

# Turning waste into energy

Join the discussion



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# 1. Introduction

Victorians tell us they want to reduce our reliance on landfill by encouraging better ways to reduce, reuse, recycle and recover energy from waste.

As Victoria's population increases, Victoria's waste is projected to increase from 12.7 million tonnes per year to over 20 million tonnes by 2046.<sup>1</sup> The Victorian Government has a long-term plan for better managing our waste, including by supporting a viable resource recovery industry and reducing the amount of waste going to landfill.

Over the same period, our energy mix is expected to change. Victoria's energy generation sector will need to transition to accommodate new technologies such as solar, wind and waste to energy systems. And the Victorian Government has set a renewable energy target of 40 per cent by 2025,<sup>2</sup> supported by a program to procure renewable energy for the state. Over the coming decades, more of Victoria's energy needs will be met by renewable sources.

The government is considering how the waste management, energy, and other sectors will contribute to meeting Victoria's climate change targets, to reduce our emissions to 15 to 20 per cent below 2005 levels by 2020, and to net zero emissions by 2050.<sup>3</sup>

Recycling and the reuse of waste materials are already well established, helping to reduce greenhouse gas emissions from landfill and provide employment and investment opportunities for the state. Our residual waste could be better used, however, to deliver even stronger environmental and economic benefits for Victorians.

Recovering energy from waste is an established practice in some landfills and sewage treatment plants in Victoria. But there remains substantial opportunity for waste to energy to deliver improved waste and energy sector outcomes across the state.

**'Waste to energy'** is a term commonly used to describe the process of generating energy—such as electricity, heat or fuels—from waste.

This discussion paper explores the opportunities and constraints facing the waste to energy sector and

considers how these technologies can best contribute to Victoria's integrated waste and energy management systems.

## Purpose of this paper

The purpose of this paper is to start a discussion about waste to energy facilities in Victoria and to seek your feedback and ideas. This discussion will inform the Victorian Government's position on the appropriate role for waste to energy technologies in Victoria's waste and energy systems.

This paper presents a preliminary position for discussion. It's designed to help us learn more from you about the opportunities and risks associated with waste to energy facilities in Victoria. It details existing government programs that offer support, and explores some of the barriers that still face new waste to energy projects.

Following this consultation, we will develop a whole of Victorian Government position on waste to energy, intended to provide certainty for investors and communities about when waste to energy facilities will be a good fit for Victoria and when they won't be. If needed, we will identify additional actions that we will take in support of the policy position.

In this discussion we want to hear from businesses in the waste and energy industries about challenges they're experiencing in trying to establish waste to energy facilities. We want to hear from local governments about their plans for making better use of municipal waste. We want to hear from large industrial energy users, and also those that generate large volumes of waste, about the potential of 'industrial ecology' and 'closed loop' solutions. We want to hear from communities that would like to see their waste used locally to generate energy, and those that might have questions or concerns about potential environmental impacts and health risks from waste to energy facilities in their vicinity.

## Scope

This discussion paper covers all processes and technologies that recover energy or fuel through the thermal, mechanical or biological processing of solid and liquid waste.

Some technologies fall outside of the scope of this paper:

- thermal combustion of waste for disposal, or flaring of biogas from landfill, without energy recovery

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1. Sustainability Victoria (2017), *Statewide Waste and Resource Recovery Infrastructure plan Victoria 2017-2046 (amendment consultation draft)*, Sustainability Victoria, Victoria.

2. Department of Environment, Land, Water and Planning (2016) *Victoria's Climate Change Framework*. Retrieved from: [https://www.climatechange.vic.gov.au/\\_\\_data/assets/pdf\\_file/0021/55254/DELWPClimateChange\\_Framework.pdf](https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0021/55254/DELWPClimateChange_Framework.pdf)

3. *Climate Change Act 2017* (Vic) s.6 (Austl.)

- aerobic conversion of waste to create outputs, without energy recovery (for example, composting)
- bioenergy where purpose grown energy-crops (non-waste materials) are used as feedstock
- treatment of contaminated soil or other hazardous waste without energy recovery.

### Building on previous work

The Victorian Advanced Resource Recovery Initiative (VARRI) was a program delivered in 2008-11 by the Victorian Government. It explored the feasibility of advanced resource recovery technologies like waste to energy for metropolitan Melbourne. It was a comprehensive investigation that drew heavily on the expertise of the industry, governments, academia and communities.

This paper extends on the VARRI to investigate the investment conditions required for waste to energy infrastructure investment in Victoria to be a sound choice for industry. It also explores the various government programs already supporting waste to energy projects in Victoria and whether any additional support or policy development is required.

### Your opportunity to participate

We are gathering information to better understand how waste to energy technologies might contribute to Victoria's economy, environment and communities – and we want your help. That includes your views on the appropriate role for waste to energy facilities in our waste and energy systems.

The government understands there are complex issues to work through in order to maximise the benefits that waste to energy facilities could bring to Victoria. We are committed to engaging with all Victorians on these issues, and this discussion paper is an opportunity for Victorians to help shape our future work.

### How we will use your ideas

We'll use your feedback to inform a whole of Victorian Government position on waste to energy facilities in Victoria.

## 2. A preliminary position for public comment

The Victorian Government is committed to using our resources wisely, reducing our waste where we can, and recovering more value from the resources we currently throw away. With the right policy settings, we can protect our environment, support our communities and build our economy.

Recovering energy from waste can deliver positive outcomes for the community, environment and economy and is one tool for managing waste. We use the waste hierarchy as an order of preference for how waste should be managed to help us achieve the best possible environmental outcomes—waste avoidance is the best option, followed by reuse, recycling, energy recovery and disposal as a last resort.

The benefits of recovering energy from waste include net reduction of greenhouse gas emissions by reducing methane from waste in landfill, and reducing carbon dioxide from fossil fuels used in electricity generation. It also offers benefits in broadening our energy mix, with the potential to add a small amount of reliable, renewable electricity supply (depending on the type of waste used). Reduced reliance on landfill also increases public amenity through minimisation of negative impacts such as noise and odour. Waste to energy solutions could offer both state-wide and regional economic development and employment prospects.

Several federal, state and local government programs currently support waste to energy projects. That support includes direct funding or loans, investment facilitation or direct involvement in developing projects. Policy settings provide incentives for generating environmental benefits and diverting waste from landfill.

Even with that support, there are relatively few operating waste to energy facilities in Victoria, using a tiny fraction of our residual waste. There is scope for waste to energy to play a larger role.

Subject to your feedback, the Victorian Government will consider facilitating greater recovery of energy from waste where there are clear net benefits to society. This is likely to be where a waste to energy facility:

- can meet Environment Protection Authority Victoria requirements to protect air quality and soil health,<sup>4</sup> and meet minimum thermal efficiency requirements for waste to energy generation;<sup>5</sup>
- helps reduce greenhouse gas emissions;
- reduces disposal of waste to landfill;
- does not displace resource recovery options that sit higher in the waste hierarchy where they are technically and economically feasible;
- is consistent with Victoria's waste and resource recovery infrastructure plans;<sup>6</sup>
- produces reliable, renewable energy;
- has health, environmental and amenity impacts that are likely to be less than the waste and energy services it would displace;
- is cost effective, with a viable, sustainable business model to process waste feedstocks and generate energy, and potentially other, outputs; and
- creates jobs and economic development, particularly in regional areas.

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4. SEPP (Ambient Air Quality), SEPP (Air Quality Management), SEPP (Prevention and Management of Contamination of Land), SEPP (Groundwaters of Victoria), SEPP (Waters of Victoria)

5. EPA Victoria (2017a), *Guideline: Energy from waste Publication 1559.1*, EPA Victoria, Victoria

6. Sustainability Victoria (2015), *Statewide Waste and Resource Recovery Infrastructure Plan*, Sustainability Victoria, Victoria

### 3. Victoria's waste and energy systems

- Victoria's waste management system follows the waste hierarchy – reduce, reuse and recycle, then recover energy, and finally dispose of waste.
- Development of markets for recycled materials is an important way to reduce reliance on landfill and increase resource recovery.
- The Victorian Government has set renewable energy targets of 25 per cent by 2020 and 40 per cent by 2025.

#### Victoria is improving waste management and increasing resource recovery

Waste to energy facilities can play an important role in an integrated waste management system. How Victoria can encourage greater investment in waste to energy projects requires careful consideration so we maximise all environmental and economic benefits.

How waste is managed impacts our communities, environment and the broader economy. If not properly managed, waste can damage the environment and pose a threat to public health, amenity and safety. Managed well, much of our waste is a resource from which we can create value.

The Victorian Government is committed to managing waste in a way that:

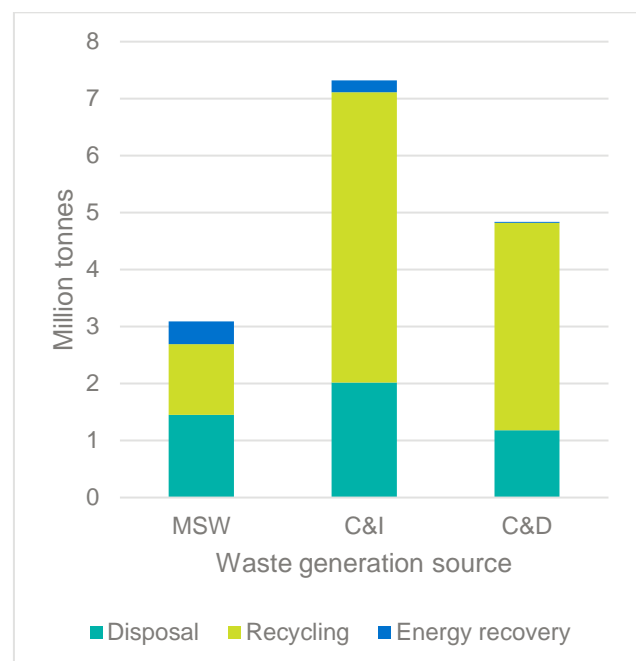
- protects the environment and human health;
- maximises the productive value of materials; and
- promotes economic growth and jobs.

Victoria's waste and resource recovery system manages more than 12.7 million tonnes of waste each year. Although we already recover over 67 per cent of our waste,<sup>7</sup> recovering more resources will reduce our environmental impact, reduce greenhouse gas emissions, create jobs and bolster our economy. Although we are recovering more resources from our waste over time, Victorians are forecast to generate over 60 per cent more waste over the next 30 years<sup>8</sup> as the state's population increases to a projected 9.5 million by 2046.<sup>9</sup>

We know we need to reduce the impacts of waste on our environment and improve resource recovery to ensure the long-term viability of the waste system. That is why the Victorian Government is also developing initiatives to drive behaviour change and reduce the generation of waste. While we will always produce some waste, managing that waste well requires strategic planning to minimise environmental harm and maximise resource recovery

To effectively manage the waste we generate, and protect human health, community amenity and our environment, the Victorian Government has developed a statewide waste and resource recovery infrastructure plan and seven regional implementation plans. This planning framework helps ensure waste is managed in a strategic, streamlined manner with the right infrastructure provided in the right place at the right time.

Figure 1: Source and fate of waste in Victoria, 2015-16



Notes: 'MSW' = municipal solid waste, 'C&I' = commercial and industrial, 'C&D' = construction and demolition  
Source: Pickin, J & Randell, P (2017)

Local governments, the waste and recycling industry, and Victorian Government agencies all work together to plan for, invest in and operate Victoria's waste and resource recovery system. That system includes almost 500 infrastructure sites, including recovery centres, transfer stations, materials recovery facilities, materials reprocessors and landfills.

7. Sustainability Victoria (2017), above, p.18

8. Sustainability Victoria (2015), *Statewide Waste and Resource Recovery Infrastructure Plan*, Sustainability Victoria, Victoria, p.16

9. Infrastructure Victoria (2016), *Victoria's 30-Year Infrastructure strategy (Dec 2016)*, Infrastructure Victoria, Victoria

Only a handful of waste to energy facilities currently operate in Victoria and only four per cent of waste is diverted to energy recovery.<sup>10</sup> Most of those use organic feedstocks to generate energy they use on site. A few Victorian waste to energy facilities export electricity to the grid or supply heat or other fuels to other energy users.

#### Victorian Government agencies responsible for waste management

##### Department of Environment, Land, Water and Planning

- Advises the government on waste and resource recovery matters.
- Develops policy and coordinates with other agencies.

##### Environment Protection Authority (Victoria)

- Regulates the waste industry to protect human health and the environment from the negative impacts of pollution and waste.
- Considers applications to build waste infrastructure in Victoria to uphold strong environmental standards.

##### Sustainability Victoria

- Coordinates planning for waste infrastructure in Victoria.
- Delivers Victorian Government strategies to increase market development for recycled materials, improve education on waste and litter issues and increase the recovery of organic materials.

##### Waste and Resource Recovery Groups

- Work collaboratively with local governments to improve waste management in each of the seven regions.
- Apply state-wide waste strategies and plans to their unique regions.

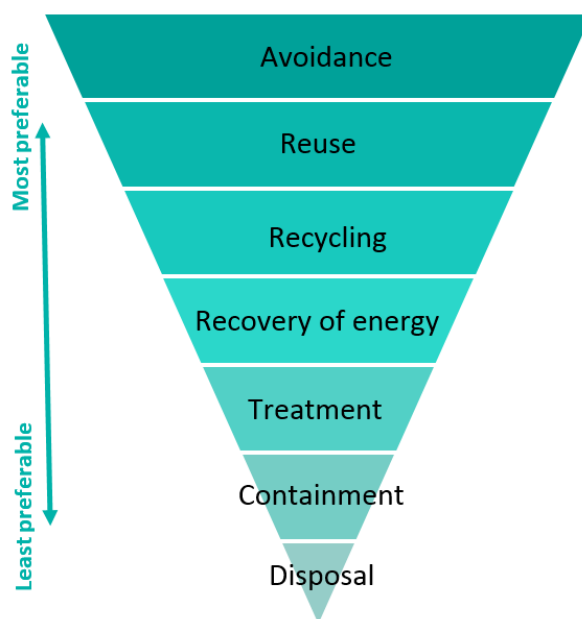
### The Waste Hierarchy

The waste hierarchy guides the efficient use of resources. The concept of a waste hierarchy is used around the world to define the order of preference for waste management activities.

The recovery of energy from waste is a lower order use below avoidance, reuse and recycling. It should only be used where higher order recovery options are not practicable, or where higher order recovery options may lead to worse outcomes for the environment or human health. For example, in remote areas higher order recovery may not be

practicable because of the small amount of recoverable waste and the benefits of recycling may be offset by the emissions generated in transporting material long distances.

Figure 2: Waste hierarchy



**Avoidance** – practices which prevent the generation of waste all together

**Reuse** – direct reuse of materials without additional processing

**Recycling** – using valuable components of waste in other processes

**Recovery of energy** – extraction of calorific value to create usable energy

**Treatment** – reduce volume or change composition to reduce hazard or nuisance

**Containment** – long-term storage of wastes requiring a high degree of control to prevent contamination

**Disposal** – deposit of materials, typically into landfill

Source: EPA Victoria (2017b)

### Current waste challenges

The Victorian Government is tackling environmental challenges and pursuing economic development opportunities by improving the way our waste and resource recovery system operates. This includes:

- reform of EPA Victoria to enable it to provide consistent and efficient regulation for industry;

10. Pickin, J & Randell, P (2017) as above.

- a ban on E-Waste (electronic waste) from landfill to increase the recovery of valuable components and decrease hazardous material going to landfill;
- an organics strategy to decrease organic waste going to landfill, helping to decrease methane gas emissions; and
- a market development strategy to stimulate industries and markets for recovered materials.

The Victorian Government is also working with federal and local governments, industry and community groups to ensure the best environmental and economic outcomes for Victorians.

### ***Reducing our reliance on landfills for disposal***

While landfills are a critical part of Victoria's waste and resource recovery system, our goal is to limit their use to only manage 'residual waste,' after options that are higher on the waste hierarchy have been exhausted.

Victoria's landfills received 33 per cent — or 4.2 million tonnes of residual waste in 2015-2016.<sup>11</sup> Victoria is exploring ways to better manage that waste, and extract value where we can. This includes considering alternative solutions like waste to energy, which has the potential to deliver better environmental and economic outcomes than landfilling.

### ***Improving recovery of priority waste materials***

Many materials managed by Victoria's waste and resource recovery system have high recovery rates and well-developed end markets, such as paper and metals. The recovery of other materials, such as organic waste (particularly food waste) and flexible plastics remains comparatively low.<sup>12</sup> For example, in 2015-2016 about 2.48 million tonnes of organic waste was generated by Victorian businesses, households and industry. Approximately 1.45 million tonnes of this organic waste ended up in landfill, representing an estimated loss to the economy of \$30 million dollars.<sup>13</sup>

Through programs and funding, Sustainability Victoria is supporting the development of markets for

recovered organic material. Other programs include the Waste to Energy Infrastructure Fund and the Resource Recovery Infrastructure Fund. While the outcomes of this work will partly depend on the market conditions for these commodities, market development activities by government can assist in reducing material going to landfill and provide economic and employment opportunities for Victoria.

## **Victoria is increasing its use of renewable energy**

Waste to energy facilities can support Victoria's energy transition by providing a small amount of distributed, reliable, partly renewable energy. Waste to energy generation is considered 'renewable energy' where organic waste (biomass) is used as the feedstock.

Victoria's energy system is a network of publicly and privately-owned infrastructure that generates, stores and distributes energy to Victorian households and businesses. Victoria is home to substantial brown coal deposits in the Latrobe Valley, and coal-fired electricity generation has been the dominant source of Victorian generation for decades.

Energy systems around the world are transforming, driven by rapid development of technologies, changing consumer behaviour, and global demands to reduce the risk of climate change. The Victorian Government has set renewable energy targets of 25 per cent by 2020 and 40 per cent by 2025.

By legislating these renewable energy targets, Victoria is providing industry with the certainty and confidence to invest in renewable energy projects. These targets will be supported by a competitive reverse auction scheme, which will enable renewable energy developers to bid for long term contracts.

The first auction for up to 650 MW of renewable energy capacity will provide enough electricity to power 389,000 households – or enough energy to power Geelong, Ballarat, Bendigo and the Latrobe Valley combined. This is expected to bring forward up to \$1.3 billion of investment, create 1,250 construction jobs over two years and 90 ongoing jobs.

This is vital to diversifying the state's energy supply, with Victoria a vital hub within the National Electricity Market. The mix of new renewables combined with emerging technologies and innovative business models, will provide a strong platform to meet the

11. Sustainability Victoria (2017), above, p.18

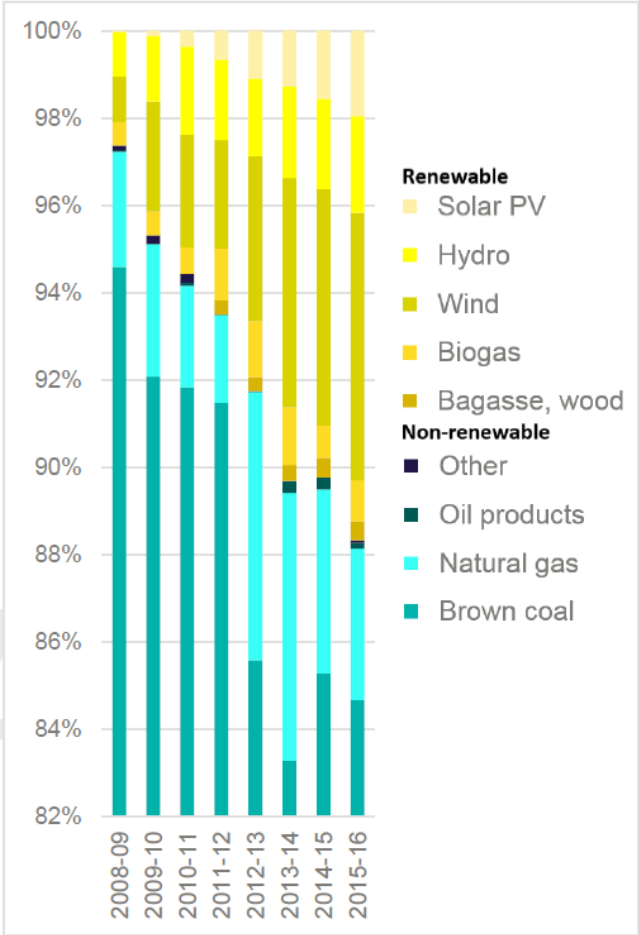
12. Pickin J and Randell P (2017), *Australian National Waste Report 2016*, Blue Environment and Department of the Environment and Energy, Melbourne, p. 62-65. Retrieved from: <http://www.environment.gov.au/protection/national-waste-policy/national-waste-reports/national-waste-report-2016>

13. Sustainability Victoria (2015), above, p.41

future needs of our fast-growing State. This will also deliver a low carbon future for the State – the VRET Scheme is expected to drive a 16 per cent reduction in Victoria’s electricity sector greenhouse gas emissions between 2019/20 and 2034-35.

Waste to energy facilities can add a small volume of supply, and improve both the reliability and diversity of Victoria’s energy mix. For example, mass combustion waste to energy facilities provide reliable, dispatchable electricity. On-site generation and consumption can reduce demand from the electricity and gas grids.

**Figure 3: Electricity generation composition in Victoria 2008-09 to 2015-16**



Source: Department of Environment and Energy (2017a)

## 4. About waste to energy

- There are two main categories of waste to energy facilities: thermal and biological.
- Waste to energy technologies also produce residual outputs such as digestate from biological treatment of organic waste or ash from thermal processing. Some of these products have value, others must be disposed of in landfill.
- Before receiving a licence in Victoria, all waste to energy facilities must demonstrate they can meet strict environment protection standards.

processing of organic waste. The main technologies for each are described in more detail in Table 1 and Appendix A.

The various technologies have many applications, and no two facilities may be quite alike. While there are only a few technology types at work, each facility will be tailored to the feedstock it uses and the outputs it produces. This section discusses some typical models for waste to energy facilities that we might see in Victoria.

Our definition of waste to energy includes gas capture and combustion at landfills. However, those facilities are not a focus of this paper. Energy generation from landfill gas is a mature technology that is common practice in Victoria.

### Types of waste to energy facilities

Waste to energy technologies fall into two broad categories: thermal treatments and the biological

**Table 1: Summary table of waste to energy technologies**

Technology	Feedstocks	Outputs	Residues
Combustion	Mixed residual MSW, mixed C&I and C&D wastes, refuse derived fuels (eg. Pellets manufactured from residual materials)	Heat, electricity, (Bottom ash residues may in some circumstances have value as road base or as an additive in building blocks)	Bottom ash, fly ash, air pollution control residues, metals
Gasification	Typically refuse derived fuel (RDF) prepared from mixed residual MSW, mixed C&I and C&D wastes, organic waste	Heat, electricity, syngas, (see above re Bottom ash)	Bottom ash, air pollution control residues
Pyrolysis	Homogenous feedstocks from sorted C&I + C&D waste (eg. wood, tyres), sorted residual MSW (eg. plastics), organic waste	Syngas, biochar (when biomass used as feedstock), pyrolysis oil to make liquid fuels	Air pollution control residues
Mechanical Biological Treatment	Residual MSW, C&I waste, organic waste	Biogas, electricity, refuse derived fuels, separated recyclables (eg. plastics, paper, glass, metals), compost-like material – depending on technology configuration that is adopted	Process water, air pollution control residues, inert materials and residual materials that have no economic value
Anaerobic Digestion	Biosolids, food waste, green waste, crop residues	Digestate, compost, heat, electricity, biogas	Liquid residues, wastewater, inert and non-compostable material, contaminants (e.g. plastics)
Fermentation	Organic waste high in sugar (eg. corn, beetroot, sugarcane crop waste)	Alcohols (eg. ethanol for fuel), digestate	Liquid residues, wastewater

### Large scale combustion plant (thermal)

A larger scale waste to energy plant is likely to use combustion to process municipal solid waste (MSW). It could process very large volumes of waste and generate significant quantities of energy. Some could also accept commercial and industrial (C&I) and construction and demolition (C&D) waste.

Figure 4: Large combustion plant



*The Amager Bakke combustion plant in Copenhagen will treat around 400,000 tonnes of waste annually produced by 500,000 – 700,000 inhabitants and at least 46,000 companies. By 2017, it will supply a minimum of 50,000 households with electricity and 120,000 households with district heating.<sup>14</sup>*

This type of plant would charge a gate fee to local governments and waste generators to take their residual waste, and sell the electricity produced to the grid. Projects at this scale would need to enter into long-term contracts to secure a reliable supply of waste feedstock. Waste is combusted, generating heat and steam to power turbines. Additional revenues can be achieved in waste to energy facilities that capture both heat and electricity. For example, in some European waste to energy facilities that are located next to large residential populations, heat is distributed through district heating systems. In Australia, heat may be more likely used by industry for manufacturing processes or could be turned into cooling for residential or commercial use.

14. Babcock & Wilcox Volund A/S (n.d), ARC, Copenhill / Amager Bakke, Copenhagen, Denmark. Retrieved from: [http://www.volund.dk/Waste\\_to\\_Energy/References/ARC\\_Amager\\_Bakke\\_Copenhagen](http://www.volund.dk/Waste_to_Energy/References/ARC_Amager_Bakke_Copenhagen)

The residual ashes are usually disposed to landfill, unless the facility can reprocess those outputs into new products, such as bricks for construction.

A large combustion plant may cost hundreds of millions of dollars to build, create hundreds of construction jobs and dozens of ongoing jobs.

### Anaerobic digestion plant (biological)

Anaerobic digesters process organic waste with high moisture content in a sealed oxygen-free environment. Good waste feedstocks for this technology include food waste, manures from farms, or sewage sludge. This kind of waste to energy produces biogas that can be used directly, in place of natural gas, or it can be used to produce electricity.

This type of plant, like a combustion model, can charge a fee to take waste and, at a suitable scale, sell electricity to the grid. With appropriate approvals, it might also further process the digestate that remains after biogas has been produced and sell it as a fertiliser or soil conditioner.

### Case Study: Yarra Valley Water Waste to Energy Facility

In June 2017, the Minister for Water Lisa Neville officially opened the \$27 million Yarra Valley Water Waste to Energy facility in Wollert. This facility is sited next to an existing Yarra Valley Water sewage treatment plant and generates enough biogas, through the digestion of organic waste, to run both sites with surplus energy exported to the grid. The site has capacity to process up to 33,000 tonnes of organic waste each year, or approximately 100 tonnes per day.

<sup>15</sup>

**Source:** Yarra Valley Water (2017)

### Precinct solutions (thermal or biological)

A waste to energy facility could meet the needs of a local community for local waste management solutions and energy generation.

15. - Yarra Valley Water (2017), *Waste to energy facility*. Retrieved from: [www.yvw.com.au/about-us/major-projects/waste-energy-facility/](http://www.yvw.com.au/about-us/major-projects/waste-energy-facility/); and - Media release (August 2017): The Hon Lisa Neville MP, *New Waste to Energy Plant*. Retrieved from: [www.premier.vic.gov.au/new-waste-to-energy-water-plant/](http://www.premier.vic.gov.au/new-waste-to-energy-water-plant/)

Some local governments in Victoria are investigating facilities that could handle their own residual waste in a smaller scale combustion plant. They could potentially use the electricity produced for council infrastructure like municipal offices and the heat energy for infrastructure like swimming pools.

In this model, the local government would reduce the costs of sending its waste to landfill and reduce its energy bills. The local government may also use the arrangement to attract new businesses to the area with the offer of discounted energy. The capital expenditure for such a facility is likely to be substantial.

### **Closed-loop industrial site (thermal or biological)**

Where an existing industrial facility produces large volumes of a homogenous waste, and also has a substantial energy demand, an on-site waste to energy facility may be an attractive option to reduce operating costs. Several Victorian companies have installed or are considering waste to energy projects that consume the waste they produce to generate energy that is used on site.

Decisions about scale and technology type will depend on the nature of the industrial site and the waste it generates. A food manufacturing plant could use organic waste in an anaerobic digestion plant to generate biogas that could be used in place of either gas or electricity from the grid.

A small-scale facility could have a relatively short payback period of less than five years, as it reduces the costs of both waste management (transport and disposal) and energy purchase. In an environment of rising energy prices, some businesses may be attracted to an option that provides reliable power at predictable cost.

### **Feedstock**

A wide variety of waste feedstocks can be used in waste to energy facilities, though some technologies are suited to particular feedstocks.

- Organic waste material with high moisture content is particularly suited to biological processes, including anaerobic digestion (eg manure).
- Mixed waste streams such as residual municipal solid waste is often processed using combustion.
- Homogenous and uncontaminated feedstocks (eg tyres) are best suited to advanced thermal technologies such as gasification and pyrolysis.

Many advanced thermal technologies are capable of using Refuse Derived Fuels (RDF). RDF are the

combustible components of certain wastes, such as non-recyclable plastics or papers labels, and other materials.

This material is separated then shredded into a uniform grain size, to produce a homogenous material which can be used as substitute for fossil fuels in cement plants, lime plants and coal fired power plants.

Technology choice for a facility therefore strongly influences options for feedstocks. In turn, choices about feedstocks and how they are pre-sorted or processed will determine the efficiency of the plant, and the nature of its outputs.

### **Energy and materials outputs**

Waste to energy facilities can produce a variety of energy outputs. Common forms of energy generated include heat, steam, biogas, synthetic gas or oil which can be further transformed into other usable forms of energy such as electricity and fuel. More information about the different technologies and their outputs is at Attachment A.

This conversion process also reduces the solid volume of waste feedstock and can produce residues such as:

- bottom ash, or air pollution control residues such as fly ash, from combustion or gasification;
- char from pyrolysis;
- digestate and water from anaerobic digestion; and
- slag from gasification.

It is possible to recycle some of these residues to generate extra value from the waste and improve the financial viability of the facility. For example, bottom ash may be used in construction or engineering products and residual metals can be readily recycled. However, environmental regulators must assess the safety of those uses before they can be permitted. In many cases, there will be a need to establish end-markets for the products. In the absence of developed markets, the residual outputs may end up in landfill. In some cases, residues may require careful and sometimes costly management.<sup>16</sup>

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16. Department of Environment, Food and Rural Affairs (2013), *Energy from Waste – A guide to the debate*. Retrieved from: [www.defra.gov.uk/publications/2013/02/27/pb13892-energy-from-waste/](http://www.defra.gov.uk/publications/2013/02/27/pb13892-energy-from-waste/) on 1 August 2017, p35

## Environmental protections

Before the EPA will grant a works approval for proposed waste to energy facilities in Victoria, the project developers must demonstrate that they will incorporate best practice measures for the protection of the land, air and water environments, as well as for energy efficiency and greenhouse gas emissions management. They must provide evidence of how they will minimise and manage emissions including pollutants, odour, dust, litter, noise and residual waste.<sup>17</sup>

Some residues from waste to energy facilities are hazardous and cannot be recycled. These residues may need further treatment before being safely used or disposed of or they may need to be deposited in a specialised landfill that takes hazardous waste.

Question 1. What is the appropriate role for waste to energy in Victoria's waste and energy sectors?

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17. EPA Victoria (2017a), above.

## 5. Waste to energy in Victoria: opportunities and risks

- Waste to energy facilities offer opportunities to reduce greenhouse gas emissions, reduce reliance on landfill, and reduce fossil fuel demand by providing an alternative fuel source.
- Waste to energy technology can extract additional value (in the form of energy) from waste and create economic and employment opportunities.
- The production of energy from waste also helps to diversify our generation mix.
- Waste to energy is not without its risks. The diversion of waste away from higher order recovery such as recycling, as well as pollution risks must be addressed.

Several waste to energy plants already operate in Victoria, usually using organic material as feedstock. For example, Australian Tartaric Products have installed a system using grape waste to reduce power bills. This feedstock from nearby wineries would otherwise have gone to landfill. The Visy waste to energy plant at Coolaroo makes use of its own paper sludge to generate heat and power to operate its papermill.

### Waste to energy opportunities

Generating energy from waste offers a range of opportunities for Victoria. It could help us make better use of our residual waste by generating a valuable product – energy. It could reduce greenhouse gas emissions and help Victoria achieve its emissions reduction targets. And it could help Victoria achieve its renewable energy targets.

Investment in waste to energy can increase economic development and jobs across the state, including in regional areas.

### Increase the recovery of resources

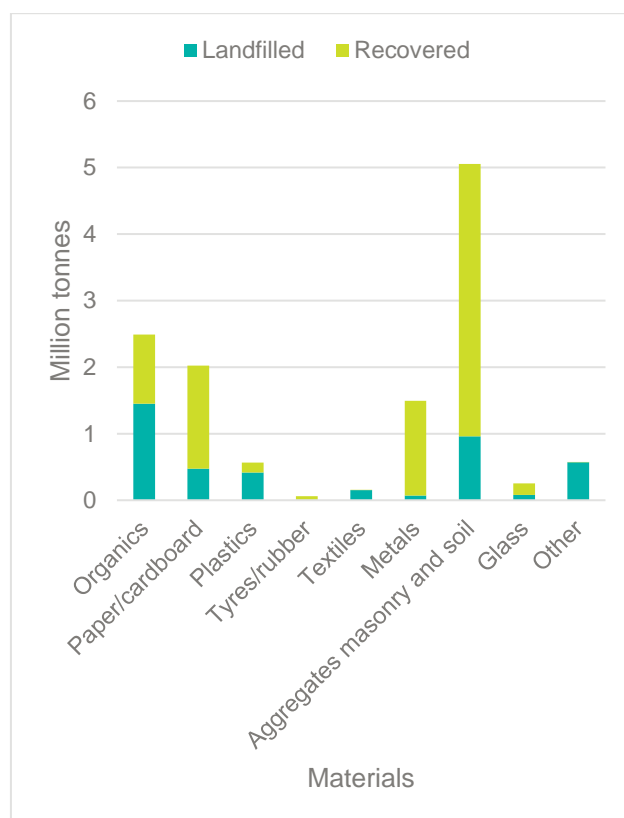
Waste to energy technologies offer opportunities to extract more value from residual wastes that cannot be reused or recycled and would otherwise be landfilled.

Diverting waste material from landfill to energy generation would increase our resource recovery rate from the current level of 67 per cent. Over four million tonnes of residual waste are landfilled

each year. The largest component - 35 per cent<sup>18</sup> - of this residual waste is organic matter. for

Both biological and thermal waste to energy facilities could divert organic waste from landfill and recover a portion of the calorific value of the waste to create energy outputs. The solid residues that remain could potentially be further reused and recycled. For example, digestate from anaerobic digestion processes could be further transformed into soil conditioner or fertiliser.

Figure 5: Composition of Victorian waste in 2015-16



Source: Sustainability Victoria (2017), p.61

### Reduce greenhouse gas emissions

The Victorian Government's commitment to reduce emissions by 15 to 20 per cent below 2005 levels by 2020 and to net zero by 2050 will require all sectors of the Victorian economy to identify emission reduction opportunities.

18. Sustainability Victoria, Waste Projection Model accessed via <http://www.sustainability.vic.gov.au/services-and-advice/business/investment-facilitation-service/waste-data-portal/waste-projection-model> on 23 July 2017

Waste to energy facilities could help reduce greenhouse gas emissions from the waste sector by diverting organic waste from landfills. They could also reduce emissions from the energy sector by displacing some energy derived from fossil fuels with energy derived from organic sources. In 2015, the Clean Energy Finance Corporation (CEFC) estimated that waste to energy and bioenergy projects combined could help avoid 9 million tonnes of CO<sub>2</sub>-e Australia-wide, each year by 2020.<sup>19</sup>

It can be difficult to estimate the emissions reductions that a waste to energy facility might achieve because it depends on what would have happened in the absence of the facility. The net impact on emissions of a facility is:

- the direct emissions from the waste to energy facility
- plus emissions from transporting waste feedstocks to the site and residual outputs to landfill
- minus any avoided emissions from not producing energy with fossil fuels
- minus the avoided transport and decomposition emissions from landfill.

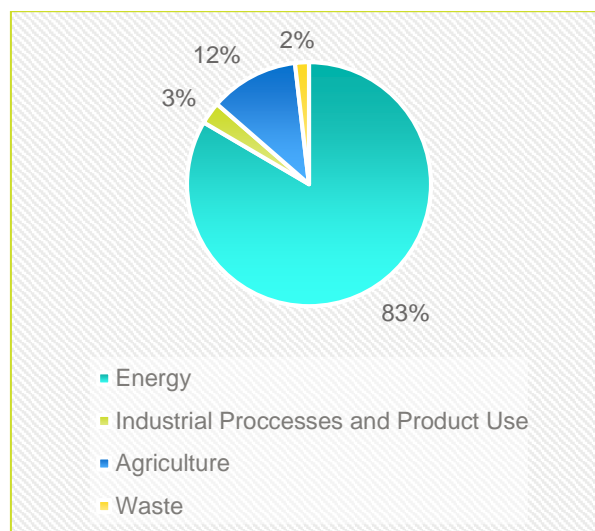
Each facility will have a different emissions outcome. While it is likely that most waste to energy facilities will provide a net emissions reduction, it will not necessarily be true in all cases. For example, avoided emissions from landfill decomposition will be lower where the landfill captures and combusts those emissions. Further, transporting waste to a facility can generate substantial emissions which should be considered when developing a project proposal. More localised solutions could provide a greater benefit.

### Reducing waste sector emissions

The waste sector generates greenhouse gas emissions from the disposal of waste to land and through the collection, sorting, transporting, processing and reprocessing of waste and recovered resources. The management of waste nationally generates about 12 million tonnes of CO<sub>2</sub>-e per year, accounting for 2 per cent of Australia's greenhouse gases.<sup>20</sup> That includes emissions from landfilling, wastewater treatment, waste incineration

and biological treatments of solid waste, like composting. Victoria's landfills emit about 1.6 million tonnes of greenhouse gases per year<sup>21</sup>, which is about two thirds of the state's waste sector emissions.

**Figure 6: Victorian emissions in 2015**



**Note:** Sector categories defined as per Kyoto accounting requirements

**Source:** State and Territory Greenhouse Gas Inventories 2015 – Australia's National Greenhouse Accounts

Organic waste in landfill accounts for close to two per cent of Victoria's greenhouse gas emissions. Most emissions from the waste sector are methane,<sup>22</sup> which is largely caused by the breakdown of organic waste in landfills and from wastewater treatment.

Therefore, greenhouse gas emissions from waste could be reduced by diverting more organic waste from landfill.

Better options for managing organic waste include composting or combustion. Alternatively, organic waste can be processed through an anaerobic digestion facility where a methane-rich biogas is generated and captured within enclosed vessels. This can then be combusted to produce energy. It is important to control fugitive emissions of methane from anaerobic digestion facilities that may arise through leaks in pipework or faulty seals.

19. Clean Energy Finance Corporation (2015), *The Australian bioenergy and energy from waste market* November 2015, CEFC, Sydney, p6

20. Department of Environment and Energy (2016), *Quarterly Update of Australia's National Greenhouse Gas Inventory: June 2016*, Commonwealth of Australia 2016

21. Department of Environment and Energy (2015), *Australian National Greenhouse Gas Accounts – State and Territory Greenhouse Gas Inventories 2015*, Table 3

22. Sustainability Victoria (2015), above, p.22

The waste sector is one of the only sectors of the economy to have reduced emissions over the past 25 years, largely due to increased combustion of landfill gas.<sup>23</sup> Waste to energy plants offer an opportunity to further reduce greenhouse gas emissions.

### Reducing energy sector emissions

Fossil fuels such as coal and natural gas currently provide about three quarters of Victoria's energy generation capacity.<sup>24</sup> Fossil fuel energy generation produces carbon dioxide, and is the largest contributor to Australia's greenhouse gas emissions. Burning fossil fuels also produces air pollutants such as carbon monoxide, sulphur dioxide and nitrogen oxides.<sup>25</sup>

Waste to energy facilities also emit greenhouse gases, but are generally less emissions-intensive than fossil fuel generation. Figure 7 compares the emissions intensity of energy generation from different technologies and feedstocks over the lifecycle of the plants. Energy produced from organic waste —biogas or biomass — is substantially less emissions-intensive than coal, diesel or natural gas generation.

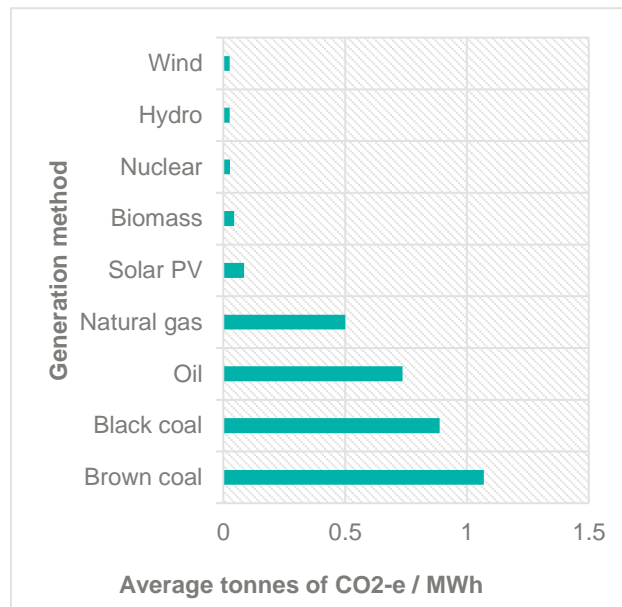
### Reduce reliance on landfills and prolonged landfill capacity

There are dozens of landfills currently operating in Victoria.<sup>26</sup> These landfills are projected to provide sufficient capacity ('airspace') to manage Victoria's residual waste over the next 10 years on current projections. However, detailed regional analysis indicates there may be shortages in some areas which could be addressed through planned expansions of existing landfills rather than new landfills.<sup>27</sup>

Landfills will remain a critical component of Victoria's waste management system, but are expected to decline in the long term as we develop new and better ways to avoid waste and recover materials for

reuse. Waste to energy presents opportunities to reduce the need for new landfills and retain existing airspace capacity for contingencies and unrecoverable materials into the future.

**Figure 7: Comparison of lifecycle greenhouse gas emission intensities across electricity generation methods**



Source: World Nuclear Association (2011)

Reducing our reliance on landfill addresses a number of environmental, amenity and economic issues as well. Reducing organic waste going to landfill reduces greenhouse gas emissions. It also decreases traffic, odour and noise for populations living close to these sites.

Using higher order recovery methods, including waste to energy technology for residual wastes, addresses the economic issue of waste being a lost resource. The cost of landfill is not just the cost of the land and the machinery and staff needed to operate it, but also the opportunity cost to recover value from waste. Higher order recovery also reduces the adverse impacts of landfill such as groundwater contamination, leachate escape, vermin and odour. The price charged by landfills for accepting waste does not always capture the full range of economic and social costs associated with landfill.

### Economic and regional development

In its 2015 Market Report *Bioenergy and energy from waste*, the CEFC identified an opportunity for up to \$5 billion of new investment between now and 2020 in Australia's bioenergy and energy from waste

23. Department of Environment and Energy (2015) above, Table 5

24. Australian Energy Market Operator (2017), Generation Information Page. Retrieved from: <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information>

25. Environment Protection Authority (2011), Australian Greenhouse Gas Calculator. Retrieved from: [http://www.epa.vic.gov.au/agc/r\\_cc\\_causes.html#!/](http://www.epa.vic.gov.au/agc/r_cc_causes.html#!/)

26. Sustainability Victoria (2017), above, p.115

27. Sustainability Victoria (2017), above, p.119

sector. This includes up to \$3.3 billion in investment for energy from urban waste streams.<sup>28</sup>

Building waste to energy facilities is likely to create jobs – initially for construction, and then to support facilities' operations. This includes jobs in environmental monitoring, facility design, commissioning and procurement, manufacturing, installation, project management, transport and delivery, and operations and maintenance.

Local waste to energy projects, that are located close to the source of feedstock, also offer regional development and employment opportunities throughout Victoria.

Residual waste sent to landfills across Victoria is transported up to 120 kilometres from the point of generation to the point of disposal.<sup>29</sup> Many materials are transported further than this for recycling. The cost of transportation can add significantly to the disposal cost of waste. Waste to energy facilities that use local, precinct-sourced or on-site waste streams offer opportunities to reduce the transport distances for waste in Victoria. Exploring options for recovering local waste to feed regional waste to energy facilities could prove cost effective in some circumstances.

### Creating value from challenging waste streams

Waste to energy technologies offer opportunities for recovery of problem wastes that cause environmental issues when disposed of in landfill, or for which recycling or recovery is difficult. For example, agricultural waste, slurries from wastewater facilities and municipal or industrial wastewater are all potential waste to energy feedstocks.

Less mature waste to energy technologies like pyrolysis and plasma gasification may be used to process specific feedstocks that are challenging to recover. The most common example identified is tyres. While some tyres are shredded and re-used for such things as road and playground base, many are still shredded and sent to landfill and many others are stockpiled whole. Sustainability Victoria, in collaboration with industry and other states and territories is working to build markets for recovered tyres, so that more can be reused in projects such as road building and civil construction. If the supply

of waste tyres exceeds the potential for recycling it could be desirable to recover energy from the remainder.

### Supplementing Victoria's energy mix

Waste to energy facilities can supplement Victoria's energy generation capacity. They would also increase the diversity of our energy mix, contributing in a small way to increased energy security for the state.

Waste to energy generation is considered 'renewable energy' to the extent that organic waste (biomass) is used as feedstock. On the other hand, waste to energy using plastic waste is the same as using fossil fuel, as plastic is made from oil.

The CEFC estimates that waste to energy and bioenergy technologies contribute about 0.9 per cent of national electricity output. This is below the OECD average of 2.4 per cent.<sup>30</sup> The CEFC contends that energy from waste could meet up to 2 per cent of Australia's electricity demands.<sup>31</sup>

Rising prices for gas and electricity have led to substantially increased interest from industry in waste to energy solutions. More businesses are considering how they might use their own or local waste in a facility on site to reduce energy costs behind the meter. This is partly because two-thirds of the gas we produce is being exported overseas.

### Waste to energy risks

While the generation of energy from waste provides a range of opportunities for all Victorians, it is not without some risks. Air pollution, ground contamination and biosecurity, as well as diverting waste from better recovery options are valid concerns that warrant careful consideration and planning.

### Facilities may stimulate waste generation or undermine resource recovery

The objective of generating energy from waste should not compromise objectives of best practice waste management. Waste to energy options are near the bottom of the waste hierarchy and far less desirable in most cases than reducing our waste, reusing it or recycling it.

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28. Clean Energy Finance Corporation (2016), Energy from waste in Australia: a state-by-state update, November 2016, CEFC, Sydney, p4

29. Sustainability Victoria (2015), above, p. 72

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30. Clean Energy Finance Corporation (2015), above, p.3

31. Clean Energy Finance Corporation (2016), above, p.5

Waste to energy provides a useful means of recovering value from waste materials that cannot otherwise be recovered. However, it is important that use of waste to energy does not undermine waste minimisation. We need to ensure that demand for feedstocks for waste to energy facilities does not create perverse incentives to create additional waste.

For example, businesses with their own on-site waste to energy facilities may relax their waste reduction efforts when that waste is feeding energy production that reduces their reliance on the grid and reduces their energy costs. There is also risk in having the wrong mix of waste to energy facilities in Victoria. If we have too many, or at too large a scale, would that stimulate greater waste generation?

As the population of Melbourne grows over coming years waste volumes are also projected to grow. We must ensure that waste to energy facilities do not undermine our efforts to avoid, reuse or recycle this waste.

**Question 2.** Is there a limit to the scale of waste to energy projects Victoria can or should support?

Waste feedstocks should not be diverted away from reuse or recycling. In most cases, there is greater environmental and economic benefit to be gained by sorting mixed waste streams to separate out valuable materials and recycle them, rather than using the unsorted stream to produce energy. Without a careful approach, encouraging waste to energy may undermine more valuable resource recovery alternatives. This risk increases as the scale of the project and the length of supply contracts increases, because a large plant could 'lock out' emerging reuse and recycling options.

**Question 3.** How can we ensure our reuse and recovery objectives are balanced against the need for business certainty to invest in waste to energy facilities over time?

### Air pollution risks

One concern about waste to energy facilities is the environmental and health risks these technologies may pose.

Thermal waste to energy facilities can generate air pollutants. These emissions need to be carefully managed and treated to remove furans (a toxic

chemical), dioxins, acid gases, heavy metals and particulate matter,<sup>32</sup> which can be toxic to humans. <sup>33</sup>Residues from the air pollution control systems are often classified as hazardous waste and need to be treated and disposed of safely.<sup>34</sup> Depending on the type of technology used, waste water from the facilities may also need careful treatment and disposal. In some cases, air pollution control residues can be treated and then partially recycled.<sup>35</sup>

Modern waste to energy facilities overseas operate within strict emissions standards, providing they are equipped with best-practice air pollution control and monitoring systems.<sup>36</sup> Several cities have such facilities in close proximity to residential populations or close to the central business district.

Emissions monitoring is a necessary prerequisite for EPA Victoria works approvals and licenses for operation. In some cases, continuous emissions monitoring is required to demonstrate that a waste to energy facility is in full compliance with emissions limits. For smaller scale facilities, especially those using homogenous feedstocks, a regular testing program, combined with annual report is required. These requirements ensure that waste to energy facilities produce only small volumes of potentially harmful emissions when compared with other sources, such as industrial activity, transport and fossil fuel electricity generation.<sup>37</sup>

### Land contamination and biosecurity risks

Biological processes such as anaerobic digestion and fermentation produce digestate as a residual output. This output could potentially be used to create soil conditioner or fertiliser, subject to regulatory approval.

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32. WSP Environmental Limited (2013), Waste Technologies: Waste to Energy Facilities – a report for the strategic waste infrastructure planning SWIP working group, commissioned by the government of Western Australia, Department of Environment and Conservation, p.32
  33. Waste Management Association of Australia (2016), Australian Energy from Waste Glossary, WMAA, Burwood NSW
  34. Clapham, P (2016) Energy from waste in the context of metropolitan Melbourne – final discussion paper, Arcadis, Melbourne, p.38
  35. ISWA Working Group on Thermal Treatment of Waste (2008), Management of APC residues from W-t-E plants, The International Solid Waste Association, Denmark
  36. Environment Protection Authority and Waste Authority (2013), Environmental and health performance of waste to energy technologies – advice of the EPA to the Minister for environment under Section 16(e) of the Environment Protection Act 1986, p.iv.
  37. -Environment Protection Authority and Waste Authority (2013), above, p.16; and  
-Energy from Waste Research and Technology Council (2017), Air Quality. Retrieved from: <http://www.wtert.co.uk/public-health/air-quality> on 1 June 2017

The source and sorting of waste feedstocks determines the nature of the outputs. Using source-separated organic materials as feedstock for a waste to energy facility will usually result in outputs better suited to producing fertiliser or compost. Using the sorted organic fractions of residual municipal solid waste will likely produce highly contaminated outputs that are suitable only for landfill.<sup>38</sup>

The appropriate end-use of digestate will depend on the nature of the feedstock and the management of the facility to prevent contamination of outputs.

In the United Kingdom, quality specifications have been developed for the collection, storage, transport and re-use of digestate.<sup>39</sup> Digestate produced from farm wastes or source-separated organic waste must be treated in accordance with these standards before being applied to agricultural land. While this creates opportunities for additional revenue streams for biological waste to energy facilities, the additional cost associated with obtaining and maintaining certification has been viewed as a barrier to the development of end-markets for digestate.<sup>40</sup>

In Australia, there are no standards or guidelines for the use of digestate, although most states have guidelines for compost, biosolids and the application of processed organic wastes to land. Under Victoria's organics strategy, the EPA is investigating the risk profiles and benefits of applying waste to land or using it as compost. International guidelines<sup>41</sup> also inform our understanding of best practice approaches and help the EPA to work with facilities to protect Victorian communities and environment.

The transport of unprocessed organic waste around Victoria may also pose biosecurity risks due to the potential spread of pests or plant diseases. EPA examines these risks in assessing applications for waste to energy facilities. Where a potential risk is identified, the risk, and its planned mitigation factors

are further examined by biosecurity experts to ensure safety.

### Amenity Risks

Like all waste management and treatment facilities, a waste to energy facility may impact upon the local community. Depending on the type of feedstock and the treatment methods used, odour, noise, local transport congestion and even dust and vermin can possibly be issues.

However, a number of waste to energy facilities in Europe operate successfully within populated areas with minimal disruption to the surrounding population. Most notable of these is the Issy-les-Moulineaux facility in Paris.

#### Case study: Isseane Facility at Issey-Les-Moulineaux

The Isseane waste to energy facility uses combustion technology to process 460,000 tonnes of waste a year. This is equivalent to just under four per cent of Melbourne's total waste generation.

The facility is located a few kilometres away from the Eiffel Tower in a densely-populated suburb of Paris. It provides district heating to 80,000 households and electricity to power the plant, with excess electricity exported to the grid.

The Isseane facility was designed to visually integrate with the surrounding urban environment. Partially underground, the 52m high building (equivalent to six stories) only protrudes to a height of 21 metres. Designers also used short stacks that are not visible from ground level. Vegetation and modern architectural form is used on the building's façade.

The building's design also assists in amenity protection for surrounding neighbours. The subterranean part of the building reduces noise and odours as trucks bring waste in through access tunnels to an underground waste receiving area.

Incorporating several stages of flue gas treatment, the plant outperforms strict European Union and local directives in relation to emissions and environmental protection standards.



Source: Hitachi Zosen INOVA (2014), Ennovia (2017).

38. Clapham, P (2016) above, p.26-27

39. The British Standards Institution (2014), PAS110:2014 Specification for whole digestate, separated liquor and separated fibre derived from the anaerobic digestion of source-segregated biodegradable materials, BSI Standards Limited, United Kingdom

40. Ricardo-AEA Ltd (2013), Waste to Energy Background Paper – report for Zero Waste SA, United Kingdom, p.44

41. Al Seadi, Teodorita and Lukehurst, Clare (2012) Quality management of digestate from biogas plants used as fertiliser, IEA Bioenergy. Retrieved from: [https://www.iea-biogas.net/files/daten-redaktion/download/publi-task37/digestate\\_quality\\_web\\_new.pdf](https://www.iea-biogas.net/files/daten-redaktion/download/publi-task37/digestate_quality_web_new.pdf)

## 6. Victoria already supports waste to energy

- Several federal and state initiatives provide funding support for waste to energy developments.
- Victoria's landfill levy creates an incentive to divert waste from landfill and instead recover more resources, including energy, from our waste.
- The EPA Victoria ensures that new waste to energy facilities will meet strict environmental requirements before granting a works approval.

The Victorian Government has clear policies to reduce greenhouse gas emissions and increase renewable energy. Many of these programs can support waste to energy facilities.

Victoria also has clear regulatory arrangements that govern how and where waste to energy facilities are to operate. The EPA regulates waste to energy facilities to protect human health and the environment.

This chapter describes existing federal, state and local government programs and services that can assist Victoria's waste to energy sector.

### Victorian sector snapshot

There are a small number of waste to energy facilities currently operating in Victoria, using thermal and biological methods to generate energy from wood waste that would otherwise have gone to landfill, sewage, food waste, agricultural residues and waste from industrial processes. No current facilities process mixed residual waste from households or businesses.

Most facilities operate on a small to medium scale and primarily produce energy for on-site use. Few waste to energy facilities in Victoria currently export energy to the electrical grid. There are some larger landfill sites generating energy from landfill gas capture. Melbourne Water's Western Treatment Plant captures and combusts biogas from sewage waste meeting nearly all of the plant's electricity needs. The Eastern Treatment Plant uses biogas to meet a large portion of the plant's electricity, heat and cooling needs.<sup>42</sup>

Biological waste to energy technologies in Victoria are most prevalent at wastewater treatment plants where anaerobic digestion is used to generate biogas from sewage sludge, and more recently, co-digested with other organic waste for higher efficiencies and yield. This organic waste is largely food waste and comes from commercial producers, such as markets and food manufacturing companies. Several small-scale agricultural operations in Victoria use biological processes to turn bio-waste such as piggery slurry, dairy production effluent, and other agricultural residues into on-site power, with any excess being sent to the grid.

Through our ongoing interactions with industry, local and federal government agencies and community groups, we are aware of the strong interest in the waste to energy sector.

Sustainability Victoria's investment facilitation service estimates between 60 and 70 per cent of all enquiries are related to investment in waste to energy projects.

### A sense of scale

Small scale waste to energy facilities currently operating in Victoria are using up to 1000 tonnes of feedstock a year.

Yarra Valley Water's facility will eventually process up to 33,000 tonnes of waste per year, which could be considered a medium scale facility.

Industry representatives have indicated that they consider a large-scale facility one that can process over 100,000 tonnes of waste per year.

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42. Melbourne Water (2017), Energy efficiencies and renewable sources. Retrieved from: <https://www.melbournewater.com.au/whatwedo/Liveability-and-environment/energy/Pages/Energy-efficiencies-and-renewable-sources.aspx>

### Case Study: Australian Tartaric Products, Colignan VIC

Australian Tartaric Products (ATP) uses grape waste from local wineries to extract tartaric acid which it sells back to the wine industry for use as a preservative and for adjusting pH levels and flavour.

ATP's main driver for installing a waste to energy plant (biomass boiler) on site was to decrease the cost of gas needed to create steam to power the distillery and plant.

The biomass boiler installed has almost eliminated (90 per cent reduction) ATP's use of gas. Total energy costs are down more than \$2 million a year and the facility avoids approximately 10,000 tonnes of carbon dioxide equivalent emissions a year. ATP collects grape waste from multiple nearby large wineries for free, saving wineries the cost of disposal to landfill.

The total project cost was \$11 million, including \$7.5 million for the boiler infrastructure and installation, with an expected payback period of 4.8 years. The company received two grants – \$1.8 million from the Victorian Government Regional Infrastructure Development Fund and \$1.7 million from the Australian Government's AusTrade Clean Energy Australia Fund.<sup>43</sup>

**Source:** Rural Industries Research and Development Corporation (2015)

## Laws to protect the environment and human health

The *Environment Protection Act 1970* (EP Act) provides the basis for waste regulation in Victoria.

The EP Act establishes EPA's powers, duties and functions to prevent pollution, minimise waste and reduce risks to the environment and human health. That includes the works approvals, licences and financial assurances that can apply to waste to energy facilities.

All waste to energy proposals are assessed in regard to siting, design, construction and operation. Where a potential bio-security issue is noted during the EPA approvals process, it is referred to bio-security experts for assessment and advice.

Proposed waste to energy facilities must also comply with:

- Energy from Waste Guideline (EPA Victoria), Publication 1559.1 (July 2017)
- *Environment Protection (Scheduled Premises) Regulations 2017*—requires high risk industry activity to be managed through works approval, financial assurance or licences
- State Environment Protection Policy (Air Quality Management)
- *Planning and Environment Act 1987*

These requirements ensure that future waste and resource recovery facilities are sited, designed, built and operated so as to minimise impacts on surrounding communities and the environment.

In January 2017, the Victorian Government released its response to the Independent Inquiry into the EPA. This reform program will strengthen the EPA's independence and scientific expertise, and deliver consistent and efficient regulation for industry. A bill to modernise EPA's governance was passed by parliament in October 2017. A bill to further overhaul the *Environment Protection Act 1970* is due to be introduced in 2018.

Question 4. Do the current regulatory arrangements provide adequate protection for Victoria's environment and communities?

## Programs for better environmental and economic outcomes from waste and energy

### Waste programs

#### *Victoria's landfill levy encourages diversion of waste from landfill*

The landfill levy is a market-based regulatory tool that creates an incentive to divert waste from landfill and recover resources. A levy is charged on each tonne of municipal and industrial wastes disposed at licensed facilities in Victoria.<sup>44</sup>

43. Rural Industries Research and Development Corporation (2015), Powering a distillery on grape waste, Biomass Producer. Retrieved from: [http://biomassproducer.com.au/case\\_study/powering-a-distillery-on-grape-waste/#.WV2PDxWGNnAQ](http://biomassproducer.com.au/case_study/powering-a-distillery-on-grape-waste/#.WV2PDxWGNnAQ)

44. Monies raised from the levy are used to fund state environment agencies including the EPA and Sustainability Victoria. The remainder is reserved in the Sustainability Fund to foster:

- environmentally sustainable uses of resources and best practices in waste management to advance the social and economic development of Victoria

Industry representatives tell us that the landfill levy is a critical factor in the financial viability of waste to energy facilities, because it reduces the gap between the lower cost of landfilling waste and the higher cost of recovering energy from waste.

**Table 2: Levy rates for waste in Victoria (2017-18)**

Region & waste	Levy amount p/tonne
Metropolitan municipal and industrial	\$63.28
Rural municipal	\$31.71
Rural industrial	\$55.46
Prescribed industrial waste (asbestos, Category C & B)	\$30-250

Landfill gate fees in Victoria are made up of the landfill levy and the operator charges. They range from \$110 per tonne for long term contracted waste in the metropolitan area, up to \$170 for spot market and domestic use elsewhere in the state. A higher fee is charged for prescribed wastes.<sup>45</sup>

Some waste to energy project developers estimate that their proposed facilities would charge an equivalent gate fee to make their project financially viable.

### **A waste infrastructure plan to guide investment**

The *Statewide Waste and Resource Recovery Infrastructure Plan* outlines state-wide infrastructure priorities, which include facilities that divert waste from landfill and activities that make materials available to the resource recovery market. The seven regional waste and resource recovery implementation plans identify regional waste flows and plan for the infrastructure required to recover this material. The plans seek to ensure we have the right infrastructure in the right places to meet the needs of Victorian communities.

A range of waste to energy opportunities are identified in the seven regional implementation plans. For example, waste to energy is being investigated in the Gippsland region as an alternative to landfill. Gippsland councils have made a collective offer of residual municipal solid waste (approximately 70,000 tonnes per annum) to prospective waste to energy operators.<sup>46</sup>

The Grampians Central West Waste and Resource Recovery Group has identified and is undertaking extensive feasibility studies into establishment of a waste to energy plant that could process municipal solid waste, commercial and industrial waste, and construction and demolition waste. A number of small facilities already operate in the region using organic waste as feedstock.<sup>47</sup> A number of other regions have highlighted opportunities to use organic and on-farm waste.

### **Strategies for developing markets for recovered resources including organics**

Waste to energy technologies play a part in two strategies that will help Victoria to achieve the goals set out in *Statewide Waste and Resource Recovery Infrastructure Plan*.

The *Victorian Organics Resource Recovery Strategy* seeks to ensure organic waste is managed appropriately, used safely and contributes to positive environmental, public health, amenity and economic outcomes. The organics strategy identifies the use of organic waste to energy as an emerging opportunity.

As part of delivering on the organics strategy, Sustainability Victoria has contributed to the Australian Biomass for Bioenergy Assessment which identifies locations and volumes of available biomass, including organic waste, across Australia.<sup>48</sup> This data may help waste to energy proponents.

Also under the organics strategy, the EPA, with support from Sustainability Victoria, is reviewing our approach to applying organic waste to land (including digestate from waste to energy facilities). It is examining national and international examples

• community action or innovation in relation to the reduction of greenhouse gas substance emissions or adaptation or adjustment to climate change in Victoria.

45. The EPA define prescribed waste as waste that would "require a high level of control and ongoing management to protect human health and the environment". Environment Protection Authority (2006), Development plan - Amendment of the Environment Protection (Prescribed Waste) Regulations 1998. Retrieved from <http://www.epa.vic.gov.au/-/media/Publications/1062.pdf>

46. Gippsland Waste and Resource Recovery Group (2017), Gippsland Waste and Resource Recovery Implementation Plan June 2017, Victoria, p.69

47. Grampians Central West Resource Recovery Group (2017), Grampians Central West Waste and Resource Recovery Implementation Plan 2017, Victoria, p.53

48. Sustainability Victoria (n.d), Victorian Organics Resource Recovery Strategy – projects to realise strategic directions. Retrieved from: <http://www.sustainability.vic.gov.au/organicsstrategy>

and considering how to address any risks to the environment and human health.

The *Victorian Market Development Strategy for Recovered Resources* seeks to stimulate markets for recovered resources by reducing barriers and developing the right conditions for material and product markets to mature. Priority materials addressed in this strategy include organics (including timber), rubber (tyres), flexible plastics, glass fines, E-waste, concrete and bricks. Actions under the strategy include to improve the consolidation and quality of these materials as resources for recovery, and improve the performance and use of end products incorporating these recovered resources. Energy is one such end product.

## Energy programs

### *Renewable energy targets*

The Victorian Government has committed to generating 25 per cent of electricity from renewable sources by 2020, and 40 per cent by 2025. Victorian regulations<sup>49</sup> define 'renewable energy' as an energy source that includes, among other things, wood waste (not native timber), agricultural waste, food waste, food processing waste and biomass-based components of municipal solid waste. It does not include materials or waste products derived from fossil fuels.

The Victorian Renewable Energy Targets will be supported by the Victorian Renewable Energy Auction Scheme (VREAS), offering long-term contracts to successful renewable energy projects.

The VREAS auction held in 2017 will deliver up to 650 megawatts (MW) of new large-scale renewable energy generating capacity to help meet Victoria's energy supply needs.

The Victorian Government will announce by 31 December 2017 how much more renewable energy generation will be required to meet the 25 per cent 2020 target.

The Victorian Government will announce by 31 December 2019 how much more renewable energy generation will be required to meet the 40 per cent 2025 target.<sup>50</sup>

The Australian Government has established a large-scale renewable energy target (RET) of 33,000 GWh by 2020. Under the RET, facilities that generate energy from landfill gas or other waste to energy technologies using organic materials can create and sell renewable energy certificates to energy retailers. This provides an economic incentive to invest in renewable energy technologies including waste to energy.

The Victorian Government will continue to work with the Australian Government to ensure we have affordable, reliable and increasingly renewable energy.

### *Encouraging greater energy productivity*

Victorian Energy Upgrades is a Victorian Government policy that uses markets to provide an incentive for households and businesses to improve their energy efficiency. It sets an annual efficiency target and obliges energy retailers to meet their proportion of the target by surrendering Victorian Energy Efficiency Certificates (VEECs). Tradable VEECs are created when accredited providers undertake an approved type of energy efficiency activity.

Since June 2017, Victorian Energy Upgrades has allowed energy-saving projects to create VEECs wherever they can reliably quantify the savings. The program allows projects that incorporate renewable energy, including energy from many forms of waste, provided the energy generated is used within the project. This means that waste to energy projects that consume all of the energy they generate on site may be eligible for incentives under the program.

### *Guiding energy productivity in key industry sectors*

The Department of Environment, Land, Water and Planning will be preparing Energy Productivity Sector Strategies for five priority industry sectors:

- food and fibre
- construction technologies
- new energy technologies
- transport
- defence.

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49. Victorian Energy Efficiency Target (Project-Based Activities) Regulations 2017 (Vic) s.4 (Austl.)

50. Department of Environment, Land, Water and Planning (n.d), Renewable Energy (Jobs and Investment) Bill 2017. Retrieved from:

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[https://www.energy.vic.gov.au/\\_\\_data/assets/pdf\\_file/0022/80509/VRE-T-fact-sheet-Bill.pdf](https://www.energy.vic.gov.au/__data/assets/pdf_file/0022/80509/VRE-T-fact-sheet-Bill.pdf)

The plans will identify opportunities, barriers and options for significant energy productivity improvements in these sectors. Some of the opportunities may involve waste to energy.

### **Australian Renewable Energy Agency**

The Australian Renewable Energy Agency (ARENA) is an Australian Government investment body that supports advanced renewable energy technologies from the early research stage to demonstration. Research support is available through ARENA's Research and Development Program, facilitating renewable energy research and commercialisation activities.<sup>51</sup> The program is always open for applications.

For example, in 2016 ARENA announced it was providing \$3 million support for Renewable Developments Australia (RDA) to build the business case for a renewable biofuel production facility at Pentland, near Charters Towers in North Queensland. ARENA is active in local waste to energy forums in support of the local industry.

### **Climate change programs**

#### **Emission Reduction Fund**

The Australian Government established the Emission Reduction Fund (ERF) to support and encourage projects that reduce greenhouse gas emissions. Businesses with approved project types may apply to the Clean Energy Regulator to receive an Australian Carbon Credit Unit (ACCU) for each tonne of greenhouse gases avoided or stored.

Depending on the type of feedstock and how that feedstock is currently managed, waste to energy plants may be eligible to create ACCUs and sell them to the Australian Government through the ERF reverse auction.

The ERF already supports activities from agriculture and waste sectors such as destruction of methane from piggeries using engineered biodigesters and capture and combustion of landfill gas.<sup>52</sup>

Most of the money allocated to the ERF was committed to projects through the first five auctions. The Australian Government has not yet clarified how

it will incentivise emissions reductions projects after current funds are exhausted.

### **Investment support programs**

#### **Collaborative procurement**

Waste and Resource Recovery Groups have the ability to procure waste and resource recovery services and infrastructure (such as waste to energy facilities) on behalf of local governments.

The Metropolitan Waste and Resource Recovery Group and the Gippsland Waste and Resource Recovery Group are both working with their local councils to collaboratively procure advanced waste and resource recovery technologies. These technologies could include waste to energy facilities that can better recover the resources contained in household garbage.

#### **Sustainability Victoria's investment service**

Sustainability Victoria provides a specialist investment facilitation service connecting waste and resource recovery investors with people, data, insight and expertise required to establish facilities in Victoria. Sustainability Victoria offers information on current and projected waste flows and available feedstocks, market intelligence and business case support. It also actively promotes existing facilities, linking prospective investors to current operators and supports industry networking. Sustainability Victoria can assist with community consultation, applying for EPA approvals and connections across government – including Invest Victoria, Regional Development Victoria, CEFC and ARENA.

Sustainability Victoria estimates that 60 to 70 per cent of enquiries to the investment facilitation service are from businesses interested in investing in waste to energy infrastructure.

#### **Waste to Energy Infrastructure Fund**

The Victorian Government's \$2 million Waste to Energy Infrastructure Fund supports new or upgraded waste to energy facilities.

The program was open to all waste to energy technologies, and has a strong focus on the recovery and reprocessing of food waste from the commercial and industrial sector as this presents a significant opportunity for greenhouse gas abatement. In 2014-15 Victoria's commercial and industrial sector produced more than 320,000 tonnes of food waste of which only 23 per cent was recovered.

Applications to the fund have now closed.

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51. Australian Renewable Energy Agency (2017), *Innovating Energy – ARENA's Investment Plan 2017*, Commonwealth of Australia

52. Department of Environment and Energy (2017b), *Eligible activities*. Retrieved from: <http://www.environment.gov.au/climate-change/emissions-reduction-fund/methods>

### **Boosting Business Productivity Program**

This \$6.1 million Victorian Government program supports businesses to access expert advice and support needed to reduce their energy and materials costs, reduce greenhouse emissions, and improve energy productivity. The program includes grants for businesses, a sustainable finance service, and various training, events, and information resources. One of the components of the program is 'Materials Efficiency Grants', which provide up to \$13,000 to smaller manufacturers looking for solutions to their waste problems.

### **New Energy Technologies Sector Strategy**

The New Energy Technologies Sector Strategy is designed to deliver a clear and focused renewable energy action plan, attract investment and facilitate access to new capital, facilitate renewable energy projects and technologies in Victoria and develop emerging energy industries.

The \$20 million New Energy Jobs Fund will support Victorian-based projects that create long-term sustainable jobs, increase the uptake of renewable energy generation, reduce greenhouse gas emissions and drive innovation in new energy technologies. Funding to support new energy technology projects is available through three annual grant rounds.

Hepburn Shire received \$650,000 in funding in 2017 to install a small-scale waste to energy unit that will divert 1,500 tonnes of waste from landfill annually, create five ongoing jobs and significantly reduce council spending on waste transport.

The project is projected to reduce greenhouse gas emissions by 200,000 tonnes over twenty years through avoided methane emissions and fossil fuel use.

### **Clean Energy Finance Corporation**

The CEFC was established by the Australian Government as a specialist clean energy financier. It supports project developers, waste companies and local governments with finance for waste to energy projects.

The CEFC has invested up to \$100 million in the Australian Bioenergy Fund to stimulate market uptake of bioenergy and waste to energy technologies that have a proven track record overseas but are not yet widely deployed in

Australia's energy mix.<sup>53</sup> The Australian Bioenergy Fund, managed by Foresight Group, is targeting equity investments in projects from \$2 million to \$100 million, ranging from small-scale anaerobic digestion to mid-scale energy from waste developments.

### **Waste to energy in other jurisdictions**

Waste to energy policies have been developed in half of Australia's states and territories to date. A summary is provided at Appendix B.

Waste to energy is a mature concept in Europe, North America and Japan. It has advanced in these places due partly to high population density and limited landfill capacity. In the EU, it was supported by strong directives to divert waste from landfill and increase renewable energy. Combustion facilities with energy capture and anaerobic digestion plants are widely used in Europe.<sup>54</sup> Commercial scale gasification plants processing mixed residual waste have been established in Europe and Japan. Whilst plasma gasification facilities remain relatively unproven, Japan has begun deploying plasma gasification facilities for 'thermal recycling' to recover materials from ash residues given increasing regulatory emphasis on recycling, material efficiency and recovery.<sup>55</sup>

**Question 5.** Are the existing programs to support waste to energy projects adequate?

53. Clean Energy Finance Corporation (2015), CEFC commitment to landmark Australian Bioenergy Fund factsheet - November 2015, Retrieved from: [https://www.cefc.com.au/media/158193/cefc-factsheet\\_australian-bioenergy-fund\\_lr.pdf](https://www.cefc.com.au/media/158193/cefc-factsheet_australian-bioenergy-fund_lr.pdf)

54. IEA bioenergy (2014), Waste to Energy – summary and conclusions from the IEA Bioenergy ExCo71 Workshop, International Energy Association, p.4

55. WSP Environmental Limited (2013b), An Investigation into the Performance (Environmental and Health) of Waste to Energy Technologies Internationally – Summary Report, London, p.13

## 7. Waste to energy barriers and possible responses

- Securing a long-term supply of waste feedstock, contracts for energy offtake, and regulatory approvals can be challenging for new market entrants.
- Developing a 'social licence' with the local community for the life of a waste to energy plant is paramount to success.
- As consumer tastes and waste management practices change over time, so will the composition of waste feedstocks, requiring flexibility in waste to energy technologies.

Waste to energy projects offer the potential to create greater environmental, social and economic benefits than landfill disposal. While only approximately four per cent of Victoria's waste is currently used to generate energy, the number of waste to energy plants is growing.

This chapter explores some of the barriers to expanding the waste to energy sector in Victoria and some of the options and tools that could be used to address them.

The mere existence of a barrier or market failure does not necessarily imply a need for government intervention. Your views on the barriers facing waste to energy in Victoria, and the appropriate role for government, will inform future policy development.

### Market Competitiveness

Victorian councils and businesses generally seek the least cost option to manage their waste whilst also addressing their environmental objectives. Waste to energy competes with other waste management options including recycling and landfill, as well as with other energy generation methods including wind, solar and fossil fuel.

The level of Victoria's landfill levy is a key factor in the business case for resource recovery. If landfill gate fees (comprising the landfill levy and the landfill's operating costs) are substantially lower than the gate fee a waste to energy facility would need to charge to be financially viable, the waste to energy facility would generally not be competitive.

Similarly, if the price the facility could produce energy at is substantially higher than alternative generation types, the facility would not be competitive in the energy market. Some technology types are well proven and already competitive in current market conditions. Others that require further development may become competitive as technology matures and costs decline.

Some groups say the landfill levy should be increased to make higher order recovery options more attractive. Others counter that it should be set at a rate that reflects the amenity and health risks of landfills. They argue that to be successful, service and technology alternatives to landfill must be able to compete in the marketplace.

The existence of operating waste to energy facilities in Victoria demonstrates that waste to energy plants can be an economically viable option for waste management.

Question 6. What landfill levy settings are likely to provide the greatest economic, environmental and social benefits for Victoria?

### Establishing bankability and securing finance

Waste to energy facilities can be expensive to construct and usually require external financing. Several factors affect the risk profile for waste to energy projects, which can substantially increase the cost of credit and make the project less 'bankable'.

These include:

- The highly-specialised nature of the plant equipment may mean its value as a security is relatively low.
- Financial markets in Australia lack deep knowledge about the waste to energy industry and so will apply a higher risk profile.
- Lack of social licence. A project that has not adequately engaged with the surrounding community may face unaddressed concerns that delay start up.

Many waste to energy facilities have been successful in Europe and Asia. That suggests that the business model can be an attractive one, depending on the market and policy settings. Several factors that affect the bankability of projects overseas differ in Australia, however, including climate and energy policies, population density, the economics of the waste sector, our climate and limited markets for heat energy.

Question 7. What are the key barriers to private investment in waste to energy projects? How do these vary across waste types and waste to energy technologies?

### Long-term secure contracts

For a waste to energy project to be bankable, it may need secure contracts for its feedstocks and outputs.

Where a project relies on waste feedstocks from outside its own facility, it must contract with the waste generator. The financial viability of the project depends largely on long-term secure access to that feedstock and sufficient revenue from accepting the waste. Some industry representatives have indicated that feedstock contracts of 15 to 20 years are necessary for a project to be bankable. They have commented that facilities using municipal solid waste may be particularly difficult to establish because typical contract terms are shorter. Contracts for municipal solid waste in Victoria are generally developed collaboratively, with several councils offering their waste to the industry together. In Victoria, those contracts are typically for ten year periods with renegotiation periods at four or two-year intervals. Commercial waste contracts with individual businesses are often shorter, one to two years.

Question 8. What would best practice contracts for waste to energy feedstock supply look like? How do these vary across the various technologies?

If a waste to energy facility plans to export energy to the grid or other energy users, those contracts generally must also provide long-term security and sufficient revenue.

Waste to energy facilities may improve the bankability of their projects by identifying additional revenue streams, such as selling heat energy along with electricity, or creating products from outputs like bottom ash. Those markets are currently under-developed in Victoria. In some cases substantial work would be required to secure regulatory approvals and build consumer confidence for products such as fertiliser or soil conditioners from digestate or aggregated construction materials incorporating ash residues.

The government's strategy, *Victorian Market Development Strategy for Recovered Resources*, addresses barriers to the use of recovered materials and supports conditions in which the industry can grow. A key element in this strategy is to increase public confidence in recovered materials and provide a long-term vision and five-year action plan to support the industry.

Sustainability Victoria leads implementation of this strategy and is developing markets for priority materials working in partnership with industry, government and academic partners to create real change. That can include assistance to industry in developing quality assurance specifications. There may be scope to further encourage research and market development for waste to energy residue derived by-products.

### **Multiple complex approvals are required**

Before it can operate in Victoria, a waste to energy facility must receive regulatory approvals for several different aspects of its business:

- Planning approvals to site a facility in a zone suited to the waste industry.
- A works approval from the EPA, after establishing that the facility will incorporate best practice measures for the protection of the land, water and air environments, and address energy efficiency and greenhouse gas emission management.
- Approvals for connecting the facility to the electricity grid where relevant, following feasibility and connection studies, application, negotiation of a connection agreement, and installation and commissioning of a generator.

Sustainability Victoria offers an investment facilitation service to support businesses trying to invest in Victoria's waste sector. That service connects investors with people, data, insight and expertise required to establish facilities in Victoria. However, project developers tell us that navigating these complex approval processes are still a barrier to investment. It may be that increased and more specialised facilitation services to proponents could address some of those concerns.

Question 9. To what extent could services that assist businesses to navigate government approvals and support programs facilitate greater investment in waste to energy in Victoria?

## Need to gain social licence

The Victorian Government supports the principles of environmental justice, which are based on the concepts of equity and participation. That means the community must be involved in decisions about the projects that may affect their local areas and communities.

Community attitudes towards waste to energy facilities are largely untested in Victoria. This is a potential barrier to new waste to energy facilities because it could affect a council or EPA decision to grant a planning or works approval. Unresolved concerns about a project are a relevant consideration. It may also affect the bankability of a project.

For this reason, EPA recommends that community concerns about the potential impacts of a new facility are addressed at an early stage in project development.

Past experience indicates that communities prefer to be informed about the potential environmental and human safety effects of waste to energy facilities early in the development process, and to hear from trusted sources.<sup>56</sup> The community also want to understand what benefits waste to energy has over landfill.

### What is Social Licence?

The concept of 'social licence to operate' evolved from broader concepts of corporate social responsibility. It is based on the idea that a business needs not only government or regulatory approval, such as a licence to operate, but also acceptance by its local community or other stakeholders.

Question 10. What role should communities play in the development of waste to energy projects?

Question 11. Is there a need for more action to inform businesses and communities about waste to energy?

## Feedstock composition

Operating waste to energy businesses also face risk from variations over time in the waste available in the market. The composition of the waste going to landfill can vary considerably over time. As Victoria's economy and population grows, our waste streams are expected to change. Waste to energy facilities are designed to allow for a degree of flexibility in terms of anticipated feedstock volume and composition as a result. Thermal waste to energy processes allow some variation in feedstock compositions providing thermal efficiencies are maintained, and are generally more resilient to variations in waste composition than biological processes.

Beyond the normal evolution resulting from changing consumption patterns, successive Victorian Governments have made a firm commitment to change the composition of Victoria's waste over the long term. In particular, the state waste infrastructure plans identify priority materials to be diverted from landfill and strategies for achieving that. Plans for waste to energy projects in Victoria need to consider the likely impacts of a residual waste stream with much lower volumes of organics or plastics.

Question 12. Are there other barriers to operating waste to energy businesses in Victoria?

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56. EPA Victoria (2017a), above

## 8. Please join the discussion

### Join the discussion on Engage Victoria

#### Households, business, community groups and governments – let's all work together

This is a great opportunity to tell us your views about turning waste into energy. Tell us how we can best harness the opportunities it presents for Victoria and address the risks involved.

Your feedback will assist the Victorian Government in forming a position on the appropriate role of waste to energy in Victoria.

### Questions

Answer these questions on Engage Victoria:

1. What is the appropriate role for waste to energy in Victoria's waste and energy sectors?
2. Is there a limit to the scale of waste to energy projects Victoria can or should support?
3. How can we ensure our reuse and recovery objectives are balanced against the need for business certainty to invest in waste to energy facilities over time?
4. Do the current regulatory arrangements provide adequate protection for Victoria's environment and communities?
5. Are the existing programs to support waste to energy projects adequate?
6. What landfill levy settings are likely to provide the greatest economic, environmental and social benefits for Victoria?
7. What are the key barriers to private investment in waste to energy projects? How do these vary across waste types and waste to energy technologies?
8. What would best practice contracts for waste to energy feedstock supply look like? How do these vary across the various technologies?
9. To what extent could services that assist businesses to navigate government approvals and support programs facilitate greater investment in waste to energy in Victoria?
10. What role should communities play in the development of waste to energy projects?
11. Is there a need for more action to inform businesses and communities about waste to energy?
12. Are there other barriers to operating waste to energy businesses in Victoria?

## Next steps

Method	Description
Engage Victoria survey	Go to <a href="http://www.engage.vic.gov.au/waste">www.engage.vic.gov.au/waste</a>
Individual or company feedback document	Send your feedback to: <b>Email:</b> <a href="mailto:wastepolicy@delwp.vic.gov.au">wastepolicy@delwp.vic.gov.au</a> <b>Post:</b> Waste and Resource Recovery team Economics, Governance and Waste Department of Environment, Land Water and Planning Level 1, 8 Nicholson St East Melbourne Vic 3002

## Key dates

Date	Action
24 December 2017	Consultation process closes
January 2018	Collation and analysis of submissions
Early 2018	Finalise the Victorian Government position on waste to energy

## Contact us

For more information, contact the Waste and Resource Recovery team at the Department of Environment, Land, Water and Planning via our email: [wastepolicy@delwp.vic.gov.au](mailto:wastepolicy@delwp.vic.gov.au).

# Appendix A: Technology types

## Thermal

### Combustion

The process of burning wastes to produce heat and steam, which can be converted into electricity. Combustion is a mature technology used globally and is capable of processing large amounts of unsorted waste. This process produces residues of 'bottom ash' and 'fly ash' and requires treatment of residual gas particulates to avoid airborne pollutants in the environment.

### Gasification

The process of heating waste in a low-oxygen environment to produce synthetic gas or 'syngas' (a mixture of carbon monoxide, methane and hydrogen), which can be used to generate heat and electricity.

Gasification is an advanced thermal process that is less mature than combustion but generally more efficient.<sup>57</sup> Gasification is more demanding in terms of feedstock specifications such as moisture content and particle size. There may also be issues with the disposal of tar residue which typically contains benzene, and the need to scrub gases to run syngas through a gas engine. Plasma gasification is a form of gasification which uses an arc gasifier to create temperatures of up to 12,000 degrees Celsius. This can convert solid waste into syngas and melt ash into a stabilised slag.<sup>58</sup>

### Pyrolysis

The process of heating waste in the absence of oxygen to create liquid fuels or gaseous products. These fuels can be used for heat and energy generation, or to synthesise chemicals. Pyrolysis is an advanced thermal process that is less mature than combustion with limited commercial operations established worldwide. It works best on a small scale using a homogenous feedstock (such as wood, plastic or tyres), and is unsuitable for processing unsorted waste. A carbon char (biochar) is left after pyrolysis when biomass is used as feedstock, which may be used later to produce heat and energy. Char may have other commercial value as a soil improvement, metallurgical reduction and carbon sequestration product.

## Biological

### Anaerobic Digestion

The process of decomposing organic waste in the absence of oxygen to produce biogas (a mixture of methane and carbon dioxide) and digestate (a nutrient-rich sludge). Biogas can be used to produce heat or electricity. Anaerobic digestion is a mature technology already used in Victoria. It requires a homogenous feedstock of wet organic waste such as sewerage sludge or wet agricultural waste and cannot process timber or large quantities of dry organics. Smaller quantities of dry organic waste can be processed if mixed in with other wet feedstock such as process effluent or water.

Anaerobic co-digestion is a term used to describe the simultaneous digestion of food or agricultural waste with sewage sludge. This is occurring at a number of waste water treatment plants in Australia.<sup>59</sup>

### Fermentation

The process of breaking down organic matter in the absence of oxygen with alcohol-producing microbial activity to produce liquid fuels like ethanol. The most suitable fermentation feedstocks are high sugar content matter such as sugarcane, corn, fruits, and beets. This process generates a nutrient-rich residue known as digestate or 'bioslurry'.

## Combined

### Mechanical Biological Treatment (MBT)

The combination of several processes which include a mechanical component such as sorting, shredding, milling, separating or screening; and a biological component such as bio-drying, composting or anaerobic digestion to create a solid recovered fuel (SRF) or refuse derived fuel (RDF) which can be further processed into fuel pellets or briquettes. SRF/RDF can then be used as feedstock in thermal waste to energy facilities, or can act as a partial replacement to fossil fuels in conventional fossil fuel dependent facilities.

### Landfill Gas Capture

Landfill gas is generated from the decomposition of waste in a landfill. Methane and carbon dioxide

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57. Environment Protection Authority and Waste Authority (2013), above, p.7

58. WSP Environmental Limited (2013a), above, p.14

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59. Edwards et al (2017), Anaerobic co-digestion of municipal food waste and sewage sludge: A comparative life cycle assessment in the context of a waste service provision, Bioresource Technology, Elsevier Ltd, p.237-238

make up approximately 99 per cent of the volume of landfill gas, with the remaining 1 per cent made up of over 500 trace components.<sup>60</sup>

In a properly managed landfill, these gaseous emissions can be captured through gas extraction systems. The captured gas is then used to produce energy while destroying up to 98 per cent of trace components.

Landfill gas capture for energy production is well established across Australia.<sup>61</sup> There are currently ten scheduled (that is, approved by the EPA) facilities in greater Melbourne that generate electrical energy from the combustion of landfill gas.

Landfill gas capture is considered a by-product of the landfilling process and helps to reduce greenhouse gas emissions from waste by harnessing the methane output for conversion to energy.

Best practice landfill gas extraction systems can generally be expected to capture around 70 per cent of methane generated in landfill. Actual capture rates achieved can be much lower however, with the average Australian landfill capturing only 25 to 65 per cent of methane produced.<sup>62</sup> Capture rates are affected by various factors such as waste composition, gas capture infrastructure, and capping strategies. Some landfills capture and flare gas, which does not produce energy, but does reduce greenhouse gas emissions.

A greater uptake of waste to energy facilities in Victoria will also impact the composition and volume of waste going to landfills and subsequently affect existing landfill gas capture activities.

The Victorian Government supports the use of waste to generate energy in a manner that is both environmentally and economically responsible and efficient. This includes the use of landfill gas capture where it yields the overall best environmental outcome and economic return and where higher order recovery options are not technically or economically viable.

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60. Environment Protection Authority Victoria (2012), Landfill Gas Factsheet Publication #1479, EPA, Carlton.

61. Ricardo-AEA Ltd (2013), above, p.6

62. Climate Change Authority (2016), Towards a climate policy toolkit: special review on Australia's climate goals and policies, Melbourne, p.137

## Appendix B: Other Australian jurisdictions

### New South Wales

The NSW EPA's 'Energy from Waste Policy Statement,' released in 2015, recognises that the recovery of energy and resources from the thermal processing of waste has the potential, as part of an integrated waste management strategy, to deliver positive outcomes for the community and environment.

Waste to energy is recognised as a valid pathway for residual waste, where further material recovery through reuse, reprocessing or recycling is not financially sustainable or technically achievable; and where community acceptance to operate has been obtained.

The Policy sets out the considerations and criteria that apply to recovering energy from waste in NSW, and ensures that energy recovery:

- poses minimal risk of harm to human health and the environment
- will not undermine higher order waste management options, such as avoidance, re-use of recycling.

The Policy covers all facilities in NSW undertaking the thermal treatment of waste or waste-derived materials. It does not cover biological processes such as anaerobic digestion.

The Policy establishes a two-tiered framework via an 'eligible waste fuels' list. Eligible waste fuels are considered to pose a low risk of harm to human health and the environment and include biomass from agriculture, forestry and sawmilling residues, uncontaminated wood waste, landfill gas and biogas, source-separated green waste (used only in processes to produce char), and tyres (used only in approved cement kilns). Eligible waste fuels may be thermally treated using a range of treatment technologies, provided a resource recovery order and exemption has been granted by the EPA.

Facilities proposing to treat waste which is not classified as an eligible waste fuel must meet additional requirements for 'energy recovery facilities'. They must demonstrate use of current international best practice techniques, particularly with respect to process design and control, emission control equipment, emission monitoring with real-time feedback to the controls of the process, arrangements for the receipt of waste, and management of residues from the energy recovery process. Proven technologies must be used, requiring reference to fully operational facilities using the same technologies and treating like waste

feedstocks in similar jurisdictions. They must also meet technical and thermal efficiency criteria, including:

- Continuous measurements of NO<sub>x</sub>, CO, particles (total), total organic compounds, HCl, HF and SO<sub>2</sub> with data made available in real-time graphical representation to the EPA;
- Regular measurements of heavy metals, polycyclic aromatic hydrocarbons, and chlorinated dioxins and furans.
- At least 25 per cent of energy generated from the thermal treatment of the material will be captured as electricity.

The Policy also sets requirements for the feedstock received from waste processing facilities or collection systems to, amongst other things, promote the source separation of waste where technically and economically achievable.

On 6 April 2017, a parliamentary inquiry was established in NSW to report on matters relating to the waste disposal industry in NSW, with particular reference to 'energy from waste' technology.

### Western Australia

The Western Australia Waste Authority's 'Waste to Energy Position Statement (Thermal Treatment)' released in 2013, addresses waste to energy in the context of WA efforts to reduce waste to landfill and increase resource recovery. The position statement complements advice and recommendations on the environmental and health performance of waste to energy technologies provided to the Minister for Environment in 2013 by the Authority and the WA EPA.

The position statement promotes waste management practices consistent with the waste hierarchy, and considers waste to energy preferable to landfill for the management of residual waste, but not at the expense of higher order processes to reuse, reprocess and recycle waste.

It also supports appropriate siting arrangements where buffers are ideally contained on site or within waste management precincts, and facilities are located close to the source of waste generation.

### South Australia

Zero Waste SA published an interim consultation paper in 2013 to commence a dialogue with stakeholders on SA's preliminary positions on waste to energy with the aim of developing a waste to energy policy position.

The paper acknowledges the resource recovery and renewable energy opportunities that waste to energy presents and sets out 7 interim policy positions for comment which provide overarching principles for the circumstances in which waste to energy could be supported. These include:

- ensuring waste to energy maximises the economic, environmental and social benefits of waste and energy management
- aligning waste to energy technologies with suitable and reliable feedstocks
- ensuring that waste to energy proposals are accompanied by a robust and transparent business case
- ensuring waste to energy is directed towards processing yields with the highest market value and provides most environmental benefits.

*South Australia's Waste Strategy 2015-2020* identifies a need for the Environment Protection Authority (EPA) to enhance the clarity of the regulatory framework relating to Energy from Waste and develop relevant assessment criteria to better support industry investment decisions. The waste strategy states:

*"In line with the waste hierarchy, the South Australian Government supports efficient energy recovery from residual waste and niche waste streams through best available technologies that suit local conditions, can deliver environmental benefits and provide economic opportunities. The South Australian Government considers that energy from waste should support and not disregard any viable options for higher order beneficial uses [of waste] and have regard to impacts to businesses and supply chains that compete for the same feedstock materials."*

In 2015, the South Australia Environment Protection Authority released a discussion paper, 'Reforming Waste Management – creating certainty for an industry to grow.'<sup>63</sup> The paper outlines key issues facing the waste management and resource recovery industry and discusses potential reform options. Building on the SA Waste Strategy, the paper states (on page 68) that:

*"The EPA proposes to develop additional Energy from Waste technical and policy guidance to help address the issues of:*

- *dealing with problematic wastes*
- *increasing interest in 'Energy from Waste' schemes*
- *further developing safe resource recovery."*

## Australian Capital Territory

Opportunities for generating energy from waste are currently being investigated in the ACT as part of the 'ACT Waste Feasibility Study.'<sup>64</sup>

The ACT Government is exploring options for an integrated materials recovery and bioenergy facility to generate energy from waste. This could help achieve their target of more than 90 per cent resource recovery by 2025 and a carbon neutral waste sector by 2020.

Currently, the only energy generated from waste in ACT is from landfill gas capture processes at two closed landfill cells.

## Queensland

The *Queensland Waste Avoidance and Resource Productivity Strategy (2014-2024)* identifies that the recovery of energy from waste provides opportunities for greater recovery efficiencies as part of a closed loop economy. It highlights there is 450 MW of installed capacity using bagasse (an agricultural waste from sugarcane), landfill gas, and biogas already in Queensland.

The strategy references the development of an alternative waste technologies policy for the state, which will facilitate the increased development of waste to energy technology.

63. EPA South Australia (2015), Reforming waste management – Creating certainty for an industry to grow. Retrieved from: [http://www.epa.sa.gov.au/files/11053\\_reforming\\_waste\\_aug2015.pdf](http://www.epa.sa.gov.au/files/11053_reforming_waste_aug2015.pdf)

64. ACT Government – Environment, Planning and Sustainable Development Directorate (2016), Energy from Waste. Retrieved from: [http://www.environment.act.gov.au/energy/cleaner-energy/energy\\_from\\_waste](http://www.environment.act.gov.au/energy/cleaner-energy/energy_from_waste)

# Glossary

Term	Definition
Aerobic Conversion	Biological process which uses naturally occurring microorganisms to convert biodegradable organic matter into a humus like product
Anaerobic Digestion	A series of processes in which microorganisms break down biodegradable material into biogas in the absence of oxygen
Avoidance	The process of preventing the generation of waste altogether
Biodrying	A waste treatment technology such as used in tunnel composting facilities that uses the waste heat of biological processes to remove moisture from biodegradable waste.
Bioenergy	The use of organic matter, also known as 'biomass', as a source of energy for power generation, heating systems or transport. It includes the generation of energy from purpose-grown energy crops differentiating it from 'waste to energy' which only uses organic waste material as feedstock.
Biogas	Gas from anaerobic digestion, which is composed from methane and carbon dioxide in various quantities.
Bottom ash	A form of ash which is different from fly ash, produced by combustion process. This material consists of the incompletely combusted or otherwise thermally treated fraction of the fuel, including the non-combustible components such as dirt, rocks, bricks, ceramics and concrete, along with metals.
Calorific Value	See 'heating value'
Closed-loop	See 'industrial ecology'
Co-digestion	Co-digestion is a term used to describe the simultaneous digestion of food or agricultural waste with sewage sludge
Combined heat and power	The simultaneous generation of both electricity and useful heat from an Energy from Waste facility
Digestate	The residue from the anaerobic digestion process that can be applied to land depending on the physical and chemical characterisation of that digestate.
Dioxins and furans	Dioxins and furans may sometimes be formed under improperly controlled burning conditions involving oxygen, carbon and chlorine particulates that are abundant in the natural environment and waste materials.
Fly ash	Fly ash consists of products in particulate form which are produced either as a result of the chemical decomposition of burnable materials or are unburned (or partially burned) materials drawn upward by thermal air currents in the incinerator and trapped in pollution control equipment.
Gasification	The process of heating waste in a low-oxygen environment to produce synthetic gas or 'syngas' (a mixture of carbon monoxide and hydrogen), which can be used to generate heat and electricity.
Heating value	The heating value of a substance, usually a fuel or a food, is the amount of heat released during the combustion of a specified amount of it.
Incineration	Thermal combustion of waste for disposal, without energy recovery
Industrial ecology	A circular approach to industrial systems which operate in continuous loops achieving systematic efficiencies observed in natural eco-systems. Resources move through a system designed to reduce use of natural resources and generate less waste. Also referred to as 'closed loop' solutions.

Landfill airspace	Landfill airspace can be defined as the volume of space on a landfill site which is permitted for the disposal of municipal solid waste. This space is initially occupied by air which will eventually be displaced by the disposed waste
Landfill gas	Gas normally composed of methane and carbon dioxide produced through the anaerobic decomposition of organic decomposition of organic materials deposited into landfill.
Mass burn	A mass burn system is one that accepts and thermally treats, burns, gasifies or pyrolyses all wastes as it presents at the facility, without firstly recovering inert or recoverable items.
Mechanical Biological Treatment (MBT)	The combination of several processes which include a mechanical component such as sorting, shredding, milling, separating or screening; and a biological component such as biodrying, composting or anaerobic digestion to create a solid recovered fuel (SRF) or refuse derived fuel (RDF) which often comes in the form of fuel pellets or briquettes.
Municipal Solid Waste (MSW)	Municipal Solid Waste which comprises of mixed residual waste, collected from households and businesses
Organic	Organic material such as food, garden and lawn clippings. It can also include animal and plant based material and degradable carbon such as paper, cardboard and timber.
Plasma gasification	A form of gasification which uses an arc gasifier to create temperatures of up to 8000 degrees Celsius. This can convert approximately 99 per cent of solid waste into syngas and melt ash into a stabilised slag.
Pyrolysis	The process of heating waste in the absence of oxygen to create liquid fuels or gaseous products. These fuels can be used for heat and energy generation, or to synthesise chemicals.
Recovery of energy	The extraction of calorific value from waste to create usable energy
Recycling	The process of converting valuable components of waste into new materials or objects
Refuse derived fuel	A fuel produced by processing waste, typically by shredding and dehydrating, as well as removal of non-combustible materials such as inerts and metals.
Reuse	The act of using materials again without additional processing
Solid recovered fuel	A fuel produced in the same manner as refuse derived fuel but to a specific quality standard.
Source separation	Separating waste materials prior to collection or subsequent streaming into specific material types.
Syngas	Synthetic gas produced from materials containing carbon and hydrogen, which is heated in an environment which contains no oxygen or insufficient oxygen to achieve complete combustion.
Treatment	The process of reducing waste volume or changing its composition to reduce hazard or nuisance
Waste to energy	'Waste to energy' and 'energy from waste' are terms that can be used interchangeably. For the purposes of this paper, 'waste to energy' is used to describe a number of technologies and treatment processes which extract the calorific value of waste material to generate energy. This process may include an intermediate conversion process as primary sources of energy generated, such as heat, steam or synthetic gas – or can be further transformed into other usable forms of energy such as electricity and fuel. This conversion process also reduces the solid volume of waste feedstock and can generate by-products such as char and ash.

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