WASTE OPTIONS DEVELOPMENT

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Executive Summary

Moreland City Council (Council) engaged Ricardo Energy Environment & Planning (Ricardo) to develop strategic waste options and research to inform Council's next Waste and Circular Economy Strategy. The options presented in this report seek to support Council's commitment to the target of zero waste to landfill by 2030, a target set and adopted by Council in the 2018 Waste and Litter Strategy.

A zero-waste target is challenging to achieve and requires a holistic approach to tackling the problem from design, manufacture, use, recycling and disposal. This leads to a complete overhaul in the way in which resources are managed. The challenge is also highlighted by:

- Some 19.4% of Moreland's kerbside waste currently has no alternative option for disposal/management other than landfill. 'Perfect' source separation by households and businesses is not achievable in real world scenarios, and even under these circumstances, a maximum diversion rate of 83.5% could be achieved.
- Countries renowned for high diversion rates, such as Sweden which sends only 1% of its waste to landfill (Blue Ocean, 2022), utilise thermal waste to energy technologies
- Reducing waste generation requires societal and cultural change
- Making it easier to separate out the recyclable materials from the garbage bin relies on good product design which is outside Moreland's scope of control.

The scope of analysis was limited to the Council kerbside service, including the three kerbside bins, hard waste service, public litter bins and dumped rubbish. Waste flowing through the private sector, such as commercial and industrial (C&I) and construction and demolition (C&D) is not included as Council does not manage these wastes.

Currently, Moreland City Council manages approximately 67,250 tonnes of waste per year and send approximately 40,100 tonnes of waste to landfill. This amount includes the garbage collected from kerbside bins, hard waste, dumped rubbish and public litter bins, as well as contamination in other waste streams and sorting processes.

The main source of waste to landfill currently is the contents of the kerbside collected garbage bin. Under the current kerbside system, approximately 19.4% of the waste stream has no alternative to landfill, which means that Moreland's current maximum possible resource recovery rate is capped at 83.5%. The hard waste collection generates the largest portion of material with no alternative destination but also presents opportunities for improved resource recovery as many of the materials could be easily recycled. Materials such as nappies and sanitary items, plastic films and soiled paper/paper towel/tissues also have limited alternative options.

Three scenarios were developed to better understand the impacts of existing/planned changes to the waste services and potential future interventions which may assist Council in progressing towards the 2030 zero waste to landfill target. Broadly, the three scenarios are:

- Scenario 1: Business as usual (BAU). Scenario 1 includes existing and planned policy reforms which must occur to the system across Victoria. These reforms are not unique to Moreland, such as the container deposit scheme. However, some reforms can be implemented according to a timeline set by Moreland, such as implementation of the glass service and weekly FOGO service.
- Scenario 2: The second scenario builds upon the BAU reforms by incorporating forecast service changes (pending successful trials and Council approval) including a combined weekly FOGO/Fortnightly garbage collection in 2025 and a booked hard waste service. Scenario 2 also includes additional intervention actions to divert more waste from landfill, that are achievable by 2030 and currently employed in other jurisdictions globally.
- Scenario 3: The third scenario focuses on possible methods to transition towards a circular economy and reach a feasible zero waste to landfill scenario. The scenario assumes a broader socio-economic move towards circular economy design practices and considers what other reforms and system changes, within the scope of City of Moreland's influence but not currently on the table, may reduce waste to landfill and benefit waste and recycling practices.

The intervention options included in the report were:

Scenario 1	Scenario 2	Scenario 3
• Single Use Plastics Ban • Container Deposit Scheme • National Packaging Targets • Export bans • Weekly FOGO	• Booked Hard Waste Collection • Weekly FOGO / Fortnightly Garbage Collection • Pay By Weight System • Sanitary Item Diversion • Drop Off Facility • Public Organics Bin • Compostable Bags / Liners (for FOGO)	• 'Dirty' materials recovery facility (MRF) • On Call Garbage • Bin Food Only Collection • Higher CDS Rebate • Landfill Ban • Food Waste Disposal Units • Minimum Recycled Content - Construction • Textile Diversion

In addition, Council is already proposing (pending trials) to implement a booked hard waste collection and a fortnightly garbage collection in the short to medium term and supports a range of community waste diversion initiatives.

The modelling results showed:

- Scenario 1 diverts an approximately 19% more waste away from landfill compared to the baseline at 2030, largely as a result of the weekly FOGO service. Planned policy and service reforms at the state level, such as Single Use Plastics Ban, CDS and export bans will provide a small benefit but not meaningfully progress towards zero waste for Moreland.
- Scenario 2 shows a significant reduction in waste generation with the amount of waste sent to landfill at 19,100 tonnes by 2030, a reduction of 42% compared to the baseline modelling in 2030.
- The remaining 19,000 tonnes of residual waste could be reduced by the other additional interventions that target approximately 73.5% of this waste stream, or 34.36% of the total waste stream within the scope of this project.
- Scenario 3 includes additional interventions to further reduce waste to landfill and better manage the community's waste. Many of these interventions could be influenced by Council, but not controlled by Council. This scenario would trend closer towards zero waste to landfill.

Council's zero waste to landfill target is also coupled with an endorsed Council position that alternatives to landfill that include thermal waste to energy (WtE) options are not acceptable. A review of WtE technologies was also included in this report to provide additional information to Council. The review showed that there are a handful of thermal WtE facilities proposed for Victoria, all of which are seeking to process a proportion of MSW as their feedstock. Whilst Council opposes thermal WtE as an alternative to landfill, it does provide a technological option to significantly reduce waste to landfill and lower GHG emissions per tonne of waste compared to landfill.

The challenging nature of achieving zero waste to landfill is highlighted by the range of options presented in this report, which show that even radical changes to Council's waste management services may not reach zero waste to landfill. This is because Council has limited control over waste which is generated by the community. This waste generation is linked to consumer behaviour, product design and manufacture and demand for recycled materials. Therefore, achieving zero waste to landfill will require sweeping changes in product creation (manufacturing and packaging), product use (use of sustainable, recycled and recyclable products), and product disposal (resource recovery or landfilling), a holistic approach across the lifecycle.

CONTENTS

Figures

Tables

Appendices

Glossary

Abbreviation	Definition
AD	Anaerobic Digestion
BAU	Business As Usual
C&D	Construction and Demolition
C&I	Commercial and Industrial
CDS	Container Deposit Scheme
CEBIC	Circular Economy Business Innovation Centre
CO_2	Carbon Dioxide
DELWP	Department of Land, Water Environment And Planning
EPA	Environment Protection Authority
FOGO	Food Organics Garden Organics
FWD	Food Waste Disposal
HDPE	High-Density Polyethylene
LDPE	Low-Density Polyethylene
MBT	Mechanical/ Biological Treatment
MRF	Materials Recovery Centre
MSW	Municipal Solid Waste
MWRRG	Metropolitan Waste And Resource Recovery Group
NGER	National Greenhouse And Energy Reporting
PDU	Product Destruction Unit
PEF	Process Engineered Fuel
PET	Polyethylene Terephthalate
PS	Polystyrene
PVC	Polyvinyl Chloride
RDF	Refuse Derived Fuel
RFID	Radio Frequency Identification
SUP	Single Use Plastics
SWRRIP	Statewide Waste and Resource Recovery Infrastructure Plan
VRIP	Victorian Recycling Infrastructure Plan
WRAP	Waste and Resources Action Programme
WtE	Waste to Energy

1. INTRODUCTION

Moreland City Council (Council) engaged Ricardo Energy Environment & Planning (Ricardo) to develop strategic waste options and research to inform Council's next Waste and Circular Economy Strategy. The options presented in this report seek to support Council's commitment to the target of zero waste to landfill by 2030, a target set and adopted by Council in the 2018 Waste and Litter Strategy. The next Waste Strategy will span 8 financial years (2023/24 to 2030/31) be supplemented by two 4-year action plans developed during the lifespan of the strategy, see **Figure 1-1**. This approach is to enable actions to be developed in response to emerging opportunities as well as better aligning strategy objectives and reporting with the timing of key state and federal waste policies and targets.

Currently, Moreland City Council's waste services manage approximately 67,250 tonnes of waste per year, and send approximately 40,100 tonnes of waste to landfill, either directly through the garbage collection, or indirectly through contamination in other waste streams and sorting processes. Council recognises that reaching the zero waste to landfill target is aspirational and will require significant investment and change in waste and recycling behaviour, infrastructure, and services provided to the community.

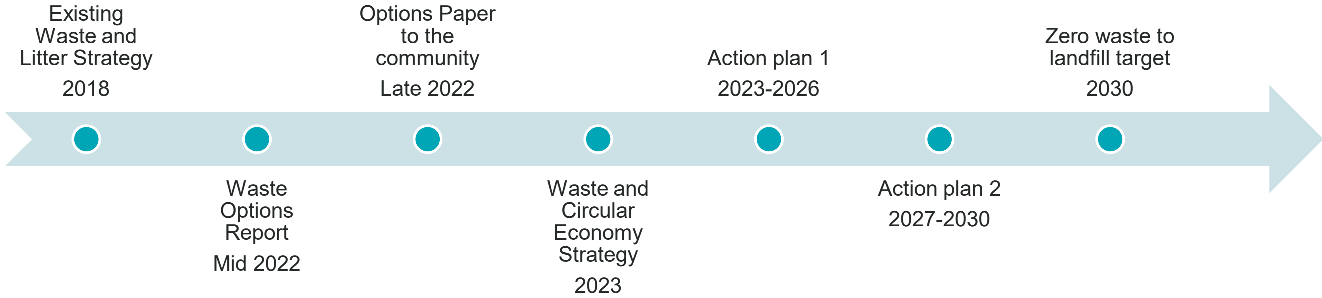

Figure 1-1 Strategic Process for Options Development

1.1 CONTEXT

Increased population, urbanisation, production of goods, and behaviour changes in the consumption and disposal of goods have contributed to increased waste generation around the world. Managing the waste generated has become an increasingly important issue for communities and local governments to address, especially the fraction which is disposed of at landfill.

In 2018, Council committed to the target of zero waste to landfill by 2030. Zero waste approaches can vary such as:

- Zero waste generation;
- Zero waste to landfill; or
- Zero recoverable waste to landfill.

In each circumstance, a zero-waste approach is challenging to achieve and requires a holistic approach to tackling the problem from design, manufacture, use, recycling and disposal. This leads to a complete overhaul in the way in which resources are managed.

Council's zero waste to landfill target is coupled with a firm position that alternatives to landfill that include thermal waste to energy options are not acceptable. These two drivers have shaped the options presented in this paper.

1.2 SCOPE OF WORKS

The scope of works for this Options Development Report is limited to the Council kerbside service, hard waste service, public litter bins and dumped rubbish. Waste flowing through the private sector, such as commercial and industrial (C&I) and construction and demolition (C&D) is not included. The scope of work includes:

- Background and baseline performance
    - Waste flow analysis showing the inputs and fates of materials included within the scope;

  - Calculation of emissions from waste services; and
  - 10-Year waste projections.
- Waste to Energy non-thermal options analysis
  - analysis on waste and emissions reduction opportunities presented by non-thermal Waste to Energy technologies and comparison to landfill/other processing options;
  - glossary of Waste to Energy terminology and classification of key technologies into thermal and non-thermal categories;
  - Provide an update on current WtE technologies in use or in development in Victoria as well as guiding policy and legislation for the sector; and
  - Include assessment of carbon impacts from waste streams and waste management technologies.
- Development of three scenarios for progressing change in waste management including:
  - Scenario 1 – the new business as usual (BAU) – existing / planned reforms by all tiers of government including likely impacts of confirmed Federal/State policy and programs plus local reforms to kerbside service planned for 2023.
  - Scenario 2 – new BAU, plus impacts from additional Council service innovation and reform options which may be feasible by 2030, including move to a combined weekly FOGO/Fortnightly garbage (2025) and move to booked hard waste service with additional recovery streams (cardboard, bundled green waste) as well as other services or innovations that Council could achieve.
  - Scenario 3 – step change for a circular economy – as above plus further priority reforms / system changes requiring State and/or Federal policy or regulation and/or social change at a household or business level (i.e., identifying system change/s that require successful advocacy and/or innovation with partnerships/collaboration or business models beyond what Council can achieve).
- Assessment of scenarios
  - Estimate costs to implement new service/s or process/es;
  - Identify most effective and achievable options to reach the zero waste to landfill target;
  - Identify key stakeholders and delivery partners;
  - Include rationale for how service options can promote the transition to a circular and resource efficient economy;
  - Provide a summary of issues/barriers and opportunities presented by the proposed waste management options; and
  - Analysis on the interaction between residential and public place waste management systems.

2. BASELINE SERVICES

The baseline waste services provided to the Moreland community, included in this scope of works, are detailed in **Table 2-1** below. As well as kerbside and street collections, Council also provides a range of waste-related services to support the community and efforts to improve waste services and outcomes, see **Appendix A**. These other services include educational programs, community events and promotion of other recycling locations and activities available to the community. These services (and improvements to them) are excluded from this analysis, however, will likely be required to assist in implementing some of the proposed options.

Table 2-1 Baseline Services

Service	Collection Frequency	Destination
Kerbside Garbage	Weekly	Melbourne Regional Landfill
Kerbside Commingled Recyclables[1] (yellow lid bin)	Weekly	Visy Heidelberg Materials Recovery Centre (MRF)
Kerbside FOGO (green lid bin)	Fortnightly	Veolia Bulla Organics Facility
Hard Rubbish	Annually – Blanket service	WM Waste Management
Street Litter Bin	Varying - collection schedule	Melbourne Regional Landfill
Dumped rubbish	Varying – as needed	Melbourne Regional Landfill
Street Sweeper	Varying - program of operation	RepurposeIt Epping

2.1 PERFORMANCE

The City of Moreland managed approximately 67,250[2] tonnes of waste through its range of waste services in 2021, as shown in **Table 2-2** below.

Table 2-2 2021 Waste and Recycling Tonnes

Service	2021 Tonnes	% of total waste
Kerbside Garbage	29,871	44.4%
Kerbside Commingled Recycling (yellow lid bin) – includes street bin recycling	16,104	23.9%
Kerbside Organics (green lid)	13,052	19.4%
Hard Rubbish	4,874	7.2%
Street Bin Garbage	673	1.0%
Dumped Rubbish	2,274	3.4%

[1] Includes Public Place Recycling bin collection

[2] The total tonnage of waste is calculated from Council data and incorporates the full suite of Council waste collection services. This number differs from the Know You Council database which looks at only the three kerbside collection services (residual red lid bin, commingled recyclable yellow lid bin, and FOGO green lid bin)

Service	2021 Tonnes	% of total waste
Street Sweeper	412[3]	0.6%
Total	**67,259**	**100%**

Approximately 44.4% of the total waste (or 29,871 tonnes) was collected in the kerbside garbage service (red lid bin) and taken directly to landfill. Other materials such as contamination, hard waste and street bin garbage also contribute to the material sent to landfill, increasing the landfilled amount to a total of approximately 40,100 tonnes for 2021. The total amount of waste generated equates to 359kgs per person[4], or 315kg per person when looking at the three-bin kerbside tonnage only. According to Sustainability Victoria's Local Government Waste Services Report (2019-20) the Victorian average yield per person for the kerbside services is 353kg, which means that Moreland residents produce less kerbside waste than average.

Council regularly commissions audits of the waste services to benchmark performance and compare against previous years. The most recent audit of the kerbside bins was completed in October 2021 by Solo Resource Recovery. The audit revealed the following waste performance measures:

- 83.5% of the food waste in the kerbside bins is incorrectly placed in the garbage red-lid bin, despite having an operational FOGO service (**Table 2-3**)
- 20.9% of the recycling material is incorrectly placed in the garbage red-lid bin, despite having an operational recycling service (**Table 2-3**)
- The contamination rate in the FOGO bin was 3.15%
- The contamination rate in the recycling bin was 31.3%

Additionally, data collected from the hard waste service shows that approximately 80.9% of the material collected is landfilled, equating to a diversion rate of 19.1% for this service.

Table 2-3 Location of Materials in Kerbside Bins

Location of Material in Kerbside Bins	Garbage red lid bin	Commingled recycling yellow lid bin	Organics green lid bin	Total
Garden organics	3.3%	0.2%	**96.6%**	**100%**
Food waste	83.5%	1.1%	**15.4%**	**100%**
Recycling material	20.9%	**78.4%**	0.7%	**100%**
Other residual materials (landfill)	**70.8%**	25.2%	4.0%	**100%**

The main source of waste to landfill is the contents of the kerbside collected garbage bin. Figure 2-1 below shows the composition of the garbage bin and highlights that 40.81% of the contents should be diverted to the FOGO service, and 11.32% to the recycling service.

[3] Average of years 2018-2020

[4] Estimated resident population is 187,336 for 2021 (Moreland City Council Population and Housing Forecasts 2021 – 2036)

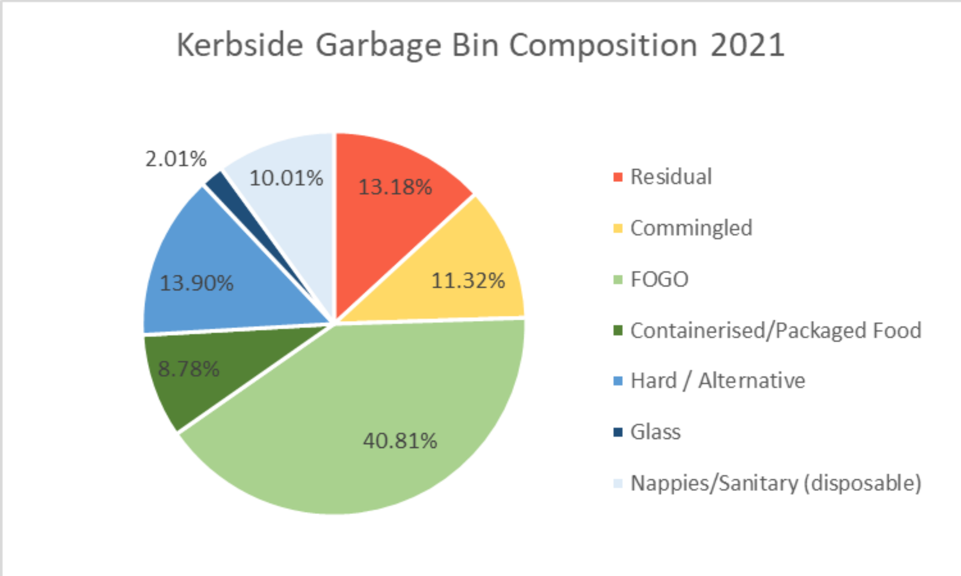

Figure 2-1 Kerbside Garbage Bin Composition 2021[5]

2.2 WASTE FLOW

A waste flow analysis was conducted to better understand the fate of the materials. According to the most recent audit report conducted on the kerbside services, Moreland's diversion rate is 54.35%. According to Sustainability Victoria's 2019-20 Local government waste services workbook, the average diversion rate for the state is approximately 41.8%, or 44.3% for the metropolitan Councils. However, this figure does not account for other waste services (such as hard waste and dumped rubbish) which contribute to landfill, nor does it consider the contaminating materials in the recycling and FOGO service which are landfilled after being processed at their respective facilities. **Figure 2-2** below shows that approximately 59% of the waste collected is landfilled, resulting in a more considered diversion rate of 41%. The more considered diversion rate is 13.35% lower than the 2019/20 audit report diversion rate.

In order to reach the zero waste to landfill target, Moreland will need to alter the way approximately 40,100 tonnes of waste are managed (based on 2021 figures). Without systemic change or service innovation, this is forecast to grow to 45,800 tonnes by the time the 2030 target date is reached, due to the increased population forecasted for Moreland.

[5] 'Hard / Alternative' refers to items that should be diverted to the hard waste service or recycled separately such as textiles, batteries, and light globes

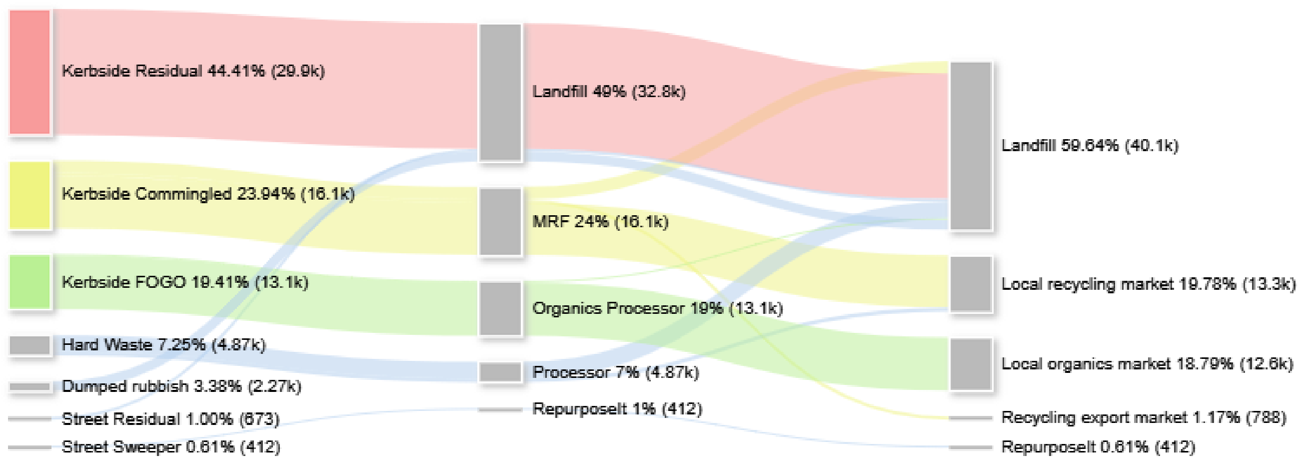

Figure 2-2 Baseline Waste Flow 2021

In order to understand the difference between materials that are not sent to the correct location, and materials that have no alternative destination than landfill, an exercise was conducted to visualise the maximum resource recovery rate that Moreland could achieve if all material types were placed in the correct bin. The exercise reviewed the composition of the various waste streams, assigning the correct bin to each material type. **Appendix B** shows the detailed categorisation. The exercise revealed that under the current services, a maximum diversion rate of 83.5% could be achieved, see **Table 2-4**.

Table 2-4 Optimum Diversion Rate

Service	Tonnes	% of total	Landfill rate / Diversion rate
Garbage (red lid bin)	11,074.07	16.5%	16.5%
Commingled (yellow lid bin)	13,532.57	20.1%	83.5%
FOGO (green lid bin)	28,999.31	43.1%	
Hard / Alternative	7,614.13	11.3%	
Glass	6,037.21	9.0%	

Assuming perfect source separation circumstances for 2021 data, Moreland would still be landfilling approximately 11,110 tonnes of residual (garbage) waste. The materials remaining in the garbage bin in this scenario are detailed in **Table 2-5.** The table shows that materials such as nappies and sanitary items, plastic films and soiled paper/paper towel/tissues are some of the top materials requiring intervention, if a zero waste to landfill target is to be theoretically achievable. The hard waste collection also contributes to the amount of waste sent to landfill and presents opportunities for improved resource recovery as many of the materials could be easily recycled.

Table 2-5 Remaining Landfill Materials 2021

Material / Audit Classification	Tonnes 2021	% of total waste stream	% of garbage waste stream
Nappies/Sanitary (disposable)	3,081.39	4.6%	27.7%
Landfill	1,949.60	2.9%	17.5%
Plastic Films	1,972.08	2.9%	17.8%
Soiled Paper/Paper Towel/Tissues	1,274.91	1.9%	11.5%

Material / Audit Classification	Tonnes 2021	% of total waste stream	% of garbage waste stream
Bagged Garbage	1,124.21	1.7%	10.1%
Rigid Plastic Not Bottle/Container	901.76	1.3%	8.1%
Other	623.04	0.9%	5.6%
Residual	82.07	0.1%	0.7%
PS (expanded) 6	62.93	0.1%	0.6%
Polystyrene (not expanded) 6	38.27	0.1%	0.3%
Total	**11,110.2**	**16.5%**	**100%**

3. BASELINE PROJECTIONS

Moreland's kerbside tonnes were projected out across a 10-year horizon. The projections were completed by applying a range of assumptions on the 2021 and historic waste data provided by Council. The following assumptions were key to the projections:

- Kerbside bin collections – projected against population forecasts completed by Carter Check Kramer in 2021 under a Moderate Recovery Scenario from Covid
- Street bin collections – projected against a straight-line trend from the past 5 year's data
- Hard waste collections - projected against population forecasts completed by Carter Check Kramer in 2021 under a Moderate Recovery Scenario from Covid. Volumes from the current blanket service arrangement were also adopted.
- Dumped rubbish - projected against a straight-line trend from the past 5 year's data
- Street sweeper – Historic data was not available for a 5-year period. A straight-line average (no forecast increase) of 2018-2020 data was applied. The straight-line average was used due to the variability in data across the three data points making trend projections difficult.

Figure 3-1 below shows that Moreland's waste generation is increasing, from approximately 67,500 in 2022, to 79,500 in 2032, an increase of 17.8%. The increased amount of material highlights that achieving zero waste must apply measures to reduce waste generation per capita as well as service innovations to improve resource recovery rates.

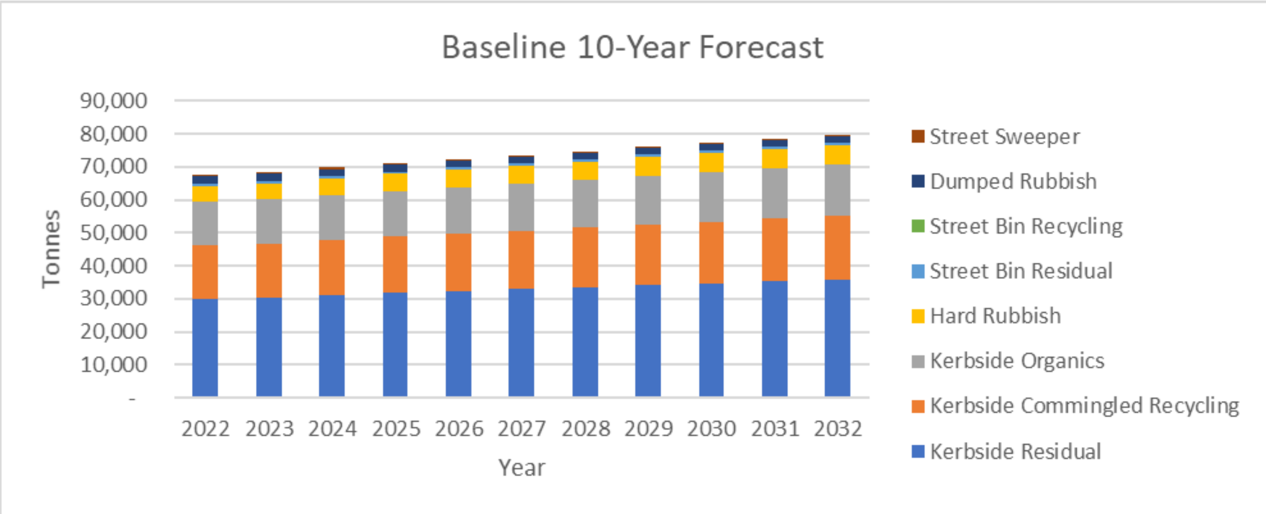

Figure 3-1 Baseline 10-Year Projection

4. WASTE TO ENERGY REVIEW

Moreland City Council does not support the use of thermal waste to energy (WtE) technologies as part of the zero waste to landfill strategy. The Moreland Waste and Litter Strategy (2018) describes Council's position as:

> *Thermal technologies can produce a host of negative environmental impacts including release of toxins into the atmosphere. Such an approach does not align with the goal of creating a regenerative and sustainable system for resource use. Council instead supports the development of technologies that do not create further environmental harm or undermine efforts to recover and recycle materials.*

This section provides a review of the existing WtE technologies across thermal and non-thermal options to provide context to this position.

4.1 GLOSSARY OF WASTE TO ENERGY TERMS

Term	Meaning
Advanced Waste Processing	Within the context of Melbourne's waste industry, a combination of processing technologies for residual (garbage) waste including sorting of residual (garbage) waste (see Dirty MRF) and thermal treatment such as Mass-burn WtE. The South East Melbourne Advanced Waste Processing project is designed to process residual waste to avoid landfill, however this phrase could be applied to many innovative technologies that process many different waste streams.
Advanced Recycling	As defined in the Victorian Waste to Energy framework, a process that chemically alters recyclable material to create new raw materials such as monomers or biocrude oil.
Anaerobic digestion (AD)	Biological breakdown by microorganisms of organic matter, in the absence of oxygen, producing biogas (a mixture of carbon dioxide and methane which can be used for energy) and digestate (a nutrient-rich residue). • Wet AD – Anaerobic digestion carried out on a liquid waste mixture • Dry AD – Anaerobic digestion carried out on a solid waste mixture
Biochar	Carbonised biomass produced by thermal treatment
Biocrude oil	An oil that is generated from biomass, with similar properties to crude oil
Bioenergy	Energy produced from biomass
Biogas	A gas generated by breaking down organic waste in the absence of oxygen. Can be produced by anaerobic digestion and landfills and is normally 40-80% methane.
Biogas engine	A stationary engine similar to a car engine that uses biogas as a fuel to produce electricity.
Biomass	Biological material including agricultural crops and waste, wood and wood waste, animal waste, garden waste and food waste, but excluding fossilised material such as crude oil.
Bioreactor landfill	A landfill optimised for capturing landfill gas and producing energy
Biorefinery	A facility that produces energy from biomass, often as liquid fuels
Bottom ash	The ash left over after combustion of waste in a mass burn or gasification WtE process
Calorific value (CV)	A measure of the amount of energy contained within the waste that could be potentially released when it is completely combusted under defined conditions.
CHP	Combined heat and power, also known as cogeneration
Co-generation	The production of both heat and electricity as useful products

Term	Meaning
Combustion	Thermal breakdown of waste with excess oxygen supplied. This turns the waste into ash. Energy may or may not be recovered.
Composting	Biological breakdown by microorganisms of organic matter, in the presence of oxygen, producing compost. No energy is produced
Digestate	The solid material produced from anaerobic digestion processes
Dirty MRF	A materials recovery facility (see MRF below) that receives waste that is unsorted or is residual waste
Diversion	A measure of how much of a waste stream is recycled or reused. Commonly interpreted as a measure of how much material is diverted away from landfill through source separation (e.g., how much material is placed in yellow lid recycling bin and green lid FOGO bins vs red lid garbage bins).
Energy from Waste (EfW)	Another term for Waste to Energy (WtE)
Fermentation	The process of using microorganisms or enzymes to break organic matter into ethanol and other useful fuels
Flue gas treatment	The process of cleaning the air produced from treating waste in a thermal WtE process
Fly ash	The ash produced from cleaning up the exhaust air in a thermal WtE process (also applies to ash from exhaust air in coal-fired power generation)
Gasification	Degradation of waste under high temperature, with limited oxygen supply, which creates a synthesis gas 'syngas' which can be burnt to generate heat and electricity • Plasma gasification – the use of plasma as the heat source for a gasification process, (as opposed to using natural gas or heat generated in the process itself)
GHG emissions	Also called greenhouse gas emissions, this refers to carbon dioxide sourced from fossil fuels that is emitted to atmosphere, plus methane and other gases emitted to the atmosphere, but excludes carbon dioxide sourced from organic waste.
Hydrothermal liquefaction	Degradation of waste in the presence of water, at moderate temperature and high pressure. This typically produces a bio-crude oil and other by-products.
Incineration	Combustion of waste for the primary purpose of disposal, with no energy recovery
Landfill	Disposal of waste onto land, typically in a hole (natural or manmade) but may also be above ground level.
Landfill gas	Biogas produced in a landfill
Mass-burn WtE	Combustion of waste, with oxygen present, producing heat that is recovered as useful energy (either heat or electricity)
MBT (mechanical/ biological treatment)	MRF that combines a sorting facility with a form of biological treatment such as composting or anaerobic digestion.
Monomer	A building block of complex materials, for example, ethylene which can be used to manufacture plastic products such as polyethylene (plastic).
MRF (material recovery facility)	Specialised plant that receives, separates and prepares recyclable materials for further use, including remanufacturing and WtE
Organic waste	Plant or animal matter, e.g., Grass clippings, tree prunings and food organics, originating from domestic or industrial sources.
Pyrolysis	Degradation of waste using high temperature in the absence of oxygen, to produce char, pyrolysis oil and syngas (e.g., The conversion of wood into biochar).

Term	Meaning
RDF/PEF – Known as either Refuse Derived Fuel (RDF) or Process Engineered Fuel (PEF)	RDF is a fuel produced after basic processing in a MRF or MBT to increase and control the calorific value and remove recyclable materials and contaminants from various wastes. These are produced to a specification including calorific value and particle size and then used to power an industrial process
Renewable natural gas	Biogas that has been cleaned up to remove most components except methane. Can replace fossil-fuel sourced natural gas.
Residual waste	Waste remaining after materials that can be viably recovered have been removed for reuse, recycling or energy generation. Ideally, the material in the red lid garbage kerbside bin
Syngas	A gas containing hydrogen and/or methane generated by pyrolysis and gasification processes
Thermal WtE	Combustion or degradation of waste using heat. Thermal WtE can be done with or without oxygen and produce a range of energy types including electricity, gases and liquid fuels. Some technologies also produce a biochar.
Torrefaction	Degradation of waste in the absence of oxygen, at moderate temperatures (250ºc to 400ºc). This primarily produces a biochar or similar, with liquid and gaseous fuels as by-products.
Trigeneration	The production of cooling, heat and electricity as useful products
Turbine	A set of blades turned by steam or combustion gases, used to produce electricity
Waste to Energy (WtE)	The process of recovering energy (either electrical or fuels) from a waste product

4.2 KEY TECHNOLOGIES AND THEIR WASTE STREAMS

There are two traditional categories of Waste to Energy (WtE) technologies. These are thermal and non-thermal technologies. Non-thermal technologies are biological processes, typically either anaerobic digestion or fermentation producing biogas or alcohols such as ethanol. These are typically limited to the treatment of organic materials such as FOGO, food organics or other forms of biomass.

Thermal technologies can be further separated into electricity-producing technologies and those that produce liquid or gaseous fuels. These thermal technologies exist on a spectrum where one end focuses primarily on managing the waste with some energy recovery as a by-product, to the other end which focuses primarily on the manufacture of fuels, where the input is a specific waste stream or commodity.

The impacts of these thermal technologies vary – for example, mass burn of garbage to recover energy has different environmental outcomes and risks compared to the production of liquid fuels from specific waste streams (e.g. HydroThermal Liquefaction to produce renewable crude oil https://arena.gov.au/projects/commercialisation-of-renewable-crude-oil-production/).

4.2.1 Thermal technologies

Thermal technologies can process a range of wastes and produce energy from the inputs that contain carbon molecules, such as plastics, food and garden wastes, textiles, paper and cardboard and soils. Different technologies have different strengths and weaknesses in handling these waste streams.

4.2.1.1 Mass Burn WtE

The typical technology under the thermal WtE banner is mass-burn WtE. Mass burn technology takes mixed garbage waste and uses a continuous process to combust the material in a controlled atmosphere. The heat from the combustion is used to create steam to drive a turbine which creates electricity. Mass burn technology reduces the volume of the input by 80%, as approximately 20% of the input is turned into “bottom ash”. Bottom ash is the remaining inert material after the burn process. Exhaust gases created by the burning are heavily treated to ensure that the final air emissions are in line with the regulatory requirements and minimise the impact on human health and the environment. The treatment of exhaust gases produces a “fly ash” waste that is often heavily contaminated and must be landfilled at a specifically licensed landfill.

Mass burn technology is primarily a waste treatment technology that minimises the need for landfill. The relative advantage of this technology is that it recovers energy from the waste, rather than simply incinerating the material to reduce its volume. Mass burn WtE facilities are typically large and require long term contracts for feedstock which leads to a risk that material is sent to these facilities to meet contractual obligations rather than incentivising further diversion to recycling. Where there is too much capacity for mass-burn WtE treatment compared to the amount of residual waste produced, this leads to perverse outcomes. Materials that have higher order uses such as recycling (rather than energy recovery) can be treated in mass burn WtE and without adequate controls, improvements in source separation and recycling may be dis-incentivised.

4.2.1.2 Gasification

Gasification is a technology that degrades waste in an oxygen limited environment. High temperatures (>1,000ºC) degrade the waste into a syngas which is cleaned and then burned (with oxygen) in a second stage. The heat from the combustion is typically used to create electricity, however syngas can also be extracted and used to create other products in some instances (typically when specific waste streams are used). Gasification is typically more challenging to operate on residual (garbage) waste than a mass burn facility, as the process is more sensitive to contaminants such as inert materials such as glass and ceramics. Waste streams that are relatively more homogenous and less likely to contain contaminants are more appropriate for gasification. Successful use of gasification to treat residual (garbage) waste is very rare globally. By-products (or wastes) from gasification processes are ash or slag as well as exhaust gas and syngas cleaning residue. Gasification can produce biochar (a useful by-product) alongside the syngas (instead of ash or slag) with the right operational parameters and waste streams. Materials that have higher order uses, such as recycling (rather than energy recovery), can be treated in gasification facilities and without adequate controls, improvements in source separation and recycling may be dis-incentivised.

4.2.1.3 Pyrolysis

Pyrolysis is a thermal technology that, similar to gasification, degrades waste using high heat (typically 400ºC – 800ºC) to produce a syngas or oil. Pyrolysis uses minimal to no oxygen in the degradation step rather than the limited supply in gasification technologies. Pyrolysis also operates at lower temperatures than gasification and thermal WtE.

Products of pyrolysis can be oils or liquid fuels as well as syngas, depending on the operating conditions. Similar to gasification, pyrolysis is sensitive to contaminants and is typically applied to clean waste streams with a known composition, such as garden waste, wood waste, soils and agricultural wastes, as well as tyres and plastics. Pyrolysis can also produce biochar from waste inputs such as woody waste and biosolids.

4.2.1.4 Torrefaction / Carbonisation

Torrefaction and carbonisation operate at lower temperatures again than pyrolysis (typically 250ºC to 400ºC). Typically, these processes are focussed on producing a biochar or solid product, and the syngas or oil produced is a by-product. These processes may produce some energy but are not typically classified as Waste to Energy.

Biochar systems that currently operate in Melbourne, such as the Earth Systems plant, fall into this category. These processes can be applied to woody and garden wastes, as well as waste soils.

4.2.1.5 Hydrothermal liquefaction

Hydrothermal liquefaction is a variation on torrefaction and carbonisation, with the conversion of material happening in a liquid environment, under high pressure and moderate heat. Hydrothermal liquefaction typically produces a renewable crude oil, along with a range of by-products and wastes. This emerging technology can treat organic wastes such as garden waste, wood waste and agricultural wastes. The technology can also treat tyres and plastics to produce the same range of fuels that are sourced from fossil fuel-sourced crude oil, including petrol, diesel and aviation fuels. These fuels are renewable if produced from organic wastes.

4.2.2 Non-thermal technologies

Non-thermal technologies process food and garden wastes, food manufacturing wastes and sometimes paper and cardboard. These technologies rely on a microbiological community to degrade the wastes and produce either methane or liquid fuels such as ethanol.

4.2.2.1 Wet Anaerobic Digestion

The term anaerobic digestion generally refers to the wet anaerobic digestion (wet AD) process. Wet AD takes organic wastes (typically food wastes) and uses anaerobic bacteria to degrade or digest that material into methane, in the form of biogas. The process occurs in a tank or lagoon, where the organic material is held for a number of days. Typically, digesters turn approximately 10-20% of the material into biogas and the remaining 80-90% carries through the process to become digestate. Organic wastes commonly have a high-water content and wet anaerobic digestion processes normally operate at 3-15% solids, which can be piped and pumped. The 85-97% water content remaining is normally removed from the digestate after the process and treated, recycled or disposed of. The solid digestate produced is similar to compost but has limited reuse options under the current regulations.

The biogas produced from wet AD is typically used to produce electricity, however it can also be cleaned to become a renewable natural gas. In some instances (where there is not enough produced, or it is poor quality) it is flared or burnt with no energy recovery.

Wet AD cannot process most garden wastes as they are too woody and do not degrade in the process. Wet AD is also sensitive to contamination, as grit, plastics, metals and garden wastes block the process and reduce its effectiveness.

4.2.2.2 Dry Anaerobic Digestion

Dry AD is an anaerobic digestion technology that is similar to composting. Despite its name, dry AD saturates a solid waste pile with water to create anaerobic conditions. Normally this involves spraying water over a pile that is inside a container or shed, where biogas can be captured. The water is recirculated to ensure the waste stays anaerobic and produces biogas. Dry AD can process food and garden wastes, including woody wastes which would float and not degrade in a wet AD process. This process extracts energy from the material, before following a similar process to composting where the material is matured and turned into a product similar to compost.

Similar to wet AD, the biogas produced can be used to produce electricity, however it can also be cleaned to become renewable natural gas.

Dry AD is an emerging technology and there are limited examples of this process operating successfully both in Australia and internationally.

4.2.2.3 Fermentation

Fermentation is a process where organic material is processed using microorganisms or enzymes to produce ethanol and other similar products. Fermentation relies on almost anaerobic conditions and is very similar to anaerobic digestion, however the process is controlled to discourage methane production and encourage fermentation. Fermentation can be used on organic wastes to generate useful liquid fuels such as ethanol which can then be used for energy, including in petrol. Fermentation of organic wastes is an emerging technology and is not commonly used, despite the common application of this technique in industrial manufacturing and food production. The technology produces a waste biomass similar to anaerobic digestion.

4.2.2.4 Landfill Gas

Landfill gas recovery is currently one of the most common forms of Waste to Energy. Organic material in landfills degrades anaerobically, producing methane as a low-quality biogas which is captured and turned into electricity (or sometimes flared (burned) where this is not viable). Older landfills are generally less efficient in capturing this gas, while modern landfills can be specifically designed to maximise biogas capture and energy recovery, such as the TiTree Bioreactor Landfill in Queensland. While landfill gas is effectively a by-product of landfilling, it forms an important component of the Waste to Energy landscape in Australia.

4.2.3 Summary of WtE technology

Thermal Waste to Energy technologies can process a wide range of carbon-containing wastes, including fossil fuel-derived plastics and tyres as well as other types of biomasses, including food and garden wastes. The thermal technologies recover energy in various forms including heat, syngas and liquid fuels, which can be turned into electricity or used to replace "virgin" fossil fuels such as petrol, natural gas and diesel. Some of the energy recovered from thermal processes can be classified as renewable when it is sourced from biomass or from wastes that exclude fossil fuel products.

Non-thermal Waste to Energy technologies only process biomass and cannot process fossil fuel-based products such as tyres and plastics. This means that only a proportion of the material that Moreland currently send to landfill is able to be processed in a non-thermal manner. The energy (either electricity, natural gas or liquid fuels) produced from these technologies is typically classified as renewable.

No technologies described above can process inert wastes such as glass and concrete, and all technologies produce a solid by-product. The solid by-product of non-thermal technologies can typically be recycled into a soil amendment or similar product, while the by-product of thermal technologies varies depending on the type of waste used in the process. Mass burn and gasification processes produce a bottom ash of about 20% the volume of the input, which would currently be landfilled. In the future it may be possible to recycle bottom ash into a construction material, as is starting to occur overseas.

4.3 WASTE TO ENERGY POLICY AND LEGISLATION

The Victorian Waste to Energy sector is subject to the Circular Economy Policy, Recycling Victoria A new economy. This policy outlined a 1 million tonne per annum cap on waste sent to energy recovery, which was designed to avoid perverse outcomes of large WtE facilities drawing in waste through contractual arrangements that could otherwise be recycled. The mechanism for measuring and enforcing this cap is outlined in the Victorian Waste to Energy Framework, which will be administered by a new body established under the Circular Economy Policy. This new body, Recycling Victoria, has replaced the existing Waste and Resource Recovery Groups and incorporates some of the infrastructure planning functions of Sustainability Victoria, including issuing an updated SWRRIP (Statewide Waste and Resource Recovery Infrastructure Plan), to be known as the VRIP (Victorian Recycling Infrastructure Plan). Recycling Victoria commenced operation on 1 July 2022 and has substantial additional regulatory powers compared to the previous bodies. Recycling Victoria is established as a business unit of the Department of Environment, Land, Water and Planning (DELWP).

The Victorian Waste to Energy Framework identifies that the waste to energy cap applies to any thermal process used: a) to recover energy from waste in the form of heat, which may be converted into steam or electricity, and/or b) to produce a fuel from waste. This includes, but is not limited to, combustion (mass burn), gasification and pyrolysis technologies (or any hybrid variant).

The following processes are not covered by the Victorian WtE cap:

- Advanced recycling: the conversion to monomer or production of new raw materials (other than fuels) by changing the chemical structure of a material.
- Biological waste to energy technologies such as anaerobic digestion and fermentation.
- Landfill gas collection and combustion.
- Incineration of waste with no energy recovery.
- Thermal processes that recover energy from materials that are not waste.

The Framework also identifies which wastes are covered under the cap, shown in **Figure 4-1** below:

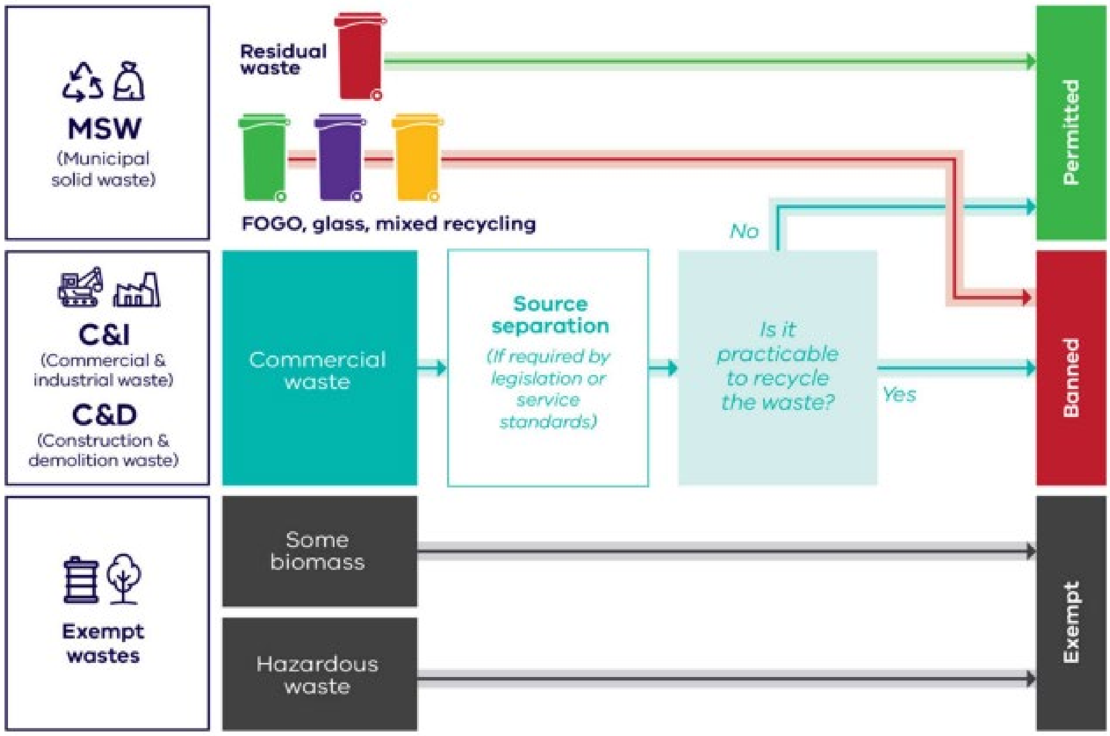

Figure 4-1 Waste to Energy Cap - Waste types

Source: Victorian Waste to Energy Framework, Figure 2

Notably, while pyrolysis is covered under the cap, waste treated by pyrolysis to produce biochar (or otherwise sequester carbon) is exempt. In addition, technologies such as torrefaction and carbonisation are not covered as they are primarily used to produce biochar rather than to recover energy.

The cap also does not apply retrospectively, and as such, any facility that had planning permission prior to 1 July 2021 is not included in the cap.

The Circular Economy (Waste Reduction and Recycling) Act 2021 legislates the powers of Recycling Victoria, and also includes legislation for the Container Deposit Scheme.

4.3.1 Existing Facilities

There are a range of WtE facilities currently operating in Victoria, both thermal and non-thermal.

Small to medium sized thermal biomass processes exist that produce energy for industrial and commercial sites, as well as facilities thermally treating hazardous wastes and recovering energy. These facilities treat predominantly exempt wastes but may include a small amount of permitted or banned wastes. There are no large WtE facilities (100,000tpa +) currently operating that process permitted wastes. The most progressed mass-burn WtE facility in Australia is the Kwinana project in Perth.

There are three existing facilities that trigger the category A08 under the Environment Protection Regulations and have EPA-regulated operating licences. These are waste to energy facilities that produce over 1MW electrical or 3MW thermal energy, all processing exempt waste (biomass). They are operated by:

- Australian Tartaric Products (Colignan VIC 3494) treating 90,000tpa of grape waste in a biomass boiler to produce 10MW thermal energy
- Select Harvests (Bannerton VIC 3549) producing 3.3MW of electricity from almond hull wastes
- Visy Industries (Coolaroo VIC 3048), combusting waste from paper production to produce 3MW of electricity

In terms of non-thermal processes, not covered by the cap, there are landfill gas projects at most operating landfills as well as a number of recently closed landfills. These projects are the most common existing waste to energy technologies.

The other currently operating WtE project is Yarra Valley Water's anaerobic digestion facility in Wollert that processes commercial and industrial food waste to generate 1MW of renewable energy.

4.3.2 Proposed Facilities

Ricardo is aware that a second Yarra Valley Water facility is planned in Lilydale which may be able to take select municipal food wastes as well as commercial and industrial wastes. These facilities cannot accept garden wastes or kerbside FOGO wastes. Further to this there are at least two additional anaerobic digesters that are either at concept or planning stages across Victoria, focussing on agricultural waste sources supplemented with commercial and industrial wastes.

A summary of approved or known potential thermal WtE facilities are detailed in **Table 4-1** below. These are all thermal mass burn WtE projects and are presented in relation to the 1 million tonne per annum cap.

Table 4-1 Thermal WtE Facility Summary

	Facility	Technology	Total Waste	MSW	C&I
Approved (outside cap)	OPAL / Veolia - Maryvale	Mass Burn	650,000	520,000	130,000
	Recovered Energy Australia – Laverton North	Gasification	200,000	200,000	-
	Great Southern Waste Technologies – Dandenong South	Gasification	100,000	80,000	20,000
Seeking Approval (subject to 1 million tonne cap)	South East Melbourne Advanced Waste Processing*	Unknown	400,000	400,000	-
	Prospect Hill - Lara	Mass Burn	400,000	320,000	80,000
Other Unused Cap Allocation	Other Available	N/A	200,000	TBC	TBC
	Total		**1,950,000**	**1,520,000**	**230,000**

*Note that the South East Melbourne Advanced Waste Processing project could utilise one or more of the existing approved facilities and therefore free up an additional 100,000 to 400,000tpa, however this is yet to be confirmed and there is a specific preferential allowance for this project in the Victorian Waste to Energy Framework, hence its inclusion in this table.

Ricardo is also aware of other proponents in the market currently seeking to establish WtE facilities, however there is limited published and publicly available data at this stage on those potential facilities.

5. REACHING ZERO WASTE TO LANDFILL

Achieving zero waste to landfill will require radical changes in product creation (manufacturing and packaging), product purchasing (use of services, such as leasing arrangements, rather than buying the products), product use (use of sustainable, recycled and recyclable products), and product disposal (resource recovery or landfilling). Zero waste to landfill is an ambitious target that Moreland have set for themselves. The ambitiousness is compounded by the target date of 2030 and achievement of the target without the use of thermal waste to energy. The challenge is also highlighted by:

- Ae estimated19.4% of Moreland's kerbside waste currently has no alternative option for disposal/management other than landfill. 'Perfect' source separation by households and businesses is not achievable in real world scenarios, and even under these circumstances, a maximum diversion rate of 83.5% could be achieved.
- Countries renowned for high diversion rates, such as Sweden which sends only 1% of its waste to landfill (Blue Ocean, 2022), utilise thermal waste to energy technologies
- Reducing waste generation requires societal and cultural change
- Making it easier to separate out the recyclable fraction of MSW relies on good product design which is outside Moreland's scope of control. Better product design includes items that are more easily broken down for recycling, have a higher recyclate content and last longer and is more within the purview of bodies such as the National Packaging Covenant

Ricardo has developed a range of scenarios that highlight these aspects and introduce a series of interventions that could approach a zero-waste outcome. Waste prevention and avoidance are the preferred methods for waste management, as per the waste hierarchy, however these methods are often difficult to implement. Supporting the community to generate less waste and achieve the zero-waste target will require significant behaviour change and shifts in public thinking. Therefore, a diverse approach in actions, such as behaviour change interventions, education, additional services and policies was adopted in the development of the scenarios. The scenarios were shaped by the following drivers and considerations:

- Prioritisation of interventions that were implementable and evidenced (particularly for Scenario 2)
- Focus where possible on measurable actions where their impact could be modelled to better understand applicability to Moreland
- Targeting of the currently landfilled items, such as the composition of the garbage (red lid) bin and the recyclable items there

6. SCENARIO DEVELOPMENT

Three scenarios were developed to better understand the impacts of existing/planned changes to the waste services and potential future interventions which may assist Council in achieving the 2030 zero waste to landfill target. Broadly, the three scenarios are:

- Scenario 1: Business as usual (BAU). Scenario 1 includes existing and planned policy reforms which must occur to the system across Victoria. These reforms are not unique to Moreland, such as the container deposit scheme. However, some reforms can be implemented according to a timeline set by Moreland, such as implementation of the glass service and weekly FOGO service.
- Scenario 2: The second scenario builds upon the BAU reforms by incorporating forecast service changes (pending successful trials and Council approval) including a combined weekly FOGO/Fortnightly garbage collection in 2025 and a booked hard waste service. Scenario 2 also includes additional intervention actions to divert more waste from landfill, that are achievable by 2030 and currently employed in other jurisdictions globally.
- Scenario 3: The third scenario focuses on possible methods to transition towards a circular economy and reach a feasible zero waste to landfill scenario. The scenario assumes a broader socio-economic move towards circular economy design practices and considers what other reforms and system changes, within the scope of City of Moreland's influence but not currently on the table, may reduce waste to landfill and benefit waste and recycling practices.

6.1 SCENARIO 1

Scenario 1 is a New BAU scenario that considers the impacts of planned reforms across Victoria. The reforms included the single use plastics ban, container deposit scheme, introduction of the glass bin, national packaging targets and export bans. These reforms are detailed further below.

6.1.1 Single Use Plastics Ban

The single use plastics (SUP) ban was announced by the Victorian Government in early 2021 and applies to common SUP items such as drinking straws, cutlery, plates, stirrers, expanded polystyrene food and drink containers and cotton bud sticks. The ban will come into force on the 1st of February 2023. According to the Regulatory Impact Statement, the purpose of the ban is to:

- Reduce plastic littering and pollution
- Reduce the amount of plastic waste going to landfill
- Reduce contamination of recycling streams.

The Regulatory Impact Statement estimates that approximately one third of Victoria's litter stream is made up of SUP. Under the SUP ban, DELWP expect that 1,893 tonnes of single-use plastic litter will be avoided in Victoria over 10-years but will be replaced with 1,769 tonnes of single use alternatives. This equates to a reduction in litter tonnes of 6.6%.

The assumed behaviour changes for the majority of the SUPs included in the ban is a transition to a non-banned single-use alternative. Other behaviour changes include a 10% reduction in straws, cutlery and drink stirrers from hospitality sources, a 10% reduction in drink stirrers from the medical sector, and a transition to reusable cutlery in medical, correction and other facilities (11.5%) and reusable plates in the medical sector (12%).

Assumptions made for the impacts of the SUP Ban on the Moreland data include:

- Negligible impact on SUPs in the kerbside stream. Given that the impacts of the SUP are outlined only for commercial and industrial sourced waste, it is assumed that there is no change to SUPs in the household kerbside system
- Litter reduction of 6.6% to align with DELWP estimates

6.1.2 Recycling Victoria: Container Deposit Scheme and Glass Service

Recycling Victoria: A New Economy was released in early 2020 and is Victoria's Circular Economy plan. The policy introduces a range of kerbside waste reforms which will impact the way waste is managed in the future. Key changes include a fourth waste service for glass available to all Victorians, a universal FOGO service (which Moreland already has), and the implementation of a Container Deposit Scheme (CDS).

The introduction of a fourth service to the standard kerbside system is a separate glass service; either via a kerbside collection or drop off locations. The service must be implemented by Councils by 2027. DELWP provided a range of assumptions in their Waste Charge Model to assist Councils in developing transition plans for the service in late 2020. The assumptions, as adopted for the Moreland data, included:

- 40% of the glass content within the commingled bin is diverted to the glass bin
- 28% of glass content within the commingled bin is diverted to CDS
- 20% of plastic and aluminium is diverted to the CDS

The CDS will be rolled out in 2023 across the state (modelled as 2024), with the government still finalising the schemes roll out and operation. Cans, bottles, cartons and juice boxes/poppers will be included in the scheme, whilst milk containers, wine glass bottles, glass spirit bottles, juice boxes over 1 litre and cordial bottles are excluded. According to DELWP, the cash reward of 10c per container will deliver:

- More and better recycling
- Less waste
- Less litter – cut by up to half

Assumptions made for the impacts of the CDS on the Moreland data include:

- Litter reduction of 50% as per DELWP estimates
- 50% improvement to contamination rate in the commingled recycling bin as a result of better recycling practices

6.1.3 National Packaging Targets

Established in 2018, the National Packaging Targets apply to all packaging that is made, used and sold in Australia and includes the following targets by 2025:

- 100% reusable, recyclable or compostable packaging.
- 70% of plastic packaging being recycled or composted.
- 50% of average recycled content included in packaging (revised from 30% in 2020).
- The phase out of problematic and unnecessary single-use plastics packaging.

Progress towards the targets as of 2019/20 data is:

- 86% reusable, recyclable or compostable packaging.
- 16% of plastic packaging being recycled or composted.
- 39% of average recycled content included in packaging
- In development phase – the phase out of problematic and unnecessary single-use plastics packaging.

Whilst good progress has been made towards the reusable, recyclable or compostable target, and the average recycled content target, the amount of plastic packaging that is being recycled or composted is only 16%. Achieving the 70% recycling of plastic packaging will include diverting the packaging materials placed in the incorrect bin (garbage red lid or FOGO) into the commingled bin. None of the targets drive a decrease in waste generation, rather they seek better recycling behaviour and outcomes.

Approximately 8.15% of the garbage red lid waste stream, 9.41% of the commingled yellow lid stream and 0.09% of the FOGO green lid stream is assumed to be packaging[6]. This equates to approximately 2,500 tonnes, 1,500 tonnes and 12 tonnes in the garbage, commingled and FOGO stream respectively in 2021, or a

[6] Audit classifications of PET 1, HDPE 2, PVC 3, LDPE 4, PP 5, Polystyrene (not expanded) 6, PS (expanded) 6, Other 7, and Plastic Films

diversion rate of 38% for Moreland, compared to the overall 16% target progress. Therefore, Moreland needs to divert an additional 32% of these materials to reach the target in the municipality.

Assumptions made for the impacts of the national packaging targets on the Moreland data include:

- Additional diversion of plastics (PET 1, HDPE 2, PVC 3, LDPE 4, PP 5) from garbage red lid and FOGO green lid streams into commingled yellow lid bin to meet packaging targets for Moreland data
- No reduction in tonnages

6.1.4 Export Bans

In March 2020 the Australian government implemented a ban on the export of specific waste types. The export bans are outlined in **Table 6-1** below.

Table 6-1 Export Bans

Material	Regulated Material	Non-regulated Material	Exempt or Subject to Export Licence	Ban
Glass	Glass that is recovered or a by-product of industrial, commercial or domestic activities	Glass that is exported for personal or domestic use, or has been imported into Australia on a temporary basis	Glass that has been processed into furnace-ready or non-furnace-ready cullet,	1st January 2021
Plastic	Mixed waste plastic, for example bales that include a combination of PET and HDPE.	Plastic that is exported for personal or domestic use, or has been imported into Australia on a temporary basis	Plastics that have been sorted into single resin or polymer type or processed with other materials into processed engineered fuel.	1 July 2021 ban on mixed plastic exports. From 1 July 2022, you cannot export plastic that has been sorted only.
Tyres	Tyres that were designed for motorised vehicles that are discarded, rejected, left over, surplus to or a by-product of an industrial, commercial, domestic or other activity, tyres that are the rubber component of one of these tyres, and tyres that are processed into shreds for use as tyre derived fuel	Tyres that are exported for personal or domestic use temporarily imported into Australia and then re-exported, tyres that ordered to be re-exported by the Minister, tyres designed for electric or non-electric single-person light transport such as scooters, skateboards and bikes (excluding electric motorbikes and similar road vehicles), tyres designed for wheelchairs or remote-controlled toys and tyres with no rubber component	A licence is required to export tyres that have been processed into shreds or crumb of not more than 150 millimetres for use as tyre derived fuel, tyres for retread by an appropriate retreading facility, tyres to an appropriate importer for re-use as a second-hand tyre on a vehicle, tyres that have been processed into shreds, crumbs, buffings or granules.	1 December 2021
Paper and Cardboard	Mixed paper and cardboard		Paper and cardboard that is processed or sorted to specific requirements	1 July 2024

The impact of the export bans relates to the emissions modelling completed for the scenarios and is presented in **Section 8**.

6.1.5 Weekly FOGO

Organic waste is a key material for diversion out of the FOGO bin as approximately 41% of the residual bin is organic was that can be diverted into the FOGO bin. A weekly FOGO collection has been modelled for implementation in 2023. Previous modelling for this option identified that 40% of the food organics, and 80% of garden organics in the kerbside garbage bin would be diverted. This equates to approximately 18% of the residual waste bin tonnage. The same modelling assumptions have been applied in this report.

6.1.6 Scenario 1 Summary

Modelling completed for Scenario 1 shows that by 2030, Moreland would be sending approximately 38,400 tonnes of waste to landfill, achieving a diversion rate of 46.7%, as shown in **Figure 6-1.** This is almost 7,400 tonnes less than the baseline projection. The main driver behind the 7,400 tonnes reduction is the implementation of the weekly FOGO service which diverts approximately 18% of the residual waste tonnage (comprising of food and garden waste) into the FOGO bin. **Figure 6-2** compares Scenario 1 against the baseline for 2030.

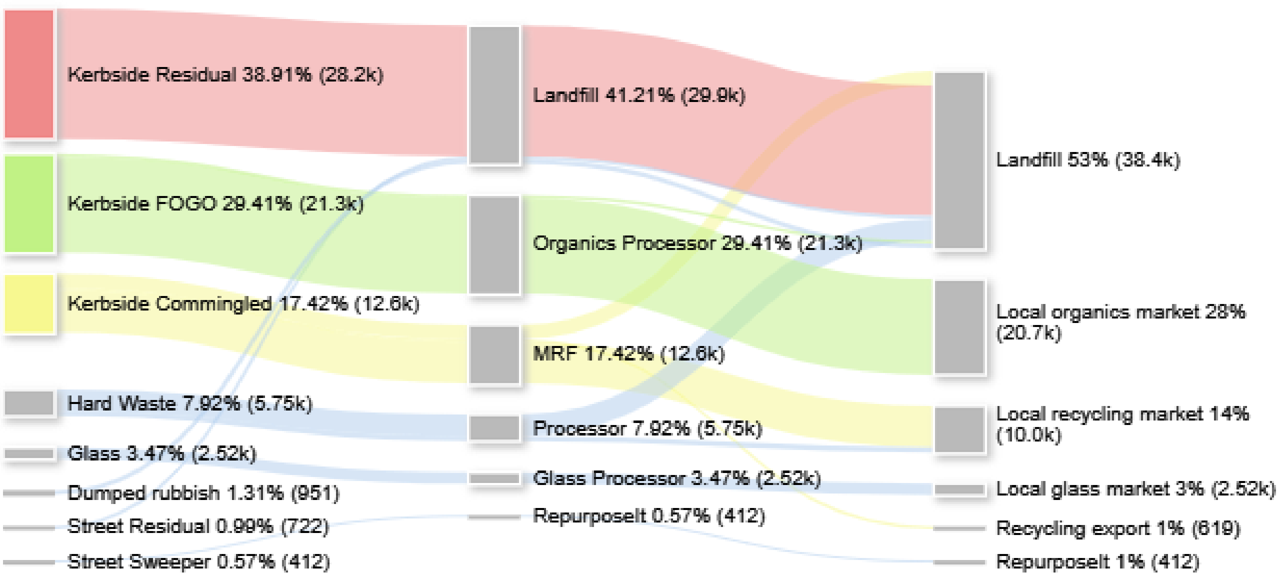

Figure 6-1 Scenario 1 Waste Flow 2030

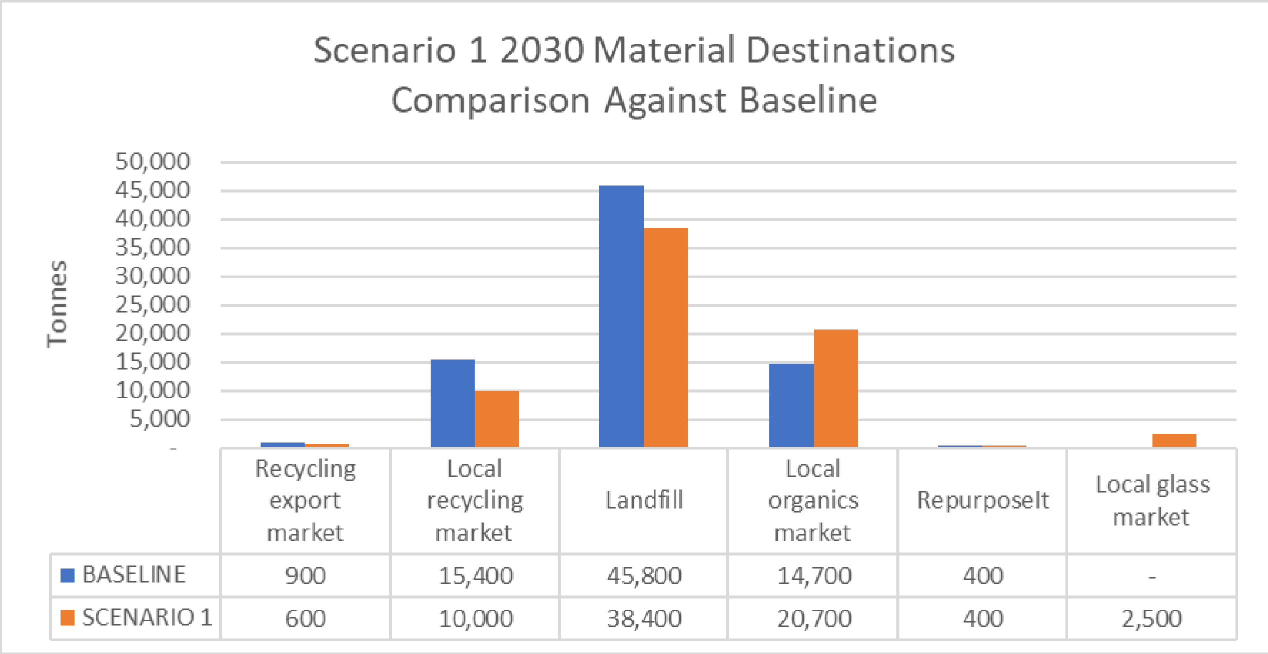

Figure 6-2 Scenario 1 Comparison Against Baseline 2030

6.2 SCENARIO 2

The modelling for Scenario 2 built upon the changes modelled for Scenario 1, adding in planned interventions such as a booked hard waste collection and combined weekly FOGO/fortnightly garbage collection. Scenario 2 also reviewed the remaining waste to landfill to develop further interventions to reduce waste to landfill.

6.2.1 Planned / Forecast Interventions

6.2.1.1 Booked Hard Waste Collection

The baseline hard waste service provided to the Moreland community was a ‘blanket’ collection that allowed all residents, twice per year, to place their hard waste on the nature strip for collection. Blanket collections typically have a higher participation rate and can lead to increased waste generation due to the ease of use for the service. The hard waste collection collected around 4,900 tonnes in the 2020/21 year, or 82kgs per participating household, with a diversion rate of 19.1%. Materials that are diverted include metal, E-waste and mattresses.

Moreland is seeking to transition to an ongoing booked collection in 2023 – pending the outcomes of a trial currently being undertaken. Residents will be allowed to book up to 2 collections of 1 cubic metre per year. Industry engagement and a review of Sustainability Victoria hard waste data provided the following assumptions which were adopted for the modelling:

- Booked collection participation rate: 40%
- Booked collection diversion rate: 21%

Furthermore, it was assumed that the volume of material per participating household, 82kgs, would not reduce over time.

Moreland Council’s booked hard waste collection may also include bundled green waste and cardboard within the collection which may improve diversion rates beyond the assumed 21%. However, 21% has been applied as a conservative measure in the modelling.

6.2.1.2 Weekly FOGO/Fortnightly Garbage Collection

In 2025, Council will seek implement a change to the collection frequency of the garbage bin service (pending Council decision). Currently, the garbage bin is collected weekly which makes it easy for residents to dispose of waste to landfill. Moving to a fortnightly collection service can support the diversion of recyclable material out of the red lid garbage bin and into the yellow lid recycling or green lid FOGO bins, and also encourage the community to consider their waste practices before using up valuable space within the garbage bin. The change to the fortnightly garbage collection is paired with a weekly FOGO collection.

Current bin stock in Moreland is outlined in **Table 6-2** below, which shows that the majority of garbage bins are 80L across the municipality. To align with the changeover of collection frequencies, Council intends to roll out 120L bins as the default size for the garbage service. The 120L bin will be provided for all residents, unless they opt for a smaller or larger size.

Table 6-2 Bin stock review 2022

Bin Size (L)	Garbage bin stock(% of total bins)	Recycling bin stock (% of total bins)	FOGO bin stock (% of total bins)
80	78.85%	0.00%	0.00%
120	16.80%	90.98%	50.72%
240	4.31%	7.67%	15.77%
660	0.03%	0.03%	0.00%
Total	100%	100%	100%

MWRRG provides a guide for local governments that details implementation of a FOGO service. The guide states that ‘councils have achieved 40-50% by weight reduction in landfilled garbage by switching to weekly FOGO and fortnightly garbage collections’. This assumption has been applied to the Moreland data, utilising the lower, 40% estimate. The modelling assumes that the weight reduction is FOGO material currently in the red lid garbage bin that is diverted to the green lid FOGO bin, no reduction in total waste generation is expected.

6.2.1.3 Summary of Planned Interventions

Following the implementation of Moreland’s planned interventions, approximately 28,600 tonnes of material will still be landfilled each year, as shown in **Figure 6-3** below. The planned interventions increase the diversion rate from 42% in Scenario 1 to 58.6%, an increase of 16.6%. **Figure 6-3** compares the planned interventions against the baseline.

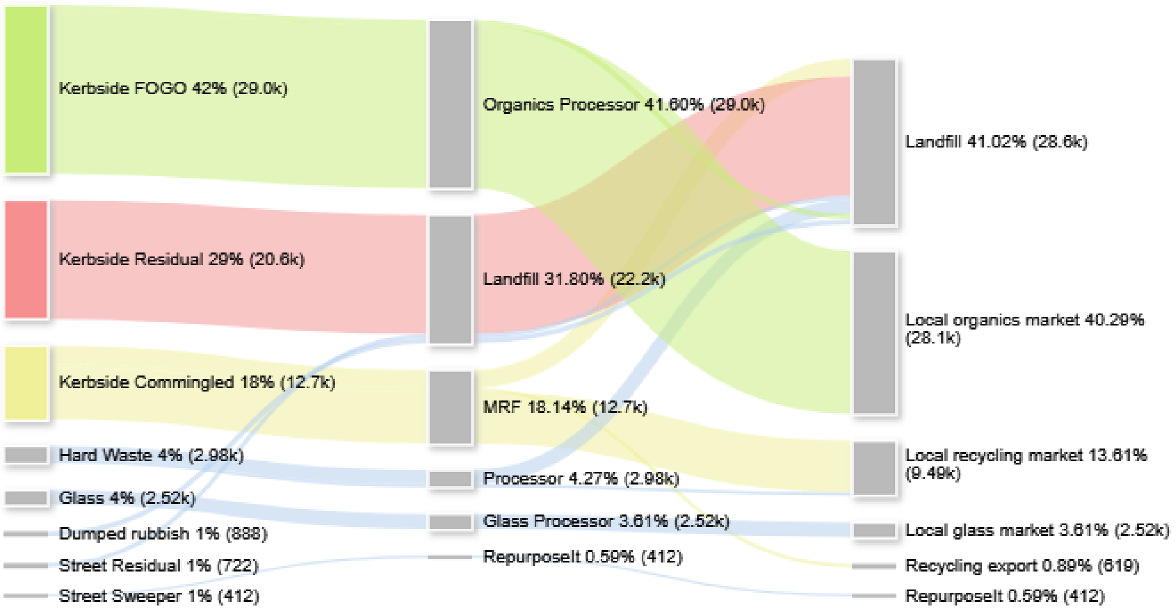

Figure 6-3 Scenario 2 Waste Flow 2030, Planned Interventions Only

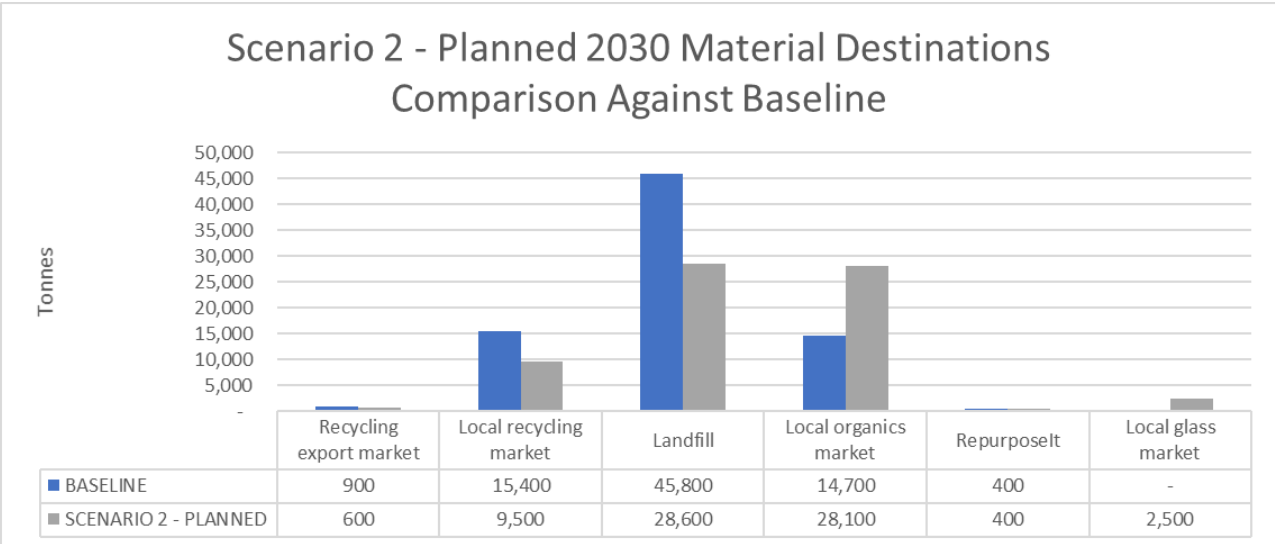

Figure 6-4 Scenario 2 Planned Interventions Comparison Against Baseline 2030

6.2.2 Additional Interventions

Moreland's currently planned interventions will not enable Council to meet the 2030 zero waste to landfill target. Additional measures are required to reduce the amount of waste sent to landfill. As detailed in Section 2.2, the primary components that make up the residual waste within the red lid garbage stream (i.e., materials that are not recyclable through Council's kerbside bin system) are:

- Hard waste materials
- Disposable nappies and sanitary items
- Plastic Films
- Soiled Paper/Paper Towel/Tissues
- Bagged rubbish
- Rigid Plastic Not Bottle/Container
- Other

- Residual (illegal dumping)
- Polystyrene (expanded) 6
- Polystyrene (not expanded) 6

The following options were developed to target the material streams listed above and to influence behaviour change towards less waste generation. Additionally, the kerbside audit data shows that the following key materials are placed in the wrong bin and have led to contamination in the system:

- Organic material in the garbage red lid bin such as avoidable and unavoidable food, containerised/packaged food, garden/vegetation, accounting for 49.6% of the garbage bin weight
- Recyclable items in the garbage bin such as paper & cardboard, plastics, metals and glass accounting for 11.3% of the garbage bin weight
- Organics and residual items in the commingled bin accounting for approximately 19% of the commingled bin weight

6.2.2.1 Pay by Weight System

A pay by weight system is an instrument that Council can apply to influence behaviour change. The benefits of the system are:

- Experience in implementing pay by weight systems in the USA has shown that the amount of garbage waste can fall from between 8-38%, and the amount of recycling can increase by 6% in mature programs (C.D. Howe Institute, 2005)
- The diversion of recyclable items from the garbage bin into the recycling bin can lead to lower waste management costs, given that recycling is generally cheaper than landfilling
- The system encourages residents to scrutinise waste generation habits and reduce the amount that they dispose for economic advantage. The system rewards less waste generation.

A 38% reduction in garbage bin waste, the best outcome modelled for the implementation of the new system, would equate to approximately 7,500 tonnes in 2030, leaving approximately 12,300 tonnes in the kerbside garbage stream.

Implementation of the system has been modelled for 2025, aligning with the planned change in kerbside collection frequencies to enable efficiencies in roll out of the system.

6.2.2.2 Sanitary Item Diversion

Sanitary items (disposable nappies and period products) account for approximately 10% of the kerbside garbage waste stream, or around 3,000 tonnes per year for Moreland. Moreland has recently introduced a subsidy program to improve the waste outcomes for these products. The subsidy includes up to $100 per household per year for cloth nappies and accessories; and $35 per resident per year for reusable period products. The subsidy is currently a pilot program running from April 2022 to March 2023 and has been successful so far with uptake of the program budget. It is recommended that Council review the impacts of this program before implementing other interventions for this material stream.

Additional interventions may include services such as ‘Diaper Recycle’, an emerging nappy recycling company operating in metropolitan Melbourne. This option is beneficial for families not willing to use cloth nappies. Diaper Recycle collects the waste nappies and separates out the plastic and fibres for recycling or reuse. The absorbent fibre is currently being made into cat litter..

6.2.2.3 Drop-off Facility

Approximately 10.3% of the Moreland waste stream is comprised of items that should not be placed in the kerbside system or are illegally dumped. The key items include:

- Clothing/Textile/Rags
- Building Materials
- Dirt/Rock/Inert Materials

- Hazardous other
- E-Waste
- Ceramics
- Pots/Pans
- Paint
- Batteries
- Fluorescent Tubes/Globes

All of the materials listed above could be managed through a resource recovery centre or material drop off facility. Neither type of facility exists within the boundaries of the Moreland municipality. Most residents (46%) will travel 5-10km to use a Council tip (Mandalay Technologies, 2020). **Figure 6-5** shows the waste and resource recovery facilities within 10km of Moreland. The figure shows that residents living in Fawkner, Glenroy, Hadfield and North Coburg are located near an array of waste facilities. Suburbs along the western and southern boundaries of the Moreland municipality have limited waste facilities nearby. The facilities are detailed in **Table 6-3**.

Improving access to drop off/resource recovery facilities for the recycling of difficult materials, the residents of Moreland may be more motivated to recycle those items. If Moreland were to divert all of those materials to a new drop off facility, the facility would need to manage approximately 5,000 tonnes of mixed materials per year, which is a small facility. This does not include use of the facility for additional items dropped off from residents, or residents outside of Moreland.

As well as a drop-off location for difficult to recycle items, the facility could provide additional services such as a re-use shop for the purchase of recycled goods, a repair café or men's shed to encourage reuse and repair of broken items.

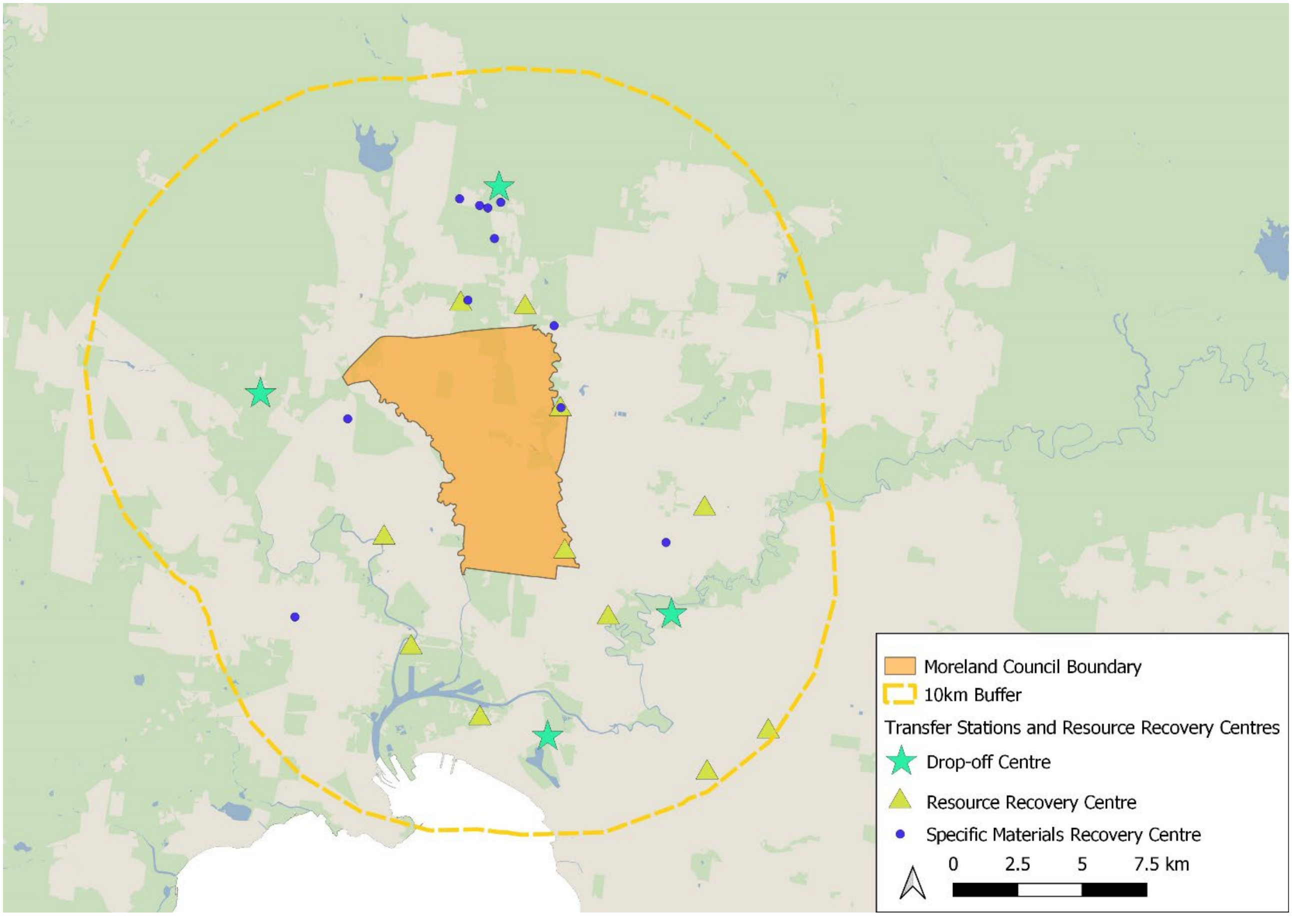

Figure 6-5 Resource Recovery / Drop Off Facilities within 10km of Moreland

Table 6-3 Waste Facilities within 10km of Moreland

Facility Type	Priority Material	Facility Name	Address	LGA locate
Drop-off Centre	E-waste	PhoneCycle	Level 7, 3 Bowen Crescent, Melbourne, 3004	Melbourne
	Multiple	Kew Drop-Off Point	31-35 Hutchinson Drive, Kew, 3101	Boroondara
	Multiple	Brimbank Resource Recovery Centre	72 Stadium Drive, Keilor Park, 3042	Brimbank
	E-waste	TES-AMM (Somerton)	23 Fillo Dr, Somerton, 3062	Hume
Resource Recovery Centre	Multiple	Stonnington Waste Transfer Station	43 Weir Street, Malvern, 3146	Stonnington
	Multiple	Boroondara Transfer Station	648 Riversdale Rd, Camberwell, 3124	Boroondara
	Multiple	Port Phillip Resource Recovery Centre	Cnr White & Boundary Street, South Melbourne, 3205	Port Phillip
	Multiple	Dynon Road Transfer Station	437 Dynon Rd, West Melbourne, 3031	Melbourne
	Multiple	Yarra Recycling Centre[1]	168 Roseneath St, Clifton Hill, 3068	Yarra
	Multiple	Kartaway – East Brunswick	32 Kirkdale St, Brunswick East, 3057	Moreland
	Multiple	Moonee Valley Transfer Station	188 Holmes Rd, Aberfeldie, 3039	Moonee Valley
	Multiple	Banyule Waste Recovery Centre	Cnr Waterdale Rd & Banksia St, Bellfield, 3081	Banyule
	Multiple	Darebin Resource Recovery Centre	Kurnai Ave, Reservoir, 3073	Darebin
	Multiple	Bolinda Road Resource Recovery Centre	71 Bolinda Rd, Cambellfield, 3061	Hume
	Multiple	Unknown – Hume	Centre Rd, Broadmeadows, 3047	Hume
Specific Materials Recovery Centre	E-waste	Green Collect	Unit 1, 75A Ashley Street, Braybrook, 3019	Maribyrnong
	Paper & Cardboard	Australian paper Recovery (Fairfield)	191 Grange Road, Fairfield, 3078	Darebin
	E-waste	Platinum Recycling	35 Hawker St, Airport West, 3042	Moonee Valley
	E-waste	Outlook Environmental (Reservoir)	30 Kurnai Avenue, Reservoir, 3073	Darebin
	E-waste	SRS Metals	304/308 Mahoneys Rd, Thomastown, 3074	Whittlesea
	E-waste	Advanced Resource Recycling	160 Camp Rd, Broadmeadows, 3047	Hume
	E-waste	Sims Metals Management (Broadmeadows)	1904 Hume Hwy, Campbellfield, 3061	Hume
	E-waste	MRI Pty Ltd.	1789-1791 Sydney Rd, Campbellfield, 3061	Hume
	E-waste	Surplus Recycling Solutions	14 Halley Cres, Campbellfield, 3061	Hume
	Paper & Cardboard	Papertrade Recycling (polytrade)	202-204 Northbourne Rd, Campbellfield, 3061	Hume
	Tyres	Oz Tyre Recyclers	21 Reo Crescent, Campbellfield, 3061	Hume

Notes: 1 – Yarra Recycling Centre only accepts materials from Yarra residents

6.2.2.4 Public Organics Bin

A 2016 audit investigated public place litter and recycling bin composition and revealed that between 26.21%, and 40.26% of waste in public bins was potentially compostable material[7]. Council therefore should consider installing organics bins in prominent public places where food consumption and takeaway restaurants are concentrated. It is recommended that current audit of the public place bins in such locations is conducted to assist in the development of this option. The audit should reveal:

- Whether the proportion of organic material in the garbage street bins is still high enough to consider the additional service
- Areas appropriate for the FOGO street bins
- A likely proportion of divertable FOGO from the garbage street bins

It is unlikely that the public organics bins will capture the entire volume of organics placed in the public bin system, therefore a conservative 50% capture rate has been applied. Furthermore, the lower estimate of 26.21% organics composition has been applied to model the volume of organics potentially diverted by this option. Approximately 95 tonnes per year of additional organic material could be diverted through this option by 2030.

It is important to note that there is a high potential for contamination in the public organics bins from items such as food packaging which may limit the effectiveness of this option.

6.2.2.5 Compostable bags/Liners

Moreland's FOGO processor, Veolia, does not permit compostable or biodegradable bin liners in the service, which may be limiting the amount of organic material captured by the green lid FOGO bin. The audit data shows that approximately 32.5% of the garbage waste bin is food scraps, or approximately 9,750 tonnes annually. According to MWRRG, higher levels of on-going participation and diversion are achieved when Councils provide a kitchen caddy, which Moreland does, and compostable bags/bin liners (Metropolitan Waste and Resource Recovery Group, 2018).

Moreland Council have already advocated to Veolia to allow compostable liners within the service and will continue to do so. The current contract for organics processing is in place until 2028. When the new tender is let, Council should specify that compostable liners must be allowed in the service. Boorondara, Melbourne and Whittlesea are all nearby Councils to Moreland where compostable bin liners, under a different processor, are accepted in the FOGO service.

Additionally, a collaboration of 8 inner-city councils known as the M9, led by the City of Melbourne, and including Moreland City Council, has received a grant from the Recycling Victoria Infrastructure Fund to create a business case for a shared organics processing facility. Moreland should seek to ensure that the business case includes consideration of compostable liners as a requirement for the facility's operation.

6.2.3 Scenario 2 Summary – Planned and Additional Interventions

The pay by weight system may provide a waste generation reduction of up to 38% and is the main impact shown in **Figure 6-6**. The figure also shows that the landfill rate has reduced to 32.5%, making the resource recovery rate 67.5%. **Figure 6-7** shows the comparison of the planned and additional interventions in Scenario 2 against the baseline.

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[7] 26.21% of the material in bins not located with a recycling bin, and 40.26% of waste in bins located with a recycling bin

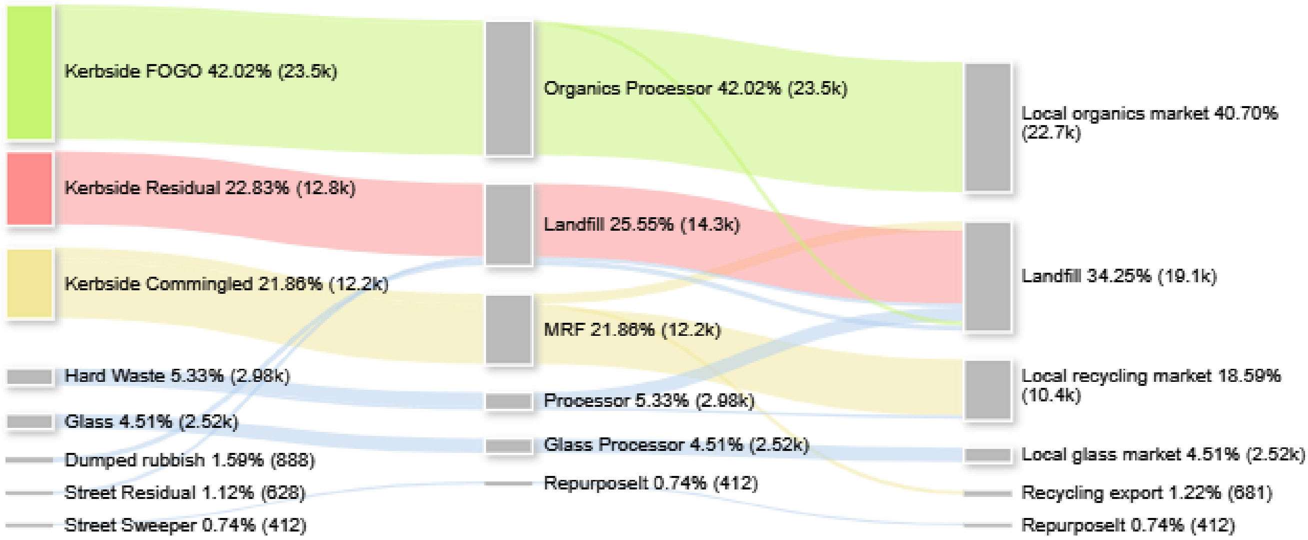
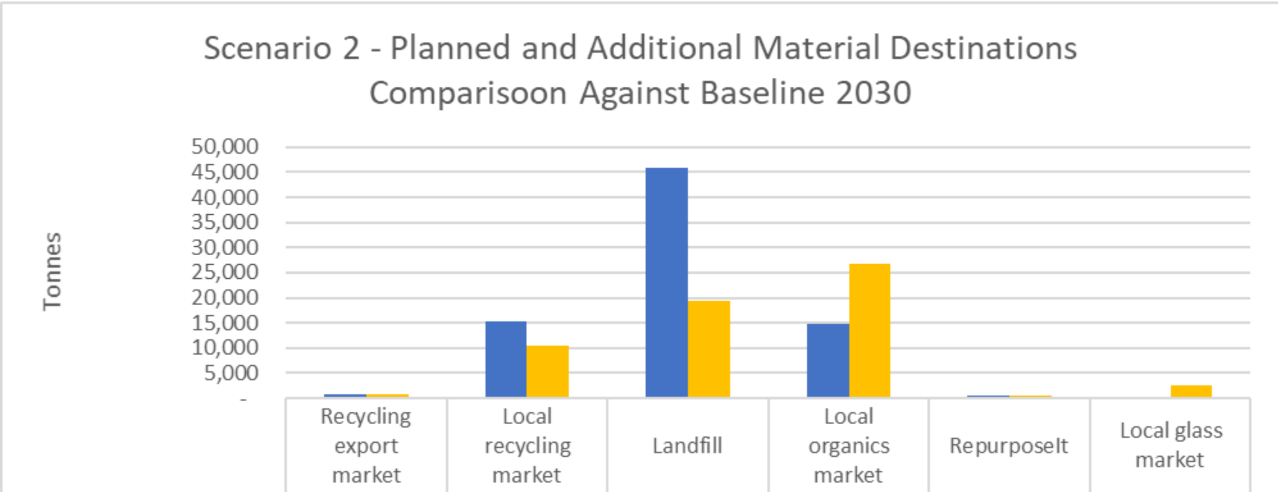


Figure 6-6 Scenario 2 Waste Flow 2030



	Recycling export market	Local recycling market	Landfill	Local organics market	Repurposelt	Local glass market
BASELINE	900	15,400	45,800	14,700	400	-
SCENARIO 2 - TOTAL	700	10,400	19,300	26,700	400	2,500

Figure 6-7 Total Scenario 2 Comparison Against Baseline 2030

The remaining 19,000 tonnes of residual waste will likely be reduced by the other additional interventions. These interventions target approximately 73.5% of the residual waste stream, and 34.36% of the total waste stream within the scope of this project. Whilst the impact of the interventions is difficult to estimate, the varied approach across different material streams and sources of waste will help reduce the remaining waste to landfill.

6.3 SCENARIO 3

Scenario 3 seeks to identify other avenues of intervention not currently considered for implementation, and not easily modelled. As previously acknowledged, achieving the aspiration of zero waste to landfill will require radical changes in product creation (manufacturing and packaging), product use (use of sustainable, recycled and recyclable products), and product disposal (resource recovery or landfilling). The interventions considered in this scenario include some radical approaches that would trigger industry or behaviour changes.

6.3.1 Dirty MRF

Broadly, there are two types of materials recycling facilities (MRFs), a dirty MRF and a clean MRF. Clean MRFs accept ‘clean’ recyclable waste streams, such as the kerbside commingled recycling and process that material into separate recyclable streams. Moreland’s commingled recycling is processed at the Visy Heidelberg MRF (a clean MRF). A dirty MRF processes mixed waste streams, such as the kerbside garbage and public litter bin waste streams to separate out the non-degradable components (such as plastics and metals). Some of the non-degradable materials can be recycled, and the non-recyclable calorific components processed into a Refuse Derived Fuel (RDF) / Process Engineered Fuel (PEF). The RDF/PEF can then be used for industrial activities such as the kiln industry or as a replacement for fossil fuels.

Use of a dirty MRF is an option for Moreland Council to further reduce waste to landfill by extracting the recyclable materials and/or processing the non-recyclable materials into a fuel. Council would need to consider its position on whether the use of processed garbage waste as a fuel is preferable over landfilling.

There are two approaches that Council may consider for the use of a dirty MRF

- Build and operate their own facility or facilitate a collaborative project to develop a regional facility; or
- Enter into an agreement with an existing or potential/future facility to accept the garbage waste.

Building and operating a facility will require considerable investment and community engagement, appropriate siting, and feasibility and business case investigations. The Gippsland Waste and Resource Recovery Group, (known as Resource Recovery Gippsland) investigated investment into a dirty MRF in 2018 which showed that around $15 million would be required for capital costs (Rawtec and Reincarnate Strategic Environmental Consultants, 2018). The same investigation also identified that up to 45% of the garbage waste sent to landfill could be diverted by a dirty MRF.

There are currently no existing/operational dirty MRFs accepting municipal kerbside collected garbage waste streams in Victoria (in other states, organics can be removed from garbage waste using MBT facilities in what could be termed a basic “first stage” of a dirty MRF development). However, it is understood that Wyndham City Council (WCC) has been seeking to develop a dirty MRF at their Wests Rd landfill. Moreland Council may seek to engage with WCC and negotiate a contract to accept and process their waste. A dirty MRF located at Wests Rd landfill is well sited due to:

- The existing waste management activities already occurring at the site
- Existing buffers to sensitive uses due to the long-term landfill operation
- Proximity to the landfill for the non-recyclable/RDF waste, reducing transportation costs and emissions
- Proximity of Wests Rd landfill to Moreland Council, whilst not as close as the current landfill operation (Melbourne Regional Landfill in Ravenhall), it is approximately 50km from the centre of Moreland, which is an achievable transport distance

Use of Wyndham’s dirty MRF will likely be a more feasible option for Council to consider than developing a separate plant.

It is noted that Council are part of the M9 project which is considering a clean MRF to optimise the use of recyclate for remanufacture.

6.3.2 On Call Garbage Bin Service

A scenario where zero waste to landfill is realised would mean that there is, theoretically, no need for the garbage bin service. In this scenario all waste generated is recyclable and recycled. However, it is unlikely that the garbage collection service will ever be redundant, as there will always be materials that can’t be recycled due to the nature of their use or poor design, and waste management behaviour by residents leading to recyclable material in the garbage bin.

A future intervention to influence behaviour change, similar to the Pay By Weight system, is the transition from a fortnightly garbage collection to an 'on-call' garbage bin service. The on-call service would require residents to organise collection of their bin as needed, rather than have a regularly scheduled collection weekly or fortnightly. Residents would then be charged a rate per collection or by weight, leading to a financial incentive to reduce the number of collections required or amount of waste needing collection. Other benefits include:

- Residents would be forced to regularly consider the impacts of their waste generation behaviour
- Potential for a reduction in collection emissions due to reduced distances travelled by heavy vehicles
- A reduction in waste generation as residents are financially motivated to generate less waste
- Improved diversion rate as more materials are placed in the correct bins (FOGO, commingled recycling and glass)

It is anticipated that this option would only become viable as volumes of garbage waste collected from the kerbside service reduce significantly, indicating that reliance on the garbage bin is also reducing.

6.3.3 Food Only Collection

Almost 9% of the garbage waste stream, or 4.39% of the total waste stream, is comprised of containerised/packaged foods, equating to approximately 3,000 tonnes of material in a year. Whilst behaviour change and education may be utilised to encourage residents to separate the organic waste from the containers, a food only collection could allow residents to place both containerised and non-containerised food into the bin.

The separate food collection would be paired with an organics processor that had a de-packaging unit, or 'product destruction unit' (PDU). These machines are able to separate out the organic fragment of packaged food items, such as food containers and liquids in bottles.

PDUs are typically used in the waste industry to manage products that are out of date, mis-labelled or surplus and cannot be sold or reused. The destruction of these products is often managed in a confidential manner in order to maintain brand and product integrity for clients.

PDUs can improve the diversion of this material stream, by diverting the organic fraction away from landfill, and possibly also the packaging material depending on the set up of the processor. Additional sorting equipment may be required to further divert the packaging material into the recyclable components, typically plastics and glass. Woody waste, such as branches which can be managed through the existing organics bin, are not suitable for PDUs as they can damage the machinery and increase maintenance or operational costs.

6.3.4 Higher CDS Rebate

The introduction of the CDS in 2023 in Victoria aims to reduce litter, improve recycling rates and lead to less waste. As the last state in Australia to implement a CDS, Victoria will align with the rebate offered in other states of 10 cents per eligible container. South Australia was the first state to implement a CDS in 1977 as a litter control measure, and now it is also used to incentivise recycling. In 2008, the refund amount in SA increased from 5 to 10 cents (EPA South Australia, 2022). According to inflation calculators, 10 cents in 2008 is the equivalent of 13 cents in 2021 (Reserve Bank of Australia, 2022).

Ricardo's ongoing engagement with industry stakeholders has indicated that better outcomes will be achieved with a financial incentive over 10 cents per eligible container. A higher rebate would encourage greater participation and likely lead to less litter. However, given that the CDS has not yet been established in Victoria, it is recommended that Moreland review the impacts of the CDS once implemented before advocating for change.

6.3.5 Landfill Ban

In 2010, the Department of Sustainability, Environment, Water, Population and Communities[8] commissioned an investigation into landfill bans. The report details that there are three typical ways of defining a waste ban:

- By waste source, such as banning MSW, or C&I generated wastes. Germany has banned the landfilling of municipal sourced waste.
- By waste type, such as E-waste which was banned from landfill in Victoria in 2019
- By waste property, such as combustibility or level of hazard such as automotive batteries

Waste bans are typically implemented on a large scale overseas where WtE technologies can accept the banned material. Where bans have been implemented in Australia, they have sought to divert hazardous materials from landfill and create alternative industries to recycle, dismantle or reuse the material.

In 2001, Germany implemented a landfill ban on any municipal waste that could be recovered and achieved total compliance by 2005. The ban was country wide and saw a reduction in their landfill rate from 27% to 1% over 6-years. The ban was complemented by other measures such as a pay-by-weight system or variable waste charging and mandatory separated collection for waste types.

A UK WRAP report (Waste and Resources Action Programme (WRAP), 2010) conducted an investigation into landfill bans and concluded that there was a strong case for restricting the landfilling of paper and cardboard, textiles, metals, wood and food waste from landfill. Whilst Moreland may consider implementing a municipal-wide ban on specific materials, or sources of materials, enforcing these measures could be problematic and a broader state-wide approach may be more effective. A state-wide approach would enable better development of alternative disposal/processing options and help aggregate materials to support innovative technologies in waste management.

6.3.6 Food Waste Disposal Units

An alternative solution to increase the recovery of organic waste is the use of food waste disposal (FWD) units, often referred to as InSinkErators. FWD units are typically installed in kitchen sinks and grind up organic waste, such as food waste, which is then flushed through to the wastewater treatment facility. FWD units make organic diversion in the home simple, clean and quick and are currently available for purchase and use in Australia.

FWD units divert organic material away from landfill to a facility where the material can already be successfully treated. These units may be more beneficial in multi-unit developments where bin storage and space for composting is limited.

Implementation of the FWD units presents some challenges, and water authorities generally do not support the increased organic load in the pipe network as it could lead to more blockages and higher maintenance costs, particularly in older pipe networks.

6.3.7 Minimum Recycled Content – Construction

Whilst diversion of materials away from landfill is important, where those materials go, and how they are used must also be considered. There is a need to improve the demand for recycled materials to support the development of the recycling industry and promote innovation in material use and reuse. One method to encourage industry development in this realm is to promote the use of recycled content.

Moreland Council is able to influence the use of recycled content in its own construction and maintenance contracts, and also in development within the municipality. Council may investigate implementing a minimum recycled content requirement for:

- Internal Council contracts such as roads, parks and public asset maintenance;
- Residential and commercial development applications

By requiring construction jobs to include a minimum recycled content for aspects of the development, such as pathways or internal roadways that incorporate recycled glass, Council will be able to drive demand for recycled products in the community.

[8] Now called the Department of Sustainability, Environment, Water, Population and Communities

Whilst this option may not have an immediate impact on the amount of waste diverted from landfill, by building stronger demand for the diverted materials, Council can help pave the way for better recycling outcomes and drive innovation in recycled content use and circular economy.

6.3.8 Textile Diversion

Fast fashion, consumer behaviour and waste generation habits are some of the key elements that contribute to the issue of textile waste. Whilst the Moreland bin system is comprised of approximately 2.5% textile waste, or 9kgs per resident, the average Victorian creates 28kg of textile waste each year (Sustainability Victoria, 2022). This indicates that the majority of textile waste bypasses the kerbside system. Nevertheless, Council recognises that textiles waste is a major issue for waste management.

Council participates in, and supports, a range of textile diversion activities such as:

- Annual participation in the Garage Sale Trail which promotes clothing reuse and repair
- Promotion of clothing donation shops such as various charity shops, and the H&M garment collection initiative which reuses, repurposes or recycles the textile
- Promotion of clothing recycling collections such as Upparel who drive innovative upcycling solutions to end textile waste

Given that textile waste, in the scope of this project, only comprises a small percentage of the waste stream, options such as an additional collection service or large-scale interventions have not been considered. According to the Monash Sustainable Development Institute, the key enablers for transitioning the textile industry towards a circular economy included the need for better leadership, growing consumer awareness and access to relevant information sources. Therefore, the options for Council to consider for reducing textile waste should focus on educational programs to improve consumer knowledge and decision making.

7. OPTIONS DETAIL

7.1 PAY BY WEIGHT SYSTEM

Pay By Weight System
Benefits / Rationale • Benefits include waste reduction, leading to reduced reliance on landfill • Strong incentive for waste reduction and diversion through the user pays system • Greater transparency in waste management costs • The system is a long-term solution to financing waste diversion • May result in a beneficial social change by enabling residents' greater control over the costs of waste management
Issues / Barriers • Pay by weight systems can lead to greater illegal dumping. The extent of the increased dumping is not known (Ukkonen & Sahimaa, 2021) • The system, depending on how it is charged, can lead to revenue uncertainty due to seasonal variability in waste generation • New administrative systems will need to be procured, installed and staff training undertaken • Significant time and effort are needed to build political will and gain buy-in from the Councillors • The system could be perceived as a burden to low-income residents or large families, however a subsidy strategy can be applied to address this issue • Gaining public support is will likely be very challenging. Concerns over fees must be fully addressed to gain public support and acceptance. • Council would bear the risk of being the first council in Victoria to implement this collection method
Delivery / Implementation • Significant engagement with the community required • Installation of a locking system on each bin to ensure that only the resident can place waste in their bin. The locking system can be a gravity-based lock, which unlocks via a key/key card for the resident, and when turned upside down by the collection vehicle • Installation of a radio frequency identification (RFID) tag to assign each bin to a residence and record collections or weight of collected material • Installation of RFID scanner for each collection vehicle • Installation of the gravity lock and RFID may be more efficiently completed when Council change the garbage bin collection frequency in 2025. Council will seek to standardise a 120L bin for the service, which will mean a bin roll-out program will be undertaken across the municipality. If the locks and RFID are able to be installed at a single location in bulk, cost savings may be realised
Costs • Supply and installation of the gravity lock are likely to be within the region of $40 per bin. With approximately 68,500 garbage bins in the municipality, the cost may be approximately $2.74 million for the locks alone. However, Council may choose to make the locks a user-pays optional item to recover costs. • Supply and installation of RFID tags to each bin is not as costly as the gravity locks. Costs around $3.50 per bin have been assumed, equating to approximately $240,000 • Supply and installation of RFID scanner and recording system for each vehicle will likely cost around $1,300 per truck

Pay By Weight System
• Cost savings, as a result of avoided landfill levy and lower waste generation, can compensate for the cost of retrofitting the gravity locks and RFIDs. • Extra administrative budget would need to be allowed for, at least 1 additional full time administration officer salary • Other implementation costs such as integration of an IT system into Council's existing system, community engagement, and educational collateral must also be allowed for

7.2 SANITARY ITEM DIVERSION

Sanitary Item Diversion
Benefits / Rationale • Sanitary items account for approximately 10% of the garbage kerbside waste stream, or around 3,000 tonnes per year for Moreland which indicates that this stream has room for improvement
Issues / Barriers • There are currently limited recycling options for absorbent hygiene products. Preferred intervention methods involve reusable items
Delivery / Implementation • The Australian Government is supporting an industry led product stewardship scheme[9] for absorbent hygiene products to pilot new technologies that chemically decompose this waste and to identify new methods to manage the waste. The scheme was planned to commence recycling in early 2022. Outcomes of the scheme may be applicable to Council and should be reviewed when available. • Council is already implementing an intervention in the form of a subsidy for the purchase of cloth nappies and reusable period products. The subsidy launched in April 2022 and will run until March 2023, with design of an ongoing scheme subject to future review and budget consideration • Council may consider assisting the uptake of the Diaper Recycling company within the municipality and more broadly promoting them on Council's website and 'A-Z guide to waste and recycling' web page
Costs • Council may seek to increase the budget for the subsidy program to encourage even greater uptake for the reusable items

7.3 DROP OFF FACILITY

Drop Off Facility
Benefits / Rationale • Moreland Council does not currently operate a transfer station or resource recovery centre within the municipality to serve the residents • Increased opportunities to recycle, such as additional facilities, encourages recycling behaviours and can make it easier for residents to participate in recycling activities • Reduced reliance on the kerbside hard waste service • Increased control/ability to recycle items and deliver better recycling outcomes by including diversion rates and performance criteria in operational contract for the facility

[9] https://www.dcceew.gov.au/environment/protection/waste/publications/recycling-absorbent-hygiene-products

Drop Off Facility
Issues / Barriers • Existing transfer stations and recycling centres in metropolitan Melbourne have typically been operating long term and have established a social licence to operate with the surrounding community and sensitive receptors. Introducing a new waste facility into a community can be met with opposition and difficulty due to the perception of waste facilities and their impact on amenity. • It is likely that Council will have difficulty in finding an appropriate site to establish the facility. There may be potential for a small scale version of a drop off facility to operate out of Council's existing depot, however this would not be able to offer the full suite of waste drop off services that a standalone facility would offer. • Considerations of sensitive receptors, buffer distances and planning zones and overlays limits the number of suitable parcels of land. • Furthermore, the cost of purchasing the land will likely be prohibitive without significant funding contributed by the private sector or government fund scheme. Alternatively, the land could be leased.
Delivery / Implementation • Delivery of a new transfer station facility would require a robust and ongoing community engagement approach • A range of procurement approaches are available to Moreland for the delivery of this piece of infrastructure including: o Traditional procurement: Council runs a tender to develop and operate the facility o Tender for equipment only: Council develops the site and tenders for the provision of equipment and operation of the facility o Collaborative procurement: Develop the site in collaboration with a neighbouring council for shared access, costs and risks. Tender out for operation of the site o Joint venture: Council and a selected industry partner form an incorporated or unincorporated joint venture • Each procurement approach has a different spread of risk across Council and the contractor, Moreland will need to determine their preferred approach early in the development of the facility business case • A smaller drop off facility for residents to recycle specific products may be an option for Council to investigate, however, whilst this may be a service improvement for the community, it may have a limited impact on diversion rates
Costs • Costs to develop a transfer station can vary greatly depending on the size and functions of the site. The City of Ballarat have investigated the development of a Community and Industry Resource Recovery Centre which includes an array of waste functions such as MSW bulk haulage shed, a community transfer station, C&I recycling, education centre and depot offices. The estimated budget for this facility is approximately $16 million for facility foundational infrastructure across the 10-hectare site. On a smaller scale, the Portland Resource Recovery facility was developed for approximately $5 million and includes a recycling drop off area and MSW bulk haulage shed. • Operational costs for the facility depend on the procurement arrangement and whether the facility is run for profit or to break even etc. If outsourcing the operation of the facility is chosen, the contractor may pay a leasing fee to Council for the site.

7.4 PUBLIC ORGANICS BIN

Public Organics Bin

Benefits / Rationale

- Data from 2016 suggests that the public bin system comprises between 26-40% of organic waste that has the potential to be diverted into the FOGO system

Issues / Barriers

- The most recent audit data was completed in 2016, more recent information on the proportion of recycling and garbage bins and their location would benefit the development of this option
- Contamination management in public organics bins will be difficult to control given users of the bins are not static. Education and signage will be key to minimising contamination. Excess contamination in a collected truck load of material can result in that load being landfilled.

Delivery / Implementation

- It is recommended that an audit of the public place bins is conducted prior to further investigation to support the development of this option
- Council will need to negotiate with the existing collection contractor to include additional bins in the collection schedule

Costs

- 240L bin costs approximately $82.50 (Digiwise Pty Ltd ATF The Digiwise Trust, 2020)
- Ricardo has assumed that the FOGO collection is conducted by the contractor for the same rate as the remaining FOGO service at $3.18 per bin lift
- A trial of public FOGO bins may include 50 bins at specified locations under a weekly collection schedule. The cost would equate to a minimum of $9,001 for one year, assuming:
    - $4,125 for the supply of bins
    - $8,268 collection costs
    - $9,335 in organics processing costs (89 tonnes charged at $105/tonne)
- -$12,727 avoided in landfilling costs (89 tonnes charged at $143/tonne)
- Additional costs should also be accounted for the following:
    - Bin surrounds for the public bins which could be in the region of $1,500 each
    - Administrative costs for comms, design of service, monitoring, evaluation of trial, project management
    - Education
    - Signage

7.5 COMPOSTABLE BAGS/LINERS

Compostable Bags / Liners

Benefits / Rationale

- Allowing compostable liners in the FOGO system would likely improve participation rates and divert more organic material away from landfill
- According to MWRRG, residents prefer compostable liners because they are convenient and remove the 'yuck' factor of managing organic waste
- Usage rates of compostable liners may be a useful method for Council to track participation rates for the service. If the bags are provided annually, with additional bags available at selected Council facilities, Council may be able to observe areas where additional bags are needed, or track seasons when organic diversion is prevalent (e.g., Christmas period)

Issues / Barriers

Compostable Bags / Liners

- The main hurdle to this option is that the current FOGO processor does not accept liners and Council is currently locked into a contract with Veolia until 2028
- The cost of supplying the liners will be an ongoing additional cost to Council
- Use of these liners may confuse come residents, as it may be seen as a contrary message to reducing single use ‘plastics’ and plastic bag use
- There is also the potential for residents to use non-compliant liners which would lead to increased FOGO contamination

Delivery / Implementation

- While Council could specify compostable liners to Australian standard AS4736 and allow residents to purchase the bags themselves from the supermarket, this method introduces the potential for ongoing contamination issues. Provision of the bags by Council is the preferred method of enabling compostable liner use. This method means that Council can control the bags that are used in the system and reduce potential contamination by unacceptable bags.
- Surf Coast Shire Council provide FOGO liners to residents and assume a usage rate of one bag used every three days, or a pack of 75 liners lasting up to six months. Surf Cost Shire Council encourage residents to collect additional bags as required from Council facilities across the shire. Whilst Surf Coast encourage the use of the Council-supplied bags, they also allow other brands and provide a list of approved bags which have been tested and approved by their compost facility.
- Approved bags provided by Council could be specifically coloured to enable the processor to easily identify non-compliant bags as contamination

Costs

- The DELWP Waste Charge Model includes an allowance of $2.00 per year for the provision of bin liners. Across Moreland’s 79,897 (2021) total dwellings, this equates to approximately $160,000 per year to supply the liners
- Additional costs in education should also be budgeted to minimise contamination from non-compliant bags

7.6 DIRTY MRF

Dirty MRF

Benefits / Rationale

- A dirty MRF intercepts recyclable content from the garbage waste before it is sent to landfill
- This option would not require behaviour change from residents to realise waste diversion improvements
- This option has the potential to divert up to 45% of the content of the garbage waste stream

Issues / Barriers

- A dirty MRF does not encourage good recycling behaviour, rather it is a means of managing incorrect behaviour
- There are currently no existing/operational dirty MRF accepting municipal kerbside collected garbage red lid waste streams available for Council
- If Council opted to develop a dirty MRF themselves, siting of the facility within the municipality or within a reasonable travel distance may present a barrier. Similar to the development of the drop off facility, nearby sensitive uses, planning zones, adequate site area, and impacts on amenity would likely limit the number of appropriate sites considerably
- Dirty MRFs achieve best outcomes when there is minimal source separation (i.e., no separated bin system). However, this option may be a suitable option for the existing street/litter bins instead of implementing a public organics bin

Delivery / Implementation

- Moreland Council may seek to engage with Wyndham City Council and negotiate a contract to accept and process their waste once the dirty MRF at West Rd landfill has been constructed and is operational.

Costs

- ReGroup is an Australian company that designs, builds, owns and operates recycling facilities. ReGroup has recently developed two clean MRFs to produce high quality material outputs and meet the requirements of the COAG bans. The first MRF is located in Cairns and was opened in early 2021. The facility cost approximately $15 million to develop and has a throughput of 30,000 tonnes. ReGroup also developed the Southern Adelaide MRF which was opened in late 2021 and has a throughput of 60,000 tonnes per annum. The Southern Adelaide MRF cost approximately $23 million to develop.
- The cost of developing a MRF will vary depending on features such as throughput, equipment selection and size of the site. A rigorous business case should be developed to provide a better understanding of capital and operational costs

7.7 ON CALL GARBAGE BIN

On Call Garbage Bin

Benefits / Rationale

- This option is a relatively radical intervention method to influence behaviour change and reduce reliance on landfilling waste

Issues / Barriers

- The option would likely place significant administrative burden on Council for both the implementation of the system and ongoing management
- It is unlikely that the community would respond positively to the change, significant engagement and support from Councillors would be required

On Call Garbage Bin

- The option may lead to waste being incorrectly placed in the yellow lid recycling or green lid FOGO bins as non-compliant residents seek to dispose of garbage waste through a regular service
- A locking system for the bins may need to be implemented to prevent waste being put in other's bins that have been organised for collection

Delivery / Implementation

- It is anticipated that this option would become more viable as volumes of residual waste collected from the kerbside service reduce, indicating that reliance on the garbage bin is also reducing. Consequently, this option should be a long-term option to be implemented when presentation rates for the garbage service have reduced.

Costs

- The flexible nature of the option would likely result in increased costs, particularly those charged by the private collection contractor for the southern portion of the Moreland municipality[10]
- Costs are assumed to be similar to implementing a booked hard waste collection and pay by weight system
- Additional administrative costs will need to be borne by Council to manage the system

7.8 FOOD ONLY COLLECTION

Food Only Collection

Benefits / Rationale

- This option is focused on improving the diversion rates for containerised food, a material that makes up almost 9% of the garbage waste stream, or 4.39% of the total waste stream.
- The collection would be paired with a processor that had a PDU to mechanically separate out the organic fraction
- The public organics bin option under Scenario 2 may benefit from a PDU, as it is likely that packaging materials would be disposed of with the food waste there too.

Issues / Barriers

- The food only collection is unlikely to be viable as a service for residents only. However, commercial and industrial (C&I) waste sources can also have a high organic waste fraction, particularly food and beverage service industries and food manufacturing. Whilst C&I waste is outside the scope of this report, it may be worth considering the viability of a food only collection that includes C&I waste.

Delivery / Implementation

- Conduct research into the proportion of food waste in C&I business waste within the municipality and survey businesses to gauge willingness to participate in a food only waste collection Funding for the research may be available through the Recycling Victoria Organics Markets Fund[11] which seeks to fund projects that:
  - remove barriers that prevent or limit the adoption of Recycled Organic Products
  - accelerate a sustained increase in the use of existing Recycled Organic Products.
- Since this option seeks to supply the organics market with a clean stream of organic material and support the sustained increase in the use of recycled organic products, it may be eligible

[10] Moreland City Council has a split collection arrangement, a legacy of amalgamation, where the southern half of the municipality is serviced by a private collection contractor, and the northern portion is collected in-house.

[11] https://www.sustainability.vic.gov.au/grants-funding-and-investment/grants-and-funding/organics-markets-fund

Food Only Collection
• To reduce amenity impacts, such as odour, the food only bins should be collected at a weekly frequency
Costs • The costs of the food only collection will be dependent on the number of participating households and businesses. Costs will include: ○ Feasibility / business case to confirm the service viability ○ Contract development, tendering and negotiation ○ Supply and maintenance of bins ○ Ongoing collection costs ○ Ongoing education, comms and monitoring • A payment system would need to be implemented as a cost recovery mechanism for the service

7.9 INCREASED CDS REBATE

CDS Rebate
Benefits / Rationale • By increasing the reward amount for returning eligible containers, individuals will be more motivated to participate in the scheme • Potentially lead to less litter due to a higher value placed on eligible containers that are currently littered
Issues / Barriers • The CDS has not yet been implemented in Victoria, time will be needed to allow the system to establish before major change such as an increase to the rebate amount is made • Council does not have the power to increase the rebate itself • No other state in Australia has a rebate higher than 10c per eligible container
Delivery / Implementation • Given that the CDS will be delivered by state government, Moreland has a limited level of control. Moreland would need to play an advocacy role to influence this change.
Costs • The CDS will be funded by beverage suppliers, therefore any increase to the rebate will also be borne by the beverage suppliers

7.10 LANDFILL BAN

Landfill Ban
Benefits / Rationale • Reduce the impact of waste on the environment from landfills • Promotes resource recovery and improve resource efficiency • Meets waste diversion targets • Promotes waste hierarchy
Issues / Barriers • Significant investment into alternative waste infrastructure to manage the previously landfilled waste would be required

Landfill Ban
• Likely to be implemented in partnership with a thermal WtE technology which would be a barrier for Moreland
Delivery / Implementation • The option is more suited to implementation at a state or national level, rather than by Council • The 2010 Landfill Ban Investigation outlines that landfill bans have been implemented according to the following typical process: 1. Identification of objectives 2. Analysis of environmental and economic outcomes and alternative treatments 3. Stakeholder consultation 4. Regulation 5. Transition period 6. Enforcement • Timing of ban implementation will require significant lead time to enable industry to prepare and for alternative methods of management to be established where required. Lead times have varied between 2-12 years, where 12-years was identified as excessive in the Landfill Ban Investigation • If banning specific waste items or sources of waste, the landfill operator is typically responsible for enforcement. Depending on the complexity of the bans (i.e., if many different waste types are banned) detailed load inspections and ongoing monitoring may be required • Consultation with local government, industry and waste service providers will be critical
Costs • The Landfill Ban Investigation summarises that 'with excellent planning and suitable complementary instruments, landfill bans could…deliver good diversion outcomes in a cost-efficient manner' • Cost implications for Council depend on the scale of the landfill ban (i.e., whether it applies to all municipal solid waste (MSW), or only food waste to landfill), the timing of the implementation (i.e., whether the alternative treatment for the banned material is comparable to landfill rates) and the responsibility for enforcement (i.e., whether Council is liable for banned material collected from the kerbside and destined for landfill) • Given that the preferred method of implementation would be at a state-wide (or federal) level, successful implementation of a ban would likely receive funding from state government

7.11 INSINKERATORS

Benefits / Rationale • Streamlines the diversion of food waste for residents • A means of improving organics diversion in MUDs where space for compost bins or green lid FOGO bins can be limited
Issues / Barriers • Existing pipelines can be susceptible to degradation and blockages under the increased load of food waste. To avoid use of the existing pipelines, holding tanks for the food waste disposal unit material could be installed and the material is then collected and transported to the treatment facility • Grease and fats can accumulate with other waste in drains and sewers causing blockages and increasing maintenance requirements for the water authorities • Can increase water usage

• Depending on the uptake of the FWD units, the water treatment facility could become overloaded with nutrients
Delivery / Implementation • Implementing FWD units into the planning process for new developments will require significant cooperation between local government and the water authority
Costs • Costs to investigate and upgrade existing pipework to ensure that the transportation of the food waste can be achieved would likely be prohibitive. It is also unlikely that the water authorities would pay for it as they have been historically opposed to widespread use of FWD units. • The cost of the unit itself is between $350-$1,000. Installation of a FWD unit in all Moreland households could therefore cost between $28-$80million, excluding installation fees.

7.12 MINIMUM RECYCLED CONTENT – CONSTRUCTION

Benefits / Rationale • Builds demand for recycled content construction products, which will support the recycling industry and build local markets for our kerbside collected recyclable materials • The Victorian Government is currently seeking to increase the use of recycled materials in Victoria's Big Build through the Recycled First initiative. The initiative seeks to identify new ways for the government to increase recycled material in major infrastructure projects – this may include the use of recycled glass in cement and asphalt production.
Issues / Barriers • Specifications for the use of recycled content products is not well established yet which can lead to reticence in the construction industry to utilise recycled content products. The lack of specifications can lead to concerns that the product may not perform as well as standard materials. • Where construction applications propose to use an innovative form of recycled content, Council may need to seek external expertise to assess whether the product is acceptable under their permit framework
Delivery / Implementation • Council would need to interrogate its internal procurement processes to develop a method of identifying contract types applicable to using recycled content.
Costs • External costs borne by construction applicant for the research and use of appropriate materials • Council may need to budget for external advice on use of innovative recycled content materials, costs will be dependent on the scope of the advice required • Additional training for new procurement approaches that include the assessment of recycled content in contract evaluation

7.13 TEXTILE DIVERSION

Textile Diversion
Benefits / Rationale

Textile Diversion

- Textile waste is a key issue in waste management and is the 2021-22 annual focus areas for the Circular Economy Business Innovation Centre (CEBIC). Whilst textiles do not comprise a significant proportion of the waste within the scope of this report, actions and additional support in this area may lead to benefits to textile wastes outside of this scope
- Educational and supporting programs are available for textiles, for example assistance from the CEBIC team through a one-to-one meeting is immediately available
- Industry has already identified that textile waste needs better leadership, growth in consumer awareness and better access to relevant information sources

Issues / Barriers

- Changing consumer behaviour is a difficult task to accomplish, it will require long-term educational programs and engagement
- Given that only a small fraction of textile waste is captured by the kerbside system, progress will be difficult for Council to measure

Delivery / Implementation

- There is a wealth of educational material available online that Council can leverage, such as Sustainability Victoria's 'Shop Sustainably for Fashion' webpage (Sustainability Victoria, 2022), or Clean Up Australia's 'Top 10 Ways to Reuse, Reduce and Recycle Your Clothes' (Clean Up Australia, 2022).
- Clean Up Australia also encourage a 'Step Up' challenge for various waste streams, and for textiles suggest saying no to new clothes for a year. Participants are encouraged to share their action by posting photos of their progress and tagging #stepuptocleanup. Council could encourage this challenge or create one of their own as a simple method of engagement and awareness raising for textile waste.
- The Department of Agriculture, Water and the Environment is currently funding a program led by the Australian Fashion Council to create Australia's First National Product Stewardship Scheme for clothing textiles. The program aims to improve the design, reuse, recovery and recycling of textiles and a roadmap for clothing circularity by 2030 in Australia. It is recommended that Council review the roadmap and stewardship program when it is completed and participate as appropriate

Costs

- Costs of educational and support programs have been assumed to be included in Council's education budget. It is not expected that additional administration staff will be required.

7.14 COST SUMMARY

Table 7-1 below provides a high-level cost summary of the various interventions discussed throughout this report. It is important to note that the costs shown are indicative only, and subject to feasibility and business case development.

Table 7-1 Cost Summary

Intervention	$0-$10,000	$10,001-$100,000	$100,001-$1million	>$1million
Pay By Weight System				
Sanitary Item Diversion				
Drop Off Facility[1]				
Public Organics Bin				
Compostable Bags / Liners				
Dirty MRF[2]				
On Call Garbage Bin				
Food Only Collection[3]				
Higher CDS Rebate				
Landfill Ban[4]				
Food Waste Disposal Units				
Minimum Recycled Content - Construction				
Textile Diversion				

Notes:

1. Construction cost >$1million. Annual costs following construction dependent on whether the operation of the facility is outsourced. A smaller scale trial facility may be achievable at a lower cost, but may not deliver the outcomes desired
2. Construction cost >$1million if Council constructs own facility.
3. Costs are dependent on the number of participating households and businesses
4. Cost implications for Council depend on the scale of the landfill ban and whether the ban is implemented by state or federal government

Legend

Implementation / trial
Annual cost after establishment
Implementation / trial and annual costs

8. EMISSIONS

Emissions modelling was completed to show the impact of the scenarios on the emissions generated by the waste activities within the scope of this report.

8.1 EMISSIONS CALCULATION ASSUMPTIONS

Table 8-1 Emissions Calculation Assumptions

Emissions Source	Emissions generation	Assumptions
Kerbside transport to destination 1 (collection truck emissions)	Kerbside garbage red lid to landfill	• Fuel combusted: Diesel • Kerbside truck capacity: 30m^3[12] • Garbage fuel consumption (litre/km/tonne): 0.022281 • Recyclables fuel consumption (litre/km/tonne): 0.041126 • FOGO fuel consumption (litre/km/tonne): 0.024370 • Hard waste fuel consumption (litre/km/tonne): 0.022281 • Distances travelled were calculated using Google maps from the Council centroid of the Coburg post office to the destination location • Emissions factors for diesel oil[13]: - Energy content factor (GJ/kL) 38.6 - CO2 (kg CO2-e/GJ) 0.0699 - CH4 (kg CO2-e/GJ) 0.0001 - N2O (kg CO2-e/GJ) 0.0005
	Kerbside commingled recyclables to MRF	
	Kerbside FOGO to processor	
	Kerbside hard waste to processor	
Processing emissions	MRF commingled recyclables processing emissions	MRF electricity usage per tonne (kWh/tonne): 22[14] Electricity usage conversion factor to CO_2-e: 0.00106[15] MRF CO_2-e / tonne: 0.02332
	FOGO processing (composting) emissions	Total emissions factor (CH4 and N20): 0.046[16] t/ CO_2-e
	Kerbside garbage landfill gas emissions	Emission factor: 0.730 t CO_2-e / tonne waste[17]
Transport to end destination emissions	MRF commingled recyclable contamination transport to landfill	As kerbside to destination 1 transport assumptions above.
	FOGO contamination transport to landfill	
	Hard waste residual to landfill	

[12] APC Environmental Management, Optimum Compaction Rate for Kerbside Recyclables for Zero Waste SA
[13] Australian National Greenhouse Accounts Factors 2021, Department of the Environment and Energy
[14] Environmental benefits of recycling, Appendix 7 – Assumptions Collection, treatment, material recovery and energy assumptions
[15] Australian National Greenhouse Accounts Factors 2021, Department of the Environment and Energy
[16] http://www.cleanenergyregulator.gov.au/NGER/Forms-and-resources/Calculators
[17] Australian National Greenhouse Accounts Factors 2021, Department of the Environment and Energy, Ricardo adjustments to account for landfill gas capture

Emissions Source	Emissions generation	Assumptions
	MRF + Hard waste recyclables + FOGO to local market	Local market is assumed to be within 50km Fuel consumption for a rigid truck for material transit (litre diesel/100km): 27.76[18] Bulk haulage fuel consumption (litre/km/tonne): 0.01388
	MRF commingled recyclables to international export	Ship fuel consumption (L/km/tonne): 0.001572802[19] Export reprocessing (km): 10,000

8.2 EMISSIONS COMPARISON

The emissions calculations for baseline, Scenario 1 and Scenario 2 were completed utilising the assumptions outlined above, and the waste modelling completed in Section 5 for each scenario. **Figure 8-1** below shows the emissions over a 10-year period. Emissions for Scenario 1 show a drop in 2023 due to the implementation of the weekly FOGO service. The diversion of the additional organic material from landfill results in a lower emissions rate for the landfill component. Scenario 2 has the lowest estimated emissions, with implementation of the combined weekly FOGO/fortnightly garbage bin and pay by weight system in 2025 making the largest impact. By 2032, Scenario 2 generates approximately 46% less tonnes of CO_2 less than the baseline.

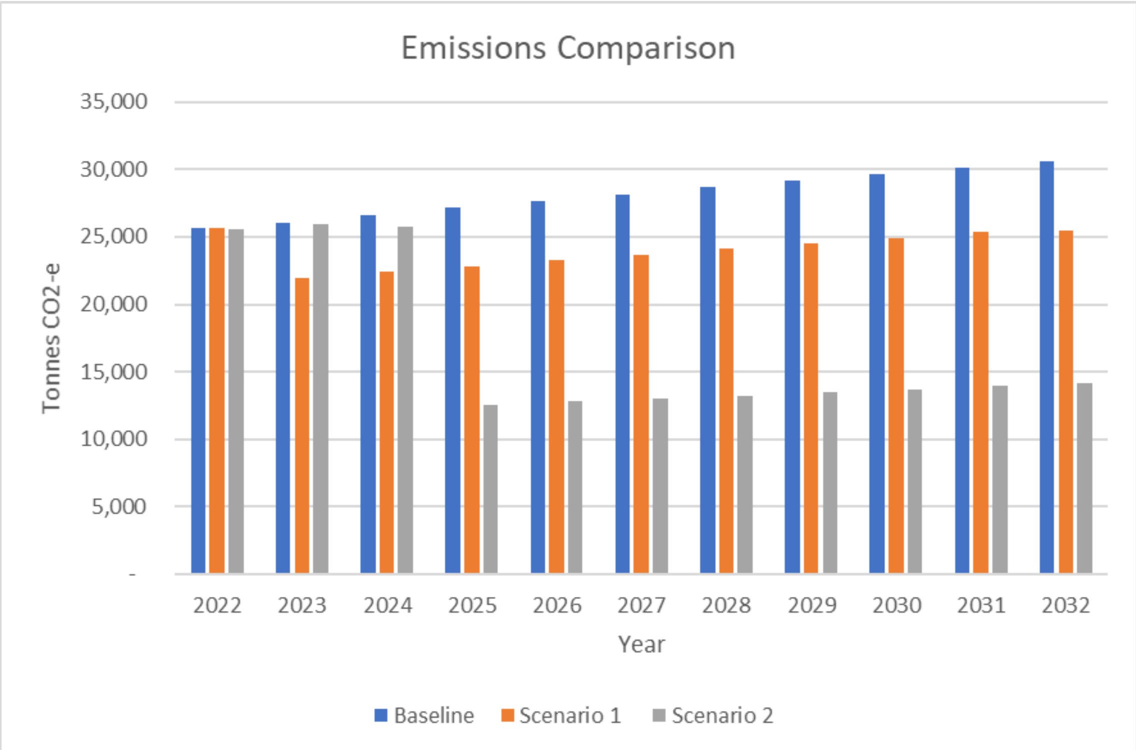


Figure 8-1 Emissions Comparison by Scenario

[18] https://www.bitre.gov.au/sites/default/files/wp_073.pdf
[19] Fuel surcharge practices of container shipping lines: Is it about cost recovery or revenue-making?

8.3 ELECTRIC WASTE COLLECTION VEHICLES

If purchasing electricity from the grid, there is a negligible difference in emissions generation when switching the kerbside vehicles from diesel fuelled to electric power. The main reason for this is the fact that the NGER rating of 1.00 kg CO2-e/kWh (Australian Government Department of Industry, Science, Energy and Resources, 2021) accounts for the source of our grid electricity being coal fired. However, Moreland sources 100% of its electricity through a 100% renewable Power Purchase Agreement and Council's strategic goal to transition to 'zero emissions' heavy fleet means that any electric trucks bought or leased (by Council or Contractors) will be powered by renewable electricity. Under this scenario, with new electric vehicles, a reduction of 80-85% of the kerbside transport emissions would be realised.

Transitioning to electric waste collection vehicles has other benefits, such as cost reductions for fuel purchase, and avoided air and noise pollution. Switching from diesel to electricity would cut the cost of transport fuel from the kerbside to destination locations (landfill, organics processor, recycling processor) by approximately 76%.

8.4 WTE TECHNOLOGY VS LANDFILL

Emissions from Waste to Energy technologies vary depending on the feedstock used and the process. An analysis of the opportunities for waste and emission reduction from the various landfill alternative technologies outlined in Section 4 has been undertaken to show the emissions impacts of the various technology options. Existing works approval applications for the proposed WtE facilities include a greenhouse gas assessment to estimate the emissions impact of the technology. These assessments were reviewed to compare the proposed technologies against landfill. **Figure 8-2** below shows the different emissions factors per tonne of waste for each facility. These figures account for the emissions from the facility itself and do not include any offsets or other benefits created. This highlights that each proposed technology is predicted to emit fewer CO_2 emissions per tonne of waste than landfill. The landfill emission rate is calculated from one tonne of typical residual waste (without diversion of food waste to green lid FOGO bins) and assumes that the landfill meets typical industry standards including capturing and converting landfill gas to energy. Actual emissions may be different due to the variable nature of kerbside garbage composition.

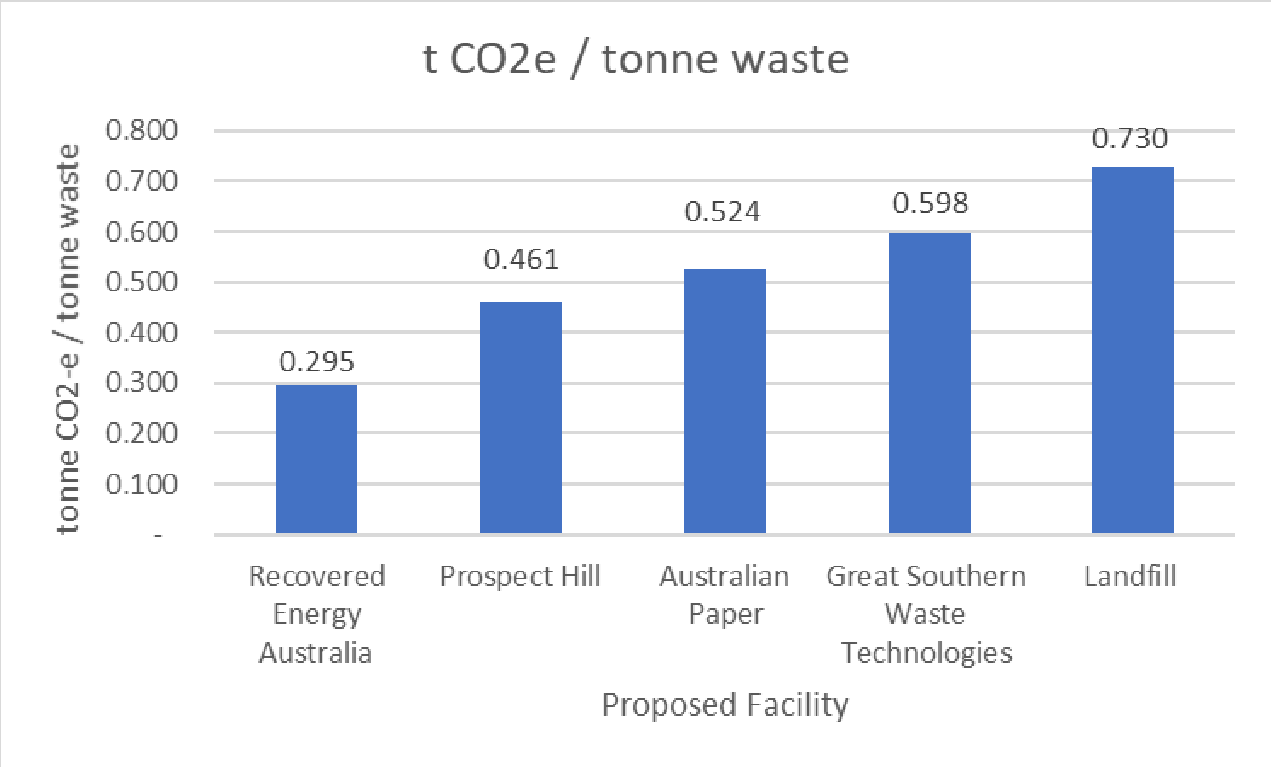


Figure 8-2 WtE Vs Landfill Emissions per Tonne Waste

Thermal WtE technologies can produce emissions from the combustion of fossil-fuel derived plastics and other materials (e.g., synthetic textiles). It is noted that:

- Whilst the CO_2 emissions generated from thermally treating fossil-fuel derived plastics contributes to climate change, placing the same materials in landfill would not contribute to climate change as they do not degrade.
- The emission of CO_2 from the combustion of biomass is not considered to contribute to climate change as the carbon contained in this material has been recently removed from the atmosphere as the biomass grew.

Non-thermal WtE technologies such as anaerobic digestion convert biomass into methane, which is 28 times[20] more potent than CO_2 as a greenhouse gas. While this methane is captured to produce energy, a proportion is lost in the process and therefore non-thermal WtE technologies also produce emissions, despite processing only biomass and not fossil fuel feedstocks.

Where alternative technologies divert putrescible waste from landfill, there is likely to be an emissions benefit because of the avoided methane generation of that material breaking down in the landfill. However, if there is a high proportion of plastics in the feedstock going to a mass burn technology, the benefits of avoided landfill emissions may be compromised. This is because plastics generate a high proportion of emissions when combusted.

[20] National Greenhouse Accounts Factors, August 2021, Table 32

9. SUMMARY

In 2018, Council adopted to the target of zero waste to landfill by 2030. Achieving zero waste to landfill will require radical changes in product creation (manufacturing and packaging), product use (use of sustainable, recycled and recyclable products), and product disposal (resource recovery or landfilling). Three scenarios were developed to better understand the impacts of existing/planned changes to the waste services and potential future interventions which may assist Council in achieving the 2030 zero waste to landfill target. Broadly, the three scenarios are:

- Scenario 1: Business as usual (BAU). Scenario 1 includes existing and planned policy reforms which must occur to the system across Victoria, and the implementation of weekly FOGO to all Moreland residents.
- Scenario 2: The second scenario builds upon the BAU reforms by including planned service changes such as combined weekly FOGO/fortnightly garbage collection in 2025 and a booked hard waste service. Scenario 2 also includes additional intervention actions to divert more waste from landfill, that are both achievable by 2030 and currently employed in other jurisdictions globally.
- Scenario 3: The third scenario focuses on possible methods to transition towards a circular economy and reach a feasible zero waste to landfill scenario. The scenario assumes a broader societal move towards circular economy design practices and considers what other reforms and system changes, within the scope of City of Moreland's influence and not currently on the table, may reduce waste to landfill and benefit waste and recycling practices.

The interventions proposed in the report include:

- Pay By Weight System
- Textile Diversion
- Sanitary Item Diversion
- Drop Off Facility
- Public Organics Bin
- Compostable Bags / Liners
- Dirty MRF
- On Call Garbage Bin
- Food Only Collection
- CDS Rebate
- Landfill Ban
- Food Waste Disposal Units
- Minimum Recycled Content - Construction

In addition, Council is already planning to implement a booked hard waste collection and a fortnightly garbage collection in the short term (subject to the outcomes of trials and Council decision processes) and supports a range of community waste diversion initiatives. The weekly FOGO service is also another intervention which council is planning to implement.

Figure 9-1 below summarises the baseline, Scenario 1 and Scenario 2 modelling for waste generation and amount of waste disposed of at landfill. The figure and modelling results show:

- Scenario 1 diverts approximately 19% more waste away from landfill compared to the baseline at 2030, largely as a result of the weekly FOGO service. Planned policy and service reforms at the state level, such as Single Use Plastics Ban, CDS and export bans will provide a small benefit but not meaningfully progress towards zero waste for Moreland.
- Scenario 2 shows a significant reduction in waste generation with the amount of waste sent to landfill at 19,100 tonnes by 2030, a reduction of 42% compared to the baseline modelling in 2030.
- The remaining 19,000 tonnes of residual waste could be reduced by the other additional interventions that target approximately 73.5% of this waste stream, or 34.36% of the total waste stream within the scope of this project.
- Scenario 3 includes additional interventions to further reduce waste to landfill and better manage the community's waste. Many of these interventions could be influenced by Council, but not controlled by Council. This scenario would trend closer towards zero waste to landfill.

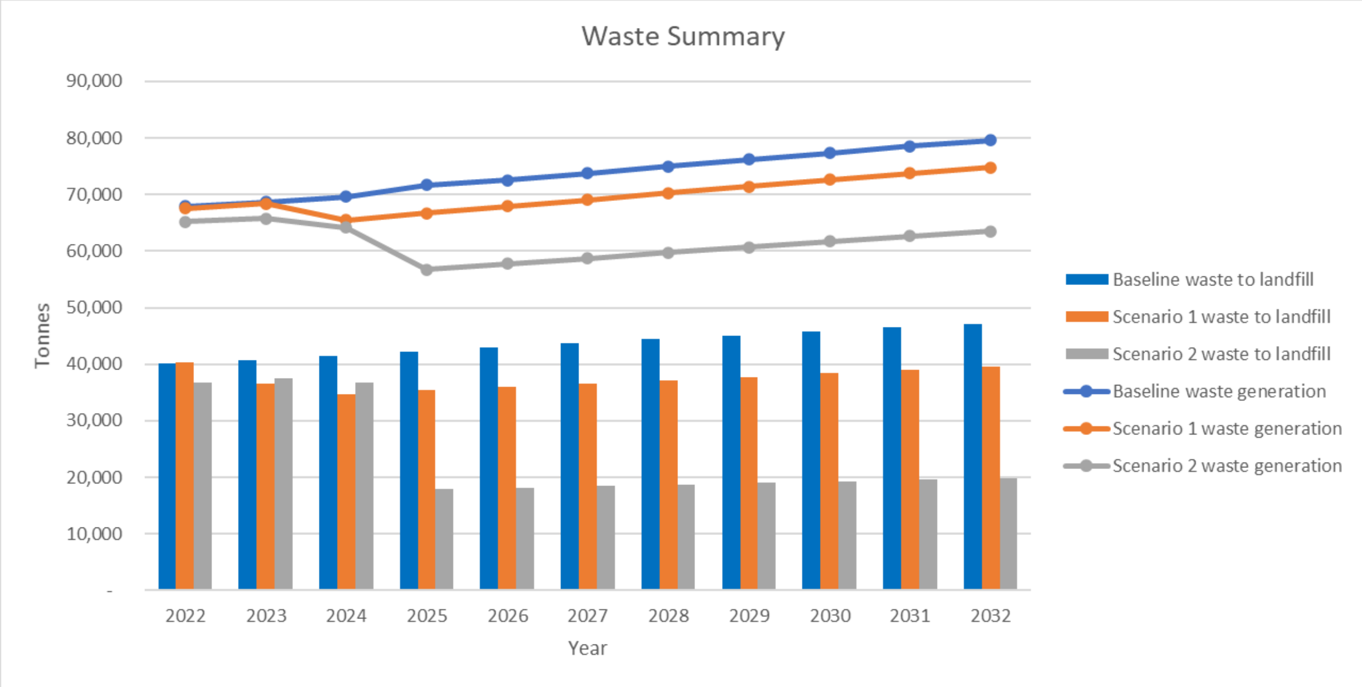


Figure 9-1 Waste Summary

The waste to energy review showed that there are a handful of thermal WtE facilities proposed for Victoria, all of which are seeking to process a proportion of MSW as their feedstock. Whilst Council opposes thermal WtE as an alternative to landfill, it does provide a simple option to significantly reduce waste to landfill and lower GHG emissions per tonne of waste compared to landfill.

This report shows that with current technologies and not using WtE, zero waste to landfill is unachievable without drastic societal and technological change. An achievable zero waste target could include:

- Extending the timeframe beyond 2030 to enable considered implementation of interventions, assessment of their impact and evaluation,
- Re-framing the commitment to 'towards zero waste to landfill', or 'zero recoverable waste to landfill', or removing the 2030 goal which is reflective of the ongoing challenge that zero waste to landfill presents
- Revising the position on thermal waste to energy

The challenging nature of achieving zero waste to landfill is highlighted by the range of options presented in this report, which show that even radical changes to Council's waste management services may not reach zero waste to landfill. This is because Council has limited control over waste generation which is linked to consumer behaviour, product design and manufacture and demand for recycled materials. Therefore, achieving zero waste to landfill will require sweeping changes in product creation (manufacturing and packaging), product use (use of sustainable, recycled and recyclable products), and product disposal (resource recovery or landfilling), a holistic approach across the lifecycle.

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Appendix A Council Supported Services and Programs

Services and programs provided by Council to support waste reduction and resource recovery

- **Compost Community:** subsidy program to increase uptake and use of home composting equipment
- **Greener Everyday:** subsidy program to increase uptake and use of cloth nappies and reusable period products
- **Recycling Stations:** three drop-off locations for the collection of household batteries, mercury-containing lamps, mobile phones and digital cameras, CDs and DVDs, eye glasses, tapes, pens and markers
- **Ecoactiv Digital Platform:** online booking platform servicing the community all year round with sustainable disposal options for a wide range of household items
- **Waste education for schools, ELCs and community:** free incursions for schools, kindergartens and community groups on a wide range of waste and recycling related topics
- **Bin inspection program:** education program to reduce contamination by providing 'at point of behaviour' information on correct bin use
- **Online A-Z guide to waste and recycling:** online listing of reuse, repair, recycling and disposal options for over 400 items
- **Garage Sale Trail:** national program to encourage household and community garage sales over one weekend in November, now also includes community education through workshops and resources
- **Community workshops:** monthly workshops on a range of waste reduction and avoidance topics such as home composting, using cloth nappies, mending clothes and recycling right

Appendix B Performance Exercise

Assumptions:

- Bagged recyclables are not bagged
- Litter bins composition is the same as the garbage kerbside bin

Service	2021 total	Composition	% composition	Weight	Correct bin
Illegal dumping (bulk waste)	2273.51	Mattresses	28.0%	635.67	Hard / Alternative
Illegal dumping (bulk waste)		Wood furniture	26.8%	609.98	Hard / Alternative
Illegal dumping (bulk waste)		Composite plastics	3.2%	72.52	Commingled
Illegal dumping (bulk waste)		Paper/Cardboard	1.2%	27.51	Commingled
Illegal dumping (bulk waste)		Wood composite	1.2%	26.83	FOGO
Illegal dumping (bulk waste)		EPS-6	0.4%	9.32	Hard / Alternative
Illegal dumping (bulk waste)		Film / sheeting	0.3%	5.91	Hard / Alternative
Illegal dumping (bulk waste)		Engine / other	5.8%	131.86	Hard / Alternative
Illegal dumping (bulk waste)		Scrap metal	4.3%	98.67	Hard / Alternative
Illegal dumping (bulk waste)		Whitegoods	1.4%	31.37	Hard / Alternative
Illegal dumping (bulk waste)		Electrical	0.6%	12.50	Hard / Alternative
Illegal dumping (bulk waste)		Garden Organics	11.6%	263.27	FOGO
Illegal dumping (bulk waste)		Treated timber	5.8%	132.77	Hard / Alternative
Illegal dumping (bulk waste)		Textiles	4.5%	101.40	Hard / Alternative
Illegal dumping (bulk waste)		Tyres	1.3%	29.33	Hard / Alternative
Illegal dumping (bulk waste)		Residual	3.7%	84.57	Residual
Litter bins	Merged with kerbside residual.				
Street sweeping	411.52		100%	411.52	Hard / Alternative
Garbage Kerbside	30543.57	Paper	3.3%	1,017.97	Commingled
Garbage Kerbside		Cardboard	3.1%	937.93	Commingled
Garbage Kerbside		Liquid paperboard containers	0.2%	57.70	Commingled
Garbage Kerbside		Nappies/Sanitary (disposable)	10.0%	3,056.02	Residual
Garbage Kerbside		Soiled Paper/Paper Towel/Tissues	4.0%	1,209.33	Residual
Garbage Kerbside		Avoidable Food (Whole Foods)	10.0%	3,057.49	FOGO
Garbage Kerbside		Unavoidable Food (Scraps)	22.5%	6,877.84	FOGO
Garbage Kerbside		Containerised/Packaged Food	8.8%	2,680.29	FOGO
Garbage Kerbside		Garden/Vegetation	3.3%	1,008.51	FOGO
Garbage Kerbside		Other Putrescible	4.4%	1,338.92	FOGO
Garbage Kerbside		Wood/ timber	0.6%	180.77	FOGO
Garbage Kerbside		Clothing/Textile/Rags	4.6%	1,395.65	Hard / Alternative

Service	2021 total	Composition	% composition	Weight	Correct bin
Garbage Kerbside		Glass Non-CDS/Wine/Spirit/Jar/Sauce	0.8%	250.05	Glass
Garbage Kerbside		Glass CDS/Other Drink Only	0.8%	248.75	Glass
Garbage Kerbside		Glass - Other (Pyrex etc.)	0.2%	56.56	Glass
Garbage Kerbside		Glass fines (non-recyclable)	0.2%	59.17	Glass
Garbage Kerbside		PET 1	0.8%	247.93	Commingled
Garbage Kerbside		HDPE 2	0.3%	88.84	Commingled
Garbage Kerbside		PVC 3	0.0%	1.63	Commingled
Garbage Kerbside		LDPE 4	0.0%	10.27	Commingled
Garbage Kerbside		PP 5	1.0%	300.09	Commingled
Garbage Kerbside		Polystyrene (not expanded) 6	0.1%	25.75	Residual
Garbage Kerbside		PS (expanded) 6	0.1%	41.57	Residual
Garbage Kerbside		Other 7	0.0%	5.71	Commingled
Garbage Kerbside		Rigid Plastic Not Bottle/Container	1.8%	560.41	Residual
Garbage Kerbside		Plastic Films	5.8%	1,768.28	Residual
Garbage Kerbside		Steel Cans	0.4%	108.56	Commingled
Garbage Kerbside		Steel Aerosol	0.1%	22.82	Commingled
Garbage Kerbside		Pots/Pans	0.1%	32.93	Hard / Alternative
Garbage Kerbside		Other Metals	1.5%	457.88	Commingled
Garbage Kerbside		Aluminium Cans	0.2%	73.68	Commingled
Garbage Kerbside		Aluminium Foil	0.3%	98.78	Commingled
Garbage Kerbside		Aluminium Aerosol	0.1%	28.20	Commingled
Garbage Kerbside		Paint	0.0%	-	Hard / Alternative
Garbage Kerbside		Fluorescent Tubes/Globes	0.0%	0.82	Hard / Alternative
Garbage Kerbside		Batteries	0.0%	13.69	Hard / Alternative
Garbage Kerbside		Hazardous other	1.6%	493.42	Hard / Alternative
Garbage Kerbside		Ceramics	0.4%	117.53	Hard / Alternative
Garbage Kerbside		Building Materials	3.6%	1,097.68	Hard / Alternative
Garbage Kerbside		Dirt/Rock/Inert Materials	2.8%	844.20	Hard / Alternative
Garbage Kerbside		E-Waste	0.8%	250.38	Hard / Alternative
Garbage Kerbside		Other	1.4%	419.58	Residual
Commingled Kerbside	16104	Paper	10.40%	1,675.07	Commingled
Commingled Kerbside		Cardboard	20.23%	3,257.30	Commingled
Commingled Kerbside		Liquid paperboard containers	1.06%	170.84	Commingled
Commingled Kerbside		Nappies/Sanitary (disposable)	0.06%	9.58	Residual

Service	2021 total	Composition	% composition	Weight	Correct bin
Commingled Kerbside		Soiled Paper/Paper Towel/Tissues	0.35%	56.21	Residual
Commingled Kerbside		Avoidable Food (Whole Foods)	0.32%	51.21	FOGO
Commingled Kerbside		Unavoidable Food (Scraps)	0.39%	62.73	FOGO
Commingled Kerbside		Containerised/Packaged Food	1.61%	259.66	FOGO
Commingled Kerbside		Garden/Vegetation	0.27%	42.88	FOGO
Commingled Kerbside		Other Putrescible	0.72%	115.88	FOGO
Commingled Kerbside		Wood/ timber	0.38%	61.06	FOGO
Commingled Kerbside		Clothing/Textile/Rags	1.17%	188.19	Hard / Alternative
Commingled Kerbside		Glass Non-CDS/Wine/Spirit/Jar/Sauce	15.57%	2,507.47	Glass
Commingled Kerbside		Glass CDS/Other Drink Only	10.53%	1,695.75	Glass
Commingled Kerbside		Glass - Other (Pyrex etc.)	0.64%	102.42	Glass
Commingled Kerbside		Glass fines (non-recyclable)	6.94%	1,117.04	Glass
Commingled Kerbside		PET 1	3.92%	631.59	Commingled
Commingled Kerbside		HDPE 2	2.30%	370.82	Commingled
Commingled Kerbside		PVC 3	0.04%	6.25	Commingled
Commingled Kerbside		LDPE 4	0.04%	7.22	Commingled
Commingled Kerbside		PP 5	1.73%	278.11	Commingled
Commingled Kerbside		Polystyrene (not expanded) 6	0.08%	12.35	Residual
Commingled Kerbside		PS (expanded) 6	0.13%	21.09	Residual
Commingled Kerbside		Other 7	0.01%	1.25	Commingled
Commingled Kerbside		Rigid Plastic Not Bottle/Container	2.06%	330.99	Residual
Commingled Kerbside		Plastic Films	1.16%	186.24	Residual
Commingled Kerbside		Steel Cans	1.75%	282.42	Commingled
Commingled Kerbside		Steel Aerosol	0.21%	34.42	Commingled
Commingled Kerbside		Pots/Pans	0.14%	22.20	Hard / Alternative
Commingled Kerbside		Other Metals	0.95%	153.77	Commingled
Commingled Kerbside		Aluminium Cans	1.60%	258.27	Commingled
Commingled Kerbside		Aluminium Foil	0.04%	6.66	Commingled
Commingled Kerbside		Aluminium Aerosol	0.19%	30.25	Commingled
Commingled Kerbside		Paint	0.16%	26.51	Hard / Alternative
Commingled Kerbside		Fluorescent Tubes/Globes	0.00%	0.42	Hard / Alternative
Commingled Kerbside		Batteries	0.00%	0.69	Hard / Alternative
Commingled Kerbside		Hazardous other	0.00%	0.28	Hard / Alternative

Service	2021 total	Composition	% composition	Weight	Correct bin
Commingled Kerbside		Ceramics	0.52%	83.41	Hard / Alternative
Commingled Kerbside		Building Materials	0.65%	104.50	Hard / Alternative
Commingled Kerbside		Dirt/Rock/Inert Materials	0.05%	7.77	Hard / Alternative
Commingled Kerbside		E-Waste	0.32%	50.79	Hard / Alternative
Commingled Kerbside		Other	1.25%	200.81	Residual
Commingled Kerbside		Bagged Recycling	2.89%	466.02	Commingled
Commingled Kerbside		Bagged Garbage	6.80%	1,094.69	Residual
Commingled Kerbside		Bagged Organics	0.38%	60.92	FOGO
FOGO Kerbside	13052.00	Paper	0.24%	31.32	Commingled
FOGO Kerbside		Cardboard	0.08%	10.44	Commingled
FOGO Kerbside		Liquid paperboard containers	0.00%	-	Commingled
FOGO Kerbside		Nappies/Sanitary (disposable)	0.02%	2.61	Residual
FOGO Kerbside		Soiled Paper/Paper Towel/Tissues	0.03%	3.92	Residual
FOGO Kerbside		Avoidable Food (Whole Foods)	2.06%	268.87	FOGO
FOGO Kerbside		Unavoidable Food (Scraps)	3.55%	463.35	FOGO
FOGO Kerbside		Containerised/Packaged Food	0.05%	6.53	FOGO
FOGO Kerbside		Garden/Vegetation	91.24%	11,908.64	FOGO
FOGO Kerbside		Other Putrescible	0.40%	52.21	FOGO
FOGO Kerbside		Wood/ timber	0.21%	27.41	FOGO
FOGO Kerbside		Clothing/Textile/Rags	0.07%	9.14	Hard / Alternative
FOGO Kerbside		Glass Non-CDS/Wine/Spirit/Jar/Sauce	0.00%	-	Glass
FOGO Kerbside		Glass CDS/Other Drink Only	0.00%	-	Glass
FOGO Kerbside		Glass - Other (Pyrex etc.)	0.00%	-	Glass
FOGO Kerbside		Glass fines (non-recyclable)	0.00%	-	Glass
FOGO Kerbside		PET 1	0.01%	1.31	Commingled
FOGO Kerbside		HDPE 2	0.00%	-	Commingled
FOGO Kerbside		PVC 3	0.00%	-	Commingled
FOGO Kerbside		LDPE 4	0.00%	-	Commingled
FOGO Kerbside		PP 5	0.01%	1.31	Commingled
FOGO Kerbside		Polystyrene (not expanded) 6	0.00%	-	Residual
FOGO Kerbside		PS (expanded) 6	0.00%	-	Residual
FOGO Kerbside		Other 7	0.00%	-	Commingled

Service	2021 total	Composition	% composition	Weight	Correct bin
FOGO Kerbside		Rigid Plastic Not Bottle/Container	0.05%	6.53	Residual
FOGO Kerbside		Plastic Films	0.07%	9.14	Residual
FOGO Kerbside		Steel Cans	0.01%	1.31	Commingled
FOGO Kerbside		Steel Aerosol	0.00%	-	Commingled
FOGO Kerbside		Pots/Pans	0.00%	-	Hard / Alternative
FOGO Kerbside		Other Metals	0.04%	5.22	Commingled
FOGO Kerbside		Aluminium Cans	0.01%	1.31	Commingled
FOGO Kerbside		Aluminium Foil	0.01%	1.31	Commingled
FOGO Kerbside		Aluminium Aerosol	0.00%	-	Commingled
FOGO Kerbside		Paint	0.00%	-	Hard / Alternative
FOGO Kerbside		Fluorescent Tubes/Globes	0.00%	-	Hard / Alternative
FOGO Kerbside		Batteries	0.00%	-	Hard / Alternative
FOGO Kerbside		Hazardous other	0.00%	-	Hard / Alternative
FOGO Kerbside		Ceramics	0.00%	-	Hard / Alternative
FOGO Kerbside		Building Materials	0.23%	30.02	Hard / Alternative
FOGO Kerbside		Dirt/Rock/Inert Materials	0.00%	-	Hard / Alternative
FOGO Kerbside		E-Waste	0.00%	-	Hard / Alternative
FOGO Kerbside		Other	0.00%	-	Residual
FOGO Kerbside		Bagged Organics	0.13%	16.97	FOGO
FOGO Kerbside		Bagged Garbage	0.19%	24.80	Residual
FOGO Kerbside		Bagged Recycling	0.00%	-	Commingled
FOGO Kerbside		Food in Compostable Liner	0.91%	118.77	FOGO
FOGO Kerbside		Food in Non-Compostable Bag	0.37%	48.29	FOGO
Hard Waste	4,874.00	Landfill	80.90%	3,943.00	Residual
Hard Waste		Metal	11.51%	561.00	Commingled
Hard Waste		Mattresses	6.67%	325.00	Hard / Alternative
Hard Waste		E-waste / fridges	0.92%	45.00	Hard / Alternative

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