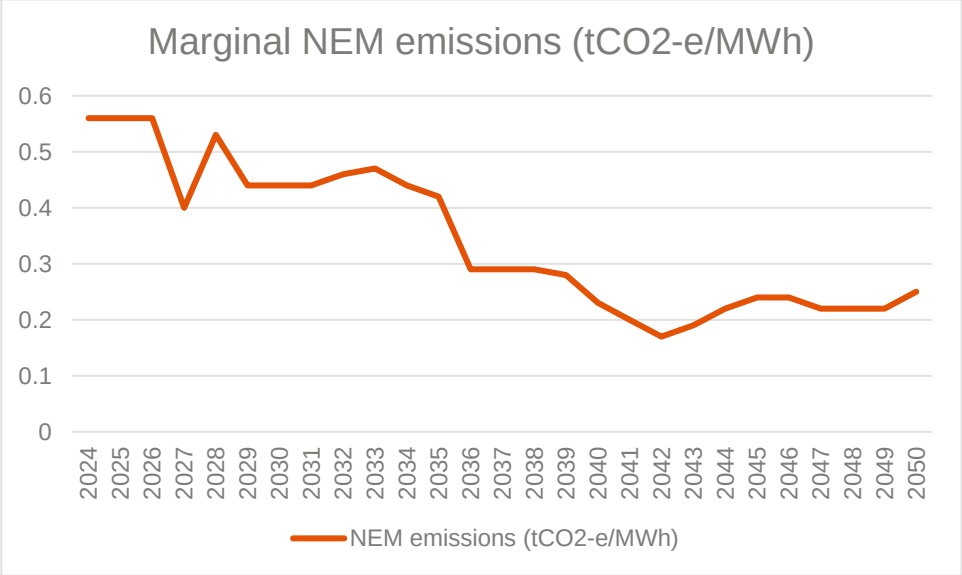

Figure I: Marginal NEM emissions (tCO_2-e/MWh)

In the early years of analysis, marginal generation shares by time are roughly 40% coal, 40% renewable sources, and 20% gas, that is. gas is the marginal generator approximately 20% of the time. As coal plants close the share shifts, until the marginal generation shares are roughly two thirds renewable sources and one third gas.

Emissions valuation

The analysis in this RIS uses a trajectory of 'carbon values' (Table B-6) based on scenarios in the Intergovernmental Panel on Climate Change's Sixth Assessment Report (2023; 2022) that is consistent with the Paris Agreement, decided by the international community in 2015, to "hold the increase in global average temperature to well below 2°C and to pursue efforts to limit the temperature increase to 1.5°C". The series is also consistent with the estimated costs of meeting Victoria's climate goals, as modelled by DEECA for analysis supporting Victoria's 2035 emissions reduction target.

Victoria is delivering its share of global action to achieve the Paris Agreement goal through the *Climate Change Act 2017*. This includes establishing a process to develop emission reduction policies (sector pledges) and committed greenhouse gas emissions reduction targets of:

- 28–33% below 2005 levels by 2025,
- 45–50% below 2005 levels by 2030,
- 75–80% below 2005 levels by 2035, and
- net zero emissions by 2045.

This will contribute to Victoria's transition to net zero emissions and the global achievement of the Paris Agreement goal.

This IPCC trajectory assumes global action is taken to keep global temperature rise to well below 2°C and is maintained out to 2100. It is derived from the median of costs of abatement that has been assessed by the IPCC as necessary to provide a 50% chance of returning global temperature increases to 1.5 degrees Celsius by 2100, after 'overshooting' (Intergovernmental Panel on Climate Change, 2022, pp. 360, Scenario C2 Figure 3.32). This means it is a 'targets-based' or 'targets-consistent' valuation, not a 'social cost of carbon'.

As the IPCC's Sixth Assessment report did not include abatement cost estimates for 2020, estimates from the closest scenario in the IPCC's Fifth Assessment report were used instead (430-480 ppm scenario, (Intergovernmental Panel on Climate Change, 2014, pp. 450, Figure 6.21) The 25th percentile and 75th percentile estimates are also derived from the IPCC's reports.

The carbon values were converted into Australian dollars for the relevant year using an annual average of daily exchange rates and then escalated to current values using the historical consumer price index (CPI) series, both sourced from the Reserve Bank of Australia.

A straight line was used to connect each data point and calculate a value for each financial year.

Table B-6: Benefits of avoiding GHG emissions

FY2023 AUD/tCO_2-e per year	Lower sensitivity (25th percentile)	Central values	Upper sensitivity (75th percentile)
2020	$58	$82	$101
2021	$62	$88	$114
2022	$65	$94	$128
2023	$69	$100	$141
2024	$73	$106	$155
2025	$77	$112	$168
2026	$80	$118	$181
2027	$84	$124	$195
2028	$88	$130	$208
2029	$92	$135	$221
2030	$95	$141	$235
2031	$106	$154	$253
2032	$116	$167	$272
2033	$127	$180	$290
2034	$137	$192	$309
2035	$148	$205	$328
2036	$158	$218	$346
2037	$169	$231	$365
2038	$179	$243	$383
2039	$190	$256	$402
2040	$200	$269	$420
2041	$211	$282	$439
2042	$221	$294	$458

FY2023 AUD/tCO_2-e per year	Lower sensitivity (25th percentile)	Central values	Upper sensitivity (75th percentile)
2043	$231	$307	$476
2044	$242	$320	$495
2045	$252	$333	$513
2046	$263	$345	$532
2047	$273	$358	$550
2048	$284	$371	$569
2049	$294	$384	$588
2050	$305	$396	$606

b. Source: DEECA, based on IPCC's Sixth Assessment Report (2022; 2023)

Land and water use analysis in this RIS

In order to assess the effects of the cannibalisation of recoverable materials by waste to energy on land and water use, we have applied a multiplier to recoverable waste burnt in waste to energy across the options. These multipliers are sourced from LCA of Kerbside Recycling in Victoria (Carre, Crossin, & Clune, 2015). These multipliers are outlined below:

Table B-7: Land and water use forgone per kilotonne of recovered waste

Material type	Material sub-type	Land use forgone ha.a/Kt	Water use forgone kL H2O/Kt
Aggregate, masonry and soils	Rubble	-	-
	Soil and natural materials	-	-
	Asphalt	-	-
	Bricks	-	-
	Concrete	-	-
	Plaster	-	-
Metal	Ferrous	-1.80	42000
	Aluminium	78.00	29000
	Other metals	-	-
Organics	Food organics	-0.22	5700
	Garden organics	-0.22	5700
	Other organics	-0.22	5700
	Wood/timber	-0.22	5700
Paper and cardboard	Printing and writing paper	140.00	11000

Material type	Material sub-type	Land use forgone ha.a/Kt	Water use forgone kL H2O/Kt
	Cardboard	140.00	11000
	Liquid paper	140.00	11000
	Newsprint and magazines	140.00	11000
	Other paper	140.00	11000
Glass	Container glass	0.29	940
	Other glass	-	-
Plastic	PET	0.84	69000
	PP	0.84	69000
	PS	-3.60	26000
	PVC	-3.60	26000
	HDPE	-3.50	23000
	LDPE	-3.50	23000
	Other plastics	-3.60	26000
Tyres and rubber	Passenger tyres	-	-
	Truck tyres	-	-
	Offroad tyres	-	-
	Other rubber	-	-
Textile	Clothing	-	-
	Other textiles	-	-

a. Source: Carre, Cross and Clune (2015)

b. Note: Carre, Cross and Clune (2015) did not include values for all waste subtypes. Some judgement was made to apply values to similar subtypes which were missing a value (e.g some plastics values were used for similar plastics).

It should be caveated that these multipliers are not specific to waste to energy, but to a generalised mix of alternatives to recovery (mostly landfill). It was explicitly mentioned in Carre, Cross and Clune (2015) that waste to energy was not included in this mix, and in this RIS, under all three options, any additional amount of recoverable waste cannibalised is done so by waste to energy, not landfill. These multipliers have still been used for waste to energy however, as they include certain land and water use factors that waste to energy has in common with other more common waste disposal methods (i.e. landfill). An explanation of these land and water use factors is included in the table below:

Table B-8: Land and water use factors from which the land and water use multipliers are derived

Factor	Relevant for waste to energy?	Explanation
Local production	Yes	As waste to energy burns waste, it requires more new products to be made to replace the disposed products which are not recovered, similar to landfill. Some of these products will be made domestically.
International production	Yes	As waste to energy burns waste, it requires more new products to be made to replace the disposed

		products which is not recovered, similar to landfill. Some of these products will be made internationally.
Landfill collection	Yes	This RIS assumes that waste to energy and landfill collection costs are the same, as we do not yet know where future waste to energy facilities will be situated. This factor can thus be used as analogue for waste to energy collection impacts.
Disposal operations	No	Landfill has different land and water costs for disposal compared to waste to energy processing, so this factor is not relevant to waste to energy.
Landfill carbon storage	No	Landfill has different land and water costs for carbon processing to waste to energy, so this factor is not relevant to waste to energy.

a. Note: To what extent these factors are responsible for the value of each multiplier has not be considered in this RIS due to the complexity of the judgement calls required.

As all of these factors are not specific to waste to energy, these forgone land and water use benefits in this RIS should be interpreted conservatively.

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