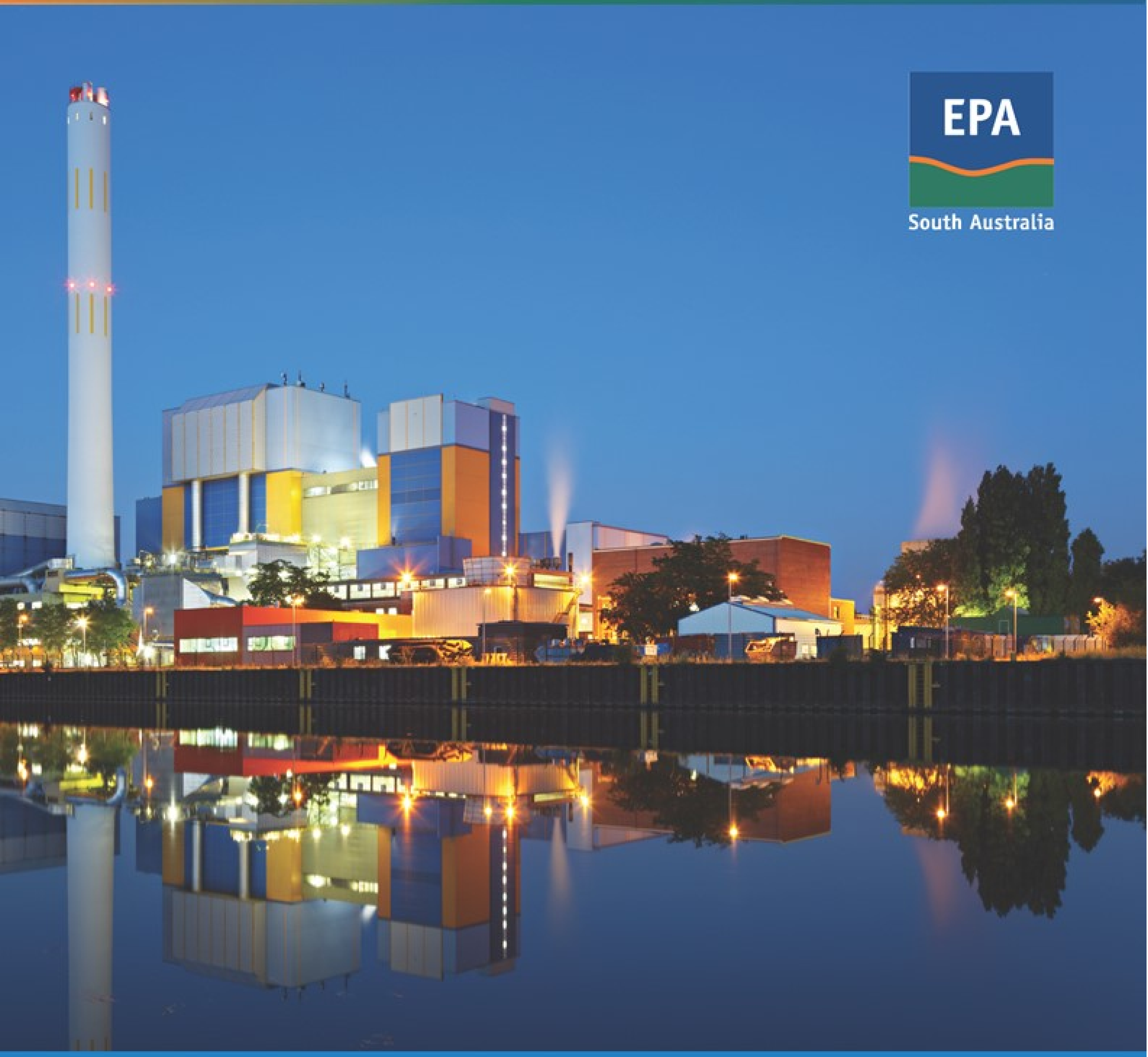

Enhancing resource recovery and discussing the place of energy recovery

Reforming waste management – creating certainty for an industry to grow

Enhancing resource recovery and discussing the place of energy recovery

Cover image: GMVA Energy from Waste facility, Oberhausen, Germany

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Invitation to comment

Engagement and collaboration with members of the waste management and resource recovery industry, and other key stakeholders has assisted the South Australian Government in formulating initial waste reform priorities, including the need for Energy from Waste policy guidance. This engagement has included the Waste Summit convened in March 2015 by the Minister for Sustainability, Environment and Conservation, the Hon Ian Hunter MLC, consultation on the discussion paper, *Reforming waste management – creating certainty for an industry to grow*, in August–October 2015, and regular discussions with high level stakeholder forums established by the Environment Protection Authority (EPA).

Building on this broad engagement, the objectives of this discussion paper are to:

- Outline Energy from Waste (EfW) technologies and relate them to the regulatory framework in SA in order to develop a regulatory position on the potential development of EfW in the state.
- Help us to seek your views on considerations for an EfW position statement.

We are keen to obtain your observations and advice on EfW policy, and in particular the proposed questions presented in this paper. You may choose to address all questions posed in the paper, focus on particular issues of interest or put forward additional ideas for consideration. Your views will be used to assist in determining an EPA position statement for EfW proposals.

Submissions should clearly reference the section and page to which each comment relates and submitted by **Friday 12 January 2018**.

Comments may be forwarded by mail or email (preferred) to:

Regulatory Reform Projects
Environment Protection Authority
GPO Box 2607
ADELAIDE SA 5001
Email: epainfo@epa.sa.gov.au [mark subject as 'Energy from Waste Discussion Paper']

All submissions received by the EPA during the consultation period will be acknowledged and treated as public documents unless provided in confidence, subject to the requirements of the *Freedom of Information Act 1991*, and may be quoted in EPA reports and on its website.

Executive summary

South Australia has celebrated many successful reforms in waste management through exceptional resource and energy recovery such as the achievement of the nation's highest recycling rates and the development of a strong foundation in energy recovery including the country's first industrial partnership in refuse derived fuel production and use.

The South Australian Government is committed to achieving the objectives of *SA's Waste Strategy 2015–2020*, which forms an endorsed Government policy, through ensuring sustainable economic development in waste management, especially with regard to the diversion of waste from landfill returning it to productive uses.

The South Australian Government, via *SA's Waste Strategy 2015–2020*, 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 Government believes that energy from waste should support and not disregard any viable options for higher order beneficial uses and have regard to impacts to businesses and supply chains that compete for the same feedstock materials.

The purpose of this paper is to provide the community and industry with general information on EfW to enable discussion of the many issues, challenges, barriers, and opportunities associated with the regulation, policy setting, and commercial pathways involved in resource and energy recovery from waste.

Informing the discussion is only the first step. We seek your help to provide constructive feedback on how you would like the resource and energy recovery industry sector to take shape for South Australia, ensuring our ability to continue to expand upon our successes in resource and energy recovery towards a more sustainable future. All feedback provided will be used as part of the process in forming a subsequent regulatory position statement on Energy from Waste (EfW).

Many questions have been posed in this discussion paper on how to approach this potential for growth and change while ensuring the security and prosperity of past successes in resource recovery. The general character of the questions raised by the discussion is as follows:

- Is there a need or opportunity for the expansion of EfW in SA?
- What are the best technologies and opportunities for EfW in South Australia?
- How do we best safeguard the consistency and security of existing material recovery facilities in accordance with the waste management hierarchy and ensure the promotion of, and investment in, future material recovery technologies?
- Does the waste depot (disposal) levy as it currently stands adequately encourage waste avoidance and the reuse and recycling of materials when considering EfW?

A complete list of the specific questions raised by the discussion can be found at the end of this paper. We are looking forward to the opportunity to hear your constructive observations and advice, and thank all participants in advance for your interest in this discussion on the future of our waste. Please feel free to address any or all of the questions raised or alternatively, raise more questions and generate additional discussion yourself.

Views and submissions are required to be submitted by **Friday 12th January 2018** and all feedback will be reviewed to inform a process developing a regulatory position statement for EfW.

1 What is Energy from Waste?

Energy from Waste (EfW) or Waste to Energy are terms often used to describe treatment technologies or processes undertaken for the primary purpose of generating and maximising the production of a usable form of energy including heat, electricity or fuel from waste. The Waste Management Association of Australia (WMAA) defines EfW as:

> The process of creating energy - usually in the form of electricity or heat - from the thermal and biological treatment of a waste source. Technologies include, but are not limited to, Direct Combustion, Anaerobic Digestion, Gasification and Pyrolysis. (WMAA 2016, pg 4)

Figure 1 shows the role of EfW facilities in making use of waste and section 3 details the key technologies that can be used to create energy from waste.

Figure 1 The role of Energy from Waste facilities

2 Why is Energy from Waste being considered for South Australia?

2.1 Our waste policy

The total waste produced in South Australia has been increasing significantly through increased waste per capita generation and population growth. As depicted in Figure 2[1], some 4.8 million tonnes of waste was generated in South Australia in 2015–16 with a little under 0.89 million tonnes disposed to landfill[2].

Figure 2 Waste generation, disposal, energy and resource recovery in South Australia (Rawtec 2017)

International trends suggest that economic growth frequently contributes to greater per-capita waste generation, while other contributing factors include a declining size of average households resulting in the ownership of more durable goods per person and increased consumption of packaging.

The State Government's waste strategies over the past decade have set ambitious targets and actions in waste management requiring innovative policy and regulatory solutions. As a result of these policies and regulatory context, South Australia has the highest landfill diversion rate in Australia with 81.5%[3] of waste material diverted to resource recovery. Of the approximately 4.8 million tonnes of waste produced during 2015–16, 3.9 million tonnes was reused, recycled or subject to energy or material recovery and 0.89 million tonnes was landfilled[4].

1 Data sourced from Rawtec (2017)

2 Rawtec (2017)

3 Rawtec (2017)

4 Rawtec (2017)

As resource recovery has increased, waste generation and the environmental protections expected by our community have changed over time, however new issues have arisen in respect of waste management. For example, *South Australia's Waste Strategy 2015–2020* (the Waste Strategy) reports:

> …patterns of waste generation change, and so do the types of chemicals and materials used to make the products we buy. With increasing material complexity (bio-composites, conductive polymers, nanotechnology, electronics and more) current recycling processes cannot extract all the components from purchased products. We need industry innovation and investment to address this and the changing forms of manufacturing, such as home manufacturing made possible by 3D printing technology. (GISA 2015, pg 14).

With changing waste generation conditions, it is necessary to continually consider new opportunities for sound management of South Australia's waste. The state government is seeking to continue its resource recovery leadership and to realise the economic potential from further innovation in waste and resource recovery technologies, while at the same time protecting our environment.

EfW facilities are commonplace across Europe together with various other nations and are beginning to be pursued in other parts of Australia (see Section 4). The EPA is therefore exploring how they may fit within the South Australian waste management context.

The Waste Strategy has as its mission:

> To achieve a resource efficient South Australia, by minimising South Australia's demand on primary resources, and maximising the reuse, recycling and recovery of materials, using the framework of the waste management hierarchy and the principles of ecologically sustainable development (GISA 2015, pg 24).

The Environment Protection Authority is required to have regard to the Waste Strategy when setting policy and this is reflected in the Environment Protection (Waste to Resources) Policy 2010 that seeks to achieve sustainable waste management by applying the waste management hierarchy (see Figure 3, from SA's Waste Strategy 2015-2020) consistently with the principles of ecologically sustainable development.

The hierarchy is defined in the *Green Industries SA Act 2004* as follows:

..."an order of priority for the management of waste in which—

(i) avoidance of the production of waste; and

(ii) minimisation of the production of waste; and

(iii) reuse of waste; and

(iv) recycling of waste; and

(v) recovery of energy and other resources from waste; and

(vi) treatment of waste to reduce potentially degrading impacts; and

(vii) disposal of waste in an environmentally sound manner,

are pursued in order with, first, avoidance of the production of waste, and second, to the extent that avoidance is not reasonably practicable, minimisation of the production of waste, and third, to the extent that minimisation is not reasonably practicable, reuse of waste, and so on."

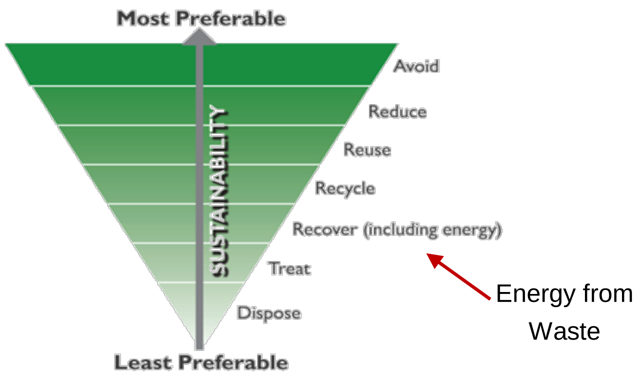

Figure 3 The waste management hierarchy

In accordance these strategic objectives, when considering the potential for the establishment of any new EfW technologies in South Australia, the EPA will seek to:

- minimise the risk of environmental harm occurring, and
- support the highest and best, safe available use of secondary materials in accordance with the waste management hierarchy,

within a fair and more certain regulatory framework.

EfW technologies could reduce the volume of waste disposed to landfill and recover some of the embodied energy contained in waste, ie achieve a higher-order waste management outcome in accordance with the waste management hierarchy in South Australia.

Consideration must also be given to ensuring that facility siting and emissions are appropriate to confidently maintain good air quality and local amenity, as well as ensuring that recycling and material resource recovery are not undermined. The Waste Strategy states:

> In line with the waste hierarchy, the South Australian Government supports efficient energy 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 believes that energy from waste should support and not disregard any viable options for higher order beneficial uses and have regard to impacts to businesses and supply chains that compete for the same feedstock materials. (GISA 2015, pg 29)

It is important to consider how much energy could be generated from the 890,000 tonnes of waste currently being disposed to landfill, noting that some landfill gas electricity generation is currently being undertaken.
Case Study 1 provides a comparison between a recently commissioned direct combustion EfW facility in Leeds, England and an established South Australian wind farm. Note, the total energy produced by a contemporary EfW facility includes the heat output and any associated heat reuse in district heating or neighbouring industrial schemes in combination with the installed maximum output of electricity as measured in megawatts (MW) which is not reflected by this case study.

An EfW facility that competes for feedstock directly with landfill such as residual kerbside municipal solid waste, should also be compared to electricity generation from landfill gas extraction and combustion in relation to energy output per tonne of waste, carbon emissions intensity, and lifecycle carbon emissions. It should be noted that the carbon emissions intensity for South Australian landfills undertaking landfill gas electricity generation is estimated at 0.06 tonnes CO_2–e /MWh[5].

[5] Acil Allen Consulting (2014)

CASE STUDY 1: Energy comparison

Wattle Point Wind Farm
Edithburgh, Yorke Peninsula SA[6]

Commissioned: 2005

Cost to build: ~A$180 million

Average capacity: ~30% or 30.33 MW

Installed capacity: 91 MW

No. of homes powered per year: 45,000

Carbon emission intensity: 0.0 tonnes CO_2–e /MWh[7]

8

9

Veolia Recycling and Energy Recovery Facility Leeds UK[10]

Commissioned: 2016

Cost to build: ~A$230 million

Waste feedstock input: ~214,000 tonnes per year

Installed capacity: 13 MW

No. of homes powered per year: 22,000

Carbon emission intensity: Equivalent data not available

2.2 Our low carbon future

The South Australian Government has developed two key initiatives with regard to ongoing carbon reductions, *South Australia's Climate Change Strategy 2015–2050*[11] and the complementary *A Low Carbon Investment Plan for South Australia*[12]. Growth in EfW has the potential to assist in the reduction of emissions while creating economic opportunities.

Table 1 shows the median life cycle CO_2–e emissions from several common electricity supply technologies. When analysing the potential life cycle emissions from an EfW facility in order to compare it to these technologies, the composition of the waste in terms of its proportion of fossil vs biogenic carbon is important, especially with regard to the combustion of residual municipal solid waste which contains both and can change through time, and due to seasonality.

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6 Based upon SA average household energy consumption according to AGL, available via AGL Interactive Asset Map, http://aglassets.reportonline.com.au/.

7 Acil Allen Consulting (2014)

8 Image sourced from https://www.aussierenewables.com.au/directory/files/images/179.jpg

9 Veolia Recycling and Energy Recovery Facility, Leeds, United Kingdom. Image sourced from www.hortweek.com/living-wall-gets-go-ahead-leeds/landscape/article/1300285

10 Data source: https://www.veolia.co.uk/leeds/about-us/about-us/background

11 https://www.environment.sa.gov.au/Science/Science_research/climate-change/climate-change-initiatives-in-south-australia/sa-climate-change-strategy

12 www.renewablessa.sa.gov.au/files/93815-dsd-low-carbon-investment-plan-for-sa-final-web-copy.pdf

Table 1 Life cycle CO_2-e from common electricity supply technologies[13]

Technology	Median (gCO_2–e/kWh)	Technology	Median (gCO_2–e/kWh)	Key indicative emissions intensity
Coal – PC[14]	820	Geothermal	38	High
Biomass – co-firing with coal	740	Concentrated solar	27	
Gas – combined cycle	490	Hydropower	24	Medium
Biomass - dedicated	230	Wind – offshore	12	
Solar PV – utility scale	48	Nuclear	12	Low
Solar PV – rooftop	41	Wind – onshore	11	

Biogenic carbon in this context refers to carbon dioxide produced by the decomposition, combustion or biological processing of modern era plant and animal based materials other than fossil fuels and mineral sources of carbon.

It is clear from this comparison that biomass has a much lower emissions intensity than coal and as such, many biomass based EfW processes could return a net benefit in terms of their carbon emissions intensity if replacing coal sourced energy. This is even though the actual emissions intensity of any EfW process is dependent upon the source material and method of energy conversion. Many countries currently offer renewable energy credits for the use of the biogenic fuel component of municipal solid waste (MSW) as opposed to fossil-based fuel components and many waste streams considered for EfW can contain a mix of both which must be accounted for when determining the carbon emissions intensity of any EfW process.

The *Creating Value, the Potential Benefits of a Circular Economy in South Australia* paper[15] recommends improved source separation of biogenic materials (organics) from other anthropogenic materials such as metals, paper, and plastics in order to maximise opportunities for reuse. However, it is acknowledged that there will be a percentage of unrecoverable mixed residuals remaining within a transitioning or established circular economy.

The US EPA indicates that MSW combustors can reduce the amount of greenhouse gases emitted into the atmosphere compared to landfill by offsetting energy produced from fossil fuel sources and avoided methane emissions from landfill[16]. The agency also considers that life cycle emissions from MSW combustion should include an understanding of factors such as:

- Avoided methane emissions from landfill – given that methane is generally accepted to have 25 times the comparative greenhouse gas impact of carbon dioxide over a 100-year time frame.
- Energy generation potential that offsets fossil fuel use (emissions avoidance).
- Metals recovery (recycling) offsets.
- Emission savings from the avoidance of long-distance transport to landfills (where relevant)[17].

However using current technologies, it remains clear that solar, geothermal, wind, hydro and nuclear energy have a lower emissions intensity than an entirely dedicated biomass EfW facility. It should also be noted that not all biomass energy

13 Schlömer S *et al* (2014)

14 PC means pulverised coal combustion

15 Lifecycles *et al* (2017)

16 US EPA (2016)

17 US EPA (2017)

can be considered EfW. The EPA S*tandard for the production and use of refuse derived fuels 2010*[18] currently addresses some common biomass materials that are not considered as waste for the purposes of that Standard, however there could be others. The regulatory approaches of VIC and NSW should also be considered with regard to biomass energy and EfW (see section 4.3 for further information).

A 2001 report to the European Commission, *Waste Management Options and Climate Change*[19] evaluates the gross greenhouse gas emissions of various waste management processes and provides net values for various waste management options from recycling to disposal. The study considers several modern waste management processes and whether they lead to the generation or avoidance of greenhouse gas emissions (Table 2).

Table 2 Notable processes attributed to greenhouse gas (GHG) emissions of various waste management options[20]

GHG generation processes	GHG avoidance processes
Methane emissions from the landfilling of putrescible waste	Avoidance of emissions from: • energy recovered from the direct combustion of waste leading to the avoidance of fossil fuel use elsewhere in the energy system • recycling which leads to a net reduction in emissions by producing materials recovered from the waste as primary resources • reuse of compost avoids emissions associated with the displacement of fertiliser and primary resources such as peat.
Emissions of fossil-derived carbon from plastics and textiles via combustion	
Nitrous oxide emissions from the combustion of waste	
Emissions of fossil-derived carbon from fuels used in the collection, transport and processing of waste	
Emissions of halogenated compounds from electronic waste (refrigerant gases and insulation foams)	

The report also provides several conclusions on the net greenhouse gas contributions coupled to different technologies, including the following which advocates for source separation, recycling, reuse and composting:

> The study has shown that overall, source segregation of MSW followed by recycling (for paper, metals, textiles and plastics) and composting (for putrescible wastes) gives the lowest net flux of greenhouse gases, compared with other options for the treatment of bulk MSW. (AEA Technology 2001, pg iii).

The emission factors for recycled wastes used in the study, all of which are shown to contribute gross negative greenhouse gas emissions are summarised in Table 3. South Australia's calculated greenhouse gas emissions as a result of recycling are presented in Figure 4.

18 See section 3.5 for further information relating to the Standard for the production and use of refuse derived fuel

19 AEA Technology (2001)

20 AEA technology (2001)

Table 3 Avoided emissions expressed in kg of CO_2–e per tonne of material recycled

Material	Avoided emissions (gCO_2–e/t)
Glass	253
HDPE	491
Paper	600
Ferrous metal	1,487
PET	1,761
Textiles	3,169
Aluminium	9,074

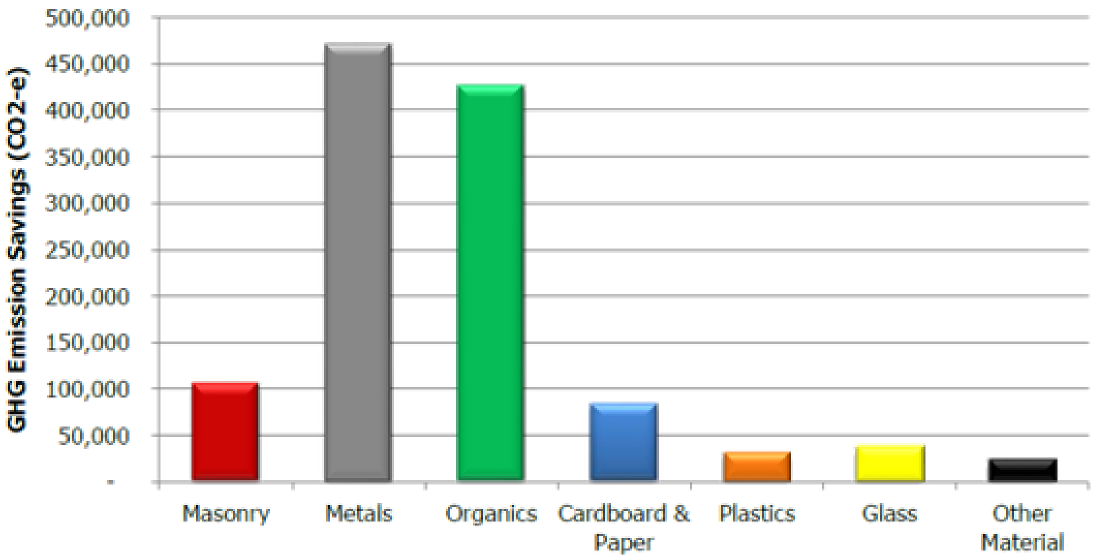

Figure 4 South Australia's avoided greenhouse gas emissions as a result of recycling[21]

The most direct route to reducing net carbon emissions may lie through the general alignment of waste management practices with the waste management hierarchy in favour of the higher order processes of avoidance, reuse and recycling in favour of material resource recovery. This in turn supports the ongoing establishment of a circular economy. A question to pose is, how much material resource recovery must be undertaken before energy recovery and disposal are considered the most efficient options under the waste hierarchy?

Questions	
1	Is there an opportunity to expand EfW in SA? If so, with what source material (waste feedstock) and technologies?
2	Could the EfW sector be further developed through public or private investment and ownership or as a partnership?

[21] Rawtec (2017) *South Australia's Recycling Activity Survey 2015–16 Financial Year Report* (the RAS). Refer to 'Survey Methodology' in Appendix 1 for additional information on environmental benefits analysis assumptions and methodology.

3 Is EfW technology best applied at a site-specific or district level, or at a larger scale?

4 Could EfW make a significant contribution to the baseload energy grid and the national energy market going forward?

5 Could the uptake of EfW assist in the reduction of the use of high greenhouse gas emissions intensity fuel contributing to a low carbon future? What are the factors that could assist with displacing high intensity fuels? What are the factors that could lead to EfW displacing renewables? What regulatory mechanisms or policy could be applied to EfW to reduce the extent of any displacement of renewables?

6 What is the EPA's role in safeguarding the waste hierarchy with regard to EfW eg ensuring that wastes with high calorific value such as plastics are not diverted to thermal EfW potentially undermining higher order recycling, reuse and reduction activities?

7 Could EfW as an alternative to landfill deliver net environmental benefits to SA in the form of greenhouse gas emission reductions, management of fugitive air emissions, and ensuring the environmental quality of waters? What regulations and policy could reduce the extent of any net cost in one or more of these factors?

8 If an EfW proposal is to be grid-connected what opportunities and challenges might lie ahead with regard to EfW energy end-user agreements, ie with regard to securing agreements and feedstock material, accessing infrastructure and the cost of bringing this energy to the market?

9 Is it feasible and necessary for proponents of EfW to demonstrate the greenhouse gas emissions intensity and lifecycle emissions of their proposal? What range of data and what level of evidence should be required? How would it be validated?

10 Should proponents of EfW be required to demonstrate that the greenhouse gas emissions intensity is less than that of currently utilised baseload and peaking energy fuels while the state transitions to its target of zero net greenhouse gas emissions by 2050?

3 Different types of Energy from Waste

There are two broad types of EfW technology – thermal and biological. Thermal technologies can be broken down further into processes involving combustion and processes involving other advanced thermal treatment. Biological processes are largely described by anaerobic digestion, however in some cases fermentation may be utilised. There are also commercial applications for combinations of biological and thermal EfW processes involving mechanical[22] or other engineered systems such as the production of refuse derived fuel (RDF) or landfill gas energy production and bioreactor landfills.

In the following sections, inputs and outputs of different technologies discussed include those that are technologically plausible and currently utilised in other jurisdictions for the purposes of transparent and informed discussion. These technologies and their associated waste feedstocks are not necessarily preferred or accepted for use in SA in the future.

3.1 Direct combustion[23,24]

Definition: The direct combustion of waste is the most commonly used technology for converting fuel to heat and/or electrical energy. During direct combustion, waste or a fuel derived from waste is burnt in excess oxygen (from air) to produce heat or release the energy contained in the fuel. Excess oxygen/air means there is more air available than necessary for the combustion process[25].

Inputs: Agricultural wastes, combustible waste biomass, wood waste and municipal solid waste (MSW). Pre-treatment of MSW and some other waste inputs is generally undertaken in order to reduce moisture content, enhancing calorific value and homogenise the MSW as an input to a combustion furnace[26].

Commercial outputs: Electricity, heat or combined heat and power (CHP). Bottom ash and fly ash may have the potential for the development of reuse markets.

Residual outputs: Emissions to air, waste water from pollution control systems, bottom ash, fly ash and air pollution control (APC) residues. Bottom ash and fly ash may require additional treatment and subsequent disposal to appropriately engineered landfill. Bottom ash and fly ash may also be subject to advanced treatment to remove residual/trace metals.

Major technological types: Moving grate, fixed grate, fluidised bed and rotary kiln.

3.2 Gasification[27,28]

Definition: The gasification of waste is a process that converts organic or fossilised organic materials such as coal, at elevated temperatures and with controlled amounts of oxygen, into a synthetic gas (syngas) comprising carbon monoxide, hydrogen, carbon dioxide, nitrogen, methane and other low molecular weight organic molecules[29].

Inputs: Sewage sludge, pyrolysis oil, agricultural wastes (biomass), organic wastes (food waste, green waste, paper pulp) and MSW.

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[22] Mechanical biological treatment (MBT), advanced waste treatment (AWT) and alternative treatment technology (ATT) are sometimes used to describe combination mechanical/biological/thermal waste treatment processes.

[23] Ricardo AEA & ZWSA (2013)

[24] WALGA (2013)

[25] WMAA (2016)

[26] Ricardo AEA & ZWSA (2013)

[27] Ricardo AEA & ZWSA (2013)

[28] WALGA (2013)

[29] WMAA (2016)

Commercial outputs: Electricity, heat, combined heat and power (CHP), bottom ash or vitrified bottom ash, fly ash, and syngas (synthetic gas) which can be refined into transport/industrial fuel or subsequently combusted in a furnace or boiler.

Residual outputs: Air emissions, bottom ash, vitrified bottom ash, fly ash, APC residues and tar.

Major technological types: Fluidised bed gasification, plasma gasification and slagging gasification. A gasification process may also be combined in-line with distinct direct combustion or pyrolysis stages.

3.3 Pyrolysis[30,31,32]

Definition: Pyrolysis is described as a thermo-chemical decomposition of organic or inorganic material – for example synthetic tyres – at elevated temperatures in the absence of oxygen. Pyrolysis can occur in a vacuum or under any pressure and typically occurs at operating temperatures above 430°C and generates oils, tars, char residue and syngas.

Inputs: There are many potential pyrolysis inputs including waste timber/wood, rubber (tyres), plastics, organic wastes and MSW.

Commercial outputs: Char, oil, syngas, heat and electricity if coupled to a generation stage ie syngas combustion by a gas engine/generator.

Residual outputs: Air emissions, unmarketable chars, oil and tar.

Major technological types: Fixed bed/retort. Pyrolysis processes can be undertaken from low to high temperatures with varying residence times. The pyrolysis process begins at 300–400°C and can be undertaken with slow to rapid heating up to approximately 600–800°C. The variation in temperature and residence time will affect the proportion of solid, liquid and gas outputs ie char, oil and gas. Torrefaction and carbonisation are also related to pyrolysis technologies.

3.4 Anaerobic digestion[33,34]

Definition: Anaerobic digestion involves a series of processes in which microorganisms break down biodegradable material to Biogas in the absence of oxygen. It is used for industrial, agricultural or domestic purposes to manage waste and/or produce fuels for energy generation.

Inputs: Any organic and sufficiently wet waste substrate that can be digested by anaerobic bacteria, eg food waste, abattoir offal, dairy waste, some liquid construction and industrial (C&I) wastes, and MSW. Pre-treatment is generally undertaken in order to recover recyclables and remove non-digestible materials such as glass, soil, metal, dry cellulose and plastic.

Commercial outputs: Electricity if coupled to biogas combustion engines, scrubbed biogas as transport fuel, pelletised or liquid fertiliser, organic outputs and digestate.

Residual outputs: Organic outputs, digestate/sludge and non-recyclable plastic.

Major technological types: Mechanical and biological treatment of MSW, single input organic waste stream, eg food waste, abattoir waste, manures, agricultural wastes, co-digestion of sewage sludge and organic liquid wastes.

3.5 Refuse derived fuel (RDF)

The production and use of RDF is widely recognised as an EfW process where combustible waste types are processed into a fuel for industrial use primarily through combustion. The combustion of RDF differs from the direct combustion of waste due to its calorific/heating value matching the fuel it is replacing, eg natural gas in cement kilns, a practice already

30 Ricardo AEA & ZWSA (2013)

31 WALGA (2013)

32 WMAA (2016)

33 WMAA (2016)

34 Ricardo AEA & ZWSA (2013)

being undertaken in Adelaide. The SA EPA regulates RDF through the *Standard for the production and use of refuse derived fuel or RDF Standard* (2010).

NOTE: Following any outcomes as a result of this broader discussion on EfW, the EPA will undertake to review the current RDF Standard.

Definition: RDF is a fuel material produced from waste that is otherwise destined to landfill and which will not cause harm to the environment or human health when used to beneficially replace or supplement a fossil or other standard commercial fuel in an industrial process[35]. RDF must be produced to an approved consistent and fit for purpose specification with sufficiently high net calorific value by segregating, targeting and processing specific wastes[36].

Inputs: C&I waste, construction and demolition waste, other specific neat or segregated waste types of high calorific/heating value, eg waste tyres, wood and sawdust. In some cases where emissions control technology can be proven to control emissions it may be possible to utilise treated timbers.

Commercial outputs: RDF with a calorific value similar to the fuel it is replacing or substituting.

Residual outputs: Air emissions, fine waste materials, non-combustible mineralogical matter and soil, bottom ash, fly ash and APC residues.

3.6 Landfill gas combustion/bioreactor

The combustion of landfill gas is widely recognised as an EfW process where electricity is generated and used in-situ or exported to offtake markets. Bioreactor landfills are purpose-built landfill facilities designed to promote the rapid decomposition of waste using liquid and air injection along with leachate treatment and recirculation producing a high landfill gas yield for electricity generation.

Definition: Landfill gas (LFG) is defined as gas nominally composed of methane and carbon dioxide produced through the anaerobic decomposition of organic materials deposited into landfill. LFG is commonly captured and combusted and often utilised for the production of energy. The methane produced in LFG is considered anthropogenic, so when released to atmosphere it is a greenhouse gas with a greenhouse warming potential of 25 times carbon dioxide. However, as the carbon dioxide produced in combustion is considered biogenic carbon, LFG to energy is regarded as a renewable energy[37].

Inputs: Any organic waste disposed to landfill such as components of MSW and C&I waste.

Commercial outputs: Electricity.

Residual outputs: Air emissions and landfill leachate.

Question
11 Is there a role for the further development of some EfW technologies or processes vs others? Why, and under what circumstances?

[35] RDF Definition as per the EPA *RDF Standard* (2010).

[36] Note: Pre-treatment of MSW prior to thermal EfW such as direct combustion or gasification is not considered to constitute the production of RDF.

[37] WMAA (2016)

Further reading

- Jacobs, Renewables SA 2015, *A Bio-energy Roadmap for South Australia*, Renewables SA, South Australia, www.renewablessa.sa.gov.au/files/a-bioenergy-roadmap-for-south-australia--report--version-1-appendix-a-removed.pdf
- Ricardo AEA, Zero Waste SA 2013, *Waste to Energy Background Paper*, Zero Waste SA, South Australia, www.greenindustries.sa.gov.au/_literature_165466/Waste_to_Energy_Background_Paper_(2013)
- Rawtec, Zero Waste SA, 2014, *Waste Biomass Opportunities Map for the South East (SA)*, South Australia, www.greenindustries.sa.gov.au/_literature_165463/Waste_Biomass_Opportunities_Map_for_the_South_East_of_SA_(2014)

4 Current Energy from Waste technology

There are more than 1,000 EfW facilities currently in operation worldwide[38]. An assortment of biological and/or thermal technologies are utilised across Europe, Asia, USA and Canada. Some EfW technologies have already been in use within Australia for over a decade and the marketplace for EfW is expected to grow.

4.1 Europe

The commercial application of EfW technologies is widespread across Europe, with the regulation of all EfW activities being guided and influenced by the laws passed by the European Commission. There are more than 400 facilities currently operating across more than 20 countries[39]. The vast majority of large-scale EfW facilities utilise direct combustion technology but there are many examples of varying scale incorporating technologies such as gasification, anaerobic digestion, co-incineration, and refuse derived fuel production and use.

Table 4 Indicative number of European thermal technology based EfW plants by country[40]

Country	Indicative/ approximate no. of facilities	Waste treated by thermal technology (million tonnes/yr)	Country	Indicative/ approximate no. of facilities	Waste treated by thermal technology (million tonnes/yr)
Austria	11	2.4	Lithuania	1	0.14
Belgium	18	3.3	Luxembourg	1	0.13
Czech Republic	3	0.64	Netherlands	12	7.6
Denmark	26	3.5	Norway	17	1.58
Estonia	1	0.22	Poland	1	0.04
Finland	9	1.2	Portugal	3	0.97
France	126	14.7	Slovakia	2	0.19
Germany	99	25	Spain	12	2.5
Hungary	1	0.38	Sweden	33	5.7
Ireland	1	0.22	Switzerland	30	3.8
Italy	44	6.3	United Kingdom	32	7.9

It is important to note that direct combustion EfW technology is commonly referred to as ‘waste to energy’ or ‘incineration’ within a European context. Early incineration technology included little to no energy recovery, however modern facilities are becoming increasingly more efficient at generating electricity and utilising process heat for industrial applications or district heating, particularly in countries with cold climates. Alternatively, district cooling can be developed by integrating absorption chiller technology into a facility in order to produce cool air from process generated heat. Table 4 provides an indicative number of ‘waste to energy’ plants operating across Europe.

38 WMAA (2016)

39 Confederation of European Waste-to-Energy Plants or CEWEP (2016)

40 Source: CEWEP (2016). Data shown only for facilities with membership in the CEWEP

4.1.1 Policy: Waste Framework Directive

The *Waste Framework Directive 2008/98/EC* (WFD) sets out general definitions, principles, and other fundamentals of waste management for the European Union (EU) and establishes the waste hierarchy in law. Within the context of commercial EfW, which has led to a reduction in landfill disposal across many member countries of the EU, there are ongoing concerns relating to the potential diminishment of continuous improvement in recycling and other material recovery and in the creation of opportunities due to the need to set long-term waste feedstock agreements with municipalities in order to secure finance for some types of EfW facilities. The WFD attempts to address this concern and reinforces the waste hierarchy by setting the following two targets by 2020:

- 'The preparing for reuse and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased to a minimum of overall 50 % by weight.'
- 'The preparing for reuse, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste excluding naturally occurring material defined in category 17 05 04 in the list of waste shall be increased to a minimum of 70% by weight[41]'.

In line with the statement above, it is acknowledged by the UK Government that many waste materials that could theoretically be recycled are currently being disposed to landfill or sent to EfW, and while barriers to recovering these resources exist, EfW should be utilised effectively to avoid the worst hierarchical outcome of landfill disposal. It is also iterated that EfW must support and not compete with these increased landfill diversion and recycling targets while ensuring that the reduction and reuse of waste as higher order options are not undermined[42].

> Government's aim is to get the most energy out of residual waste, rather than to get the most waste into energy recovery. (DEFRA (UK) 2014, pg 25).

Figure 5**[43]** shows the proportions of waste recycled, landfilled and subjected to energy recovery within Europe.

In 2014, 43.6% of the waste treated in the EU was subject to disposal operations other than waste incineration ie landfill. A total of 39% of the waste was recycled. Just over one tenth (10.8%) of the waste treated was backfilled, where backfilling is described as similar to SA's use of waste derived fill. The remaining 6.5% of the waste treated was sent for incineration, either with energy recovery or without.

Figure 5**[44]** shows the development of waste treatment in the EU ie recovery/recycling, incineration (including energy recovery), and disposal ie landfill from 2004 to 2014.

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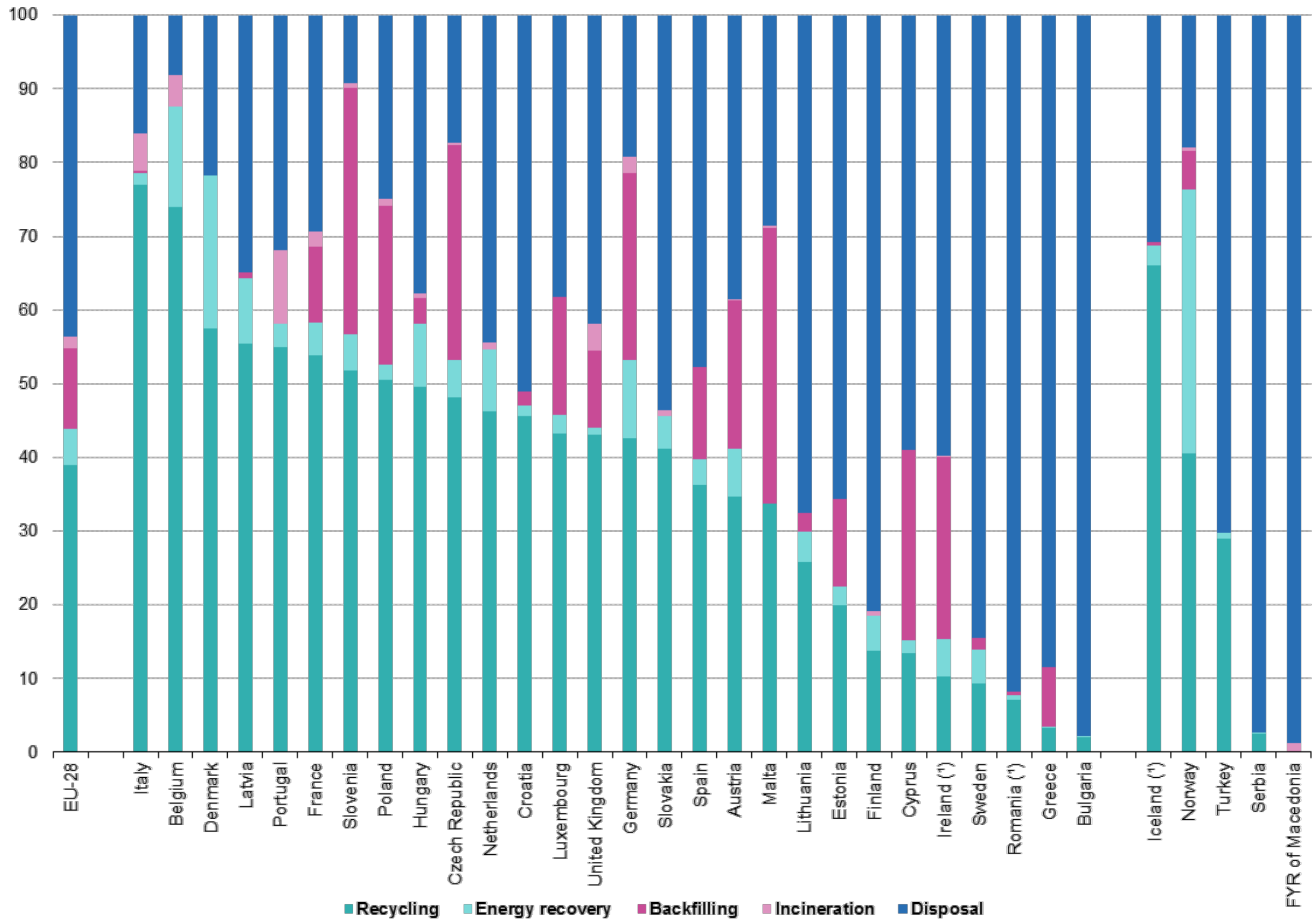
[41] European Commission (2016), http://ec.europa.eu/environment/waste/framework/targets.htm

[42] DEFRA (2014)

[43] http://ec.europa.eu/eurostat/statistics-explained/index.php/Waste_statistics.

[44] http://ec.europa.eu/eurostat/statistics-explained/index.php/Waste_statistics.



Note: Ranked on the share of recycled waste.
(¹) 2012.
Source: Eurostat (online data code: env_wastrt)

Figure 5 **European graph showing the proportion of waste recycled, subjected to energy recovery, backfilled, incinerated, and disposed to landfill**

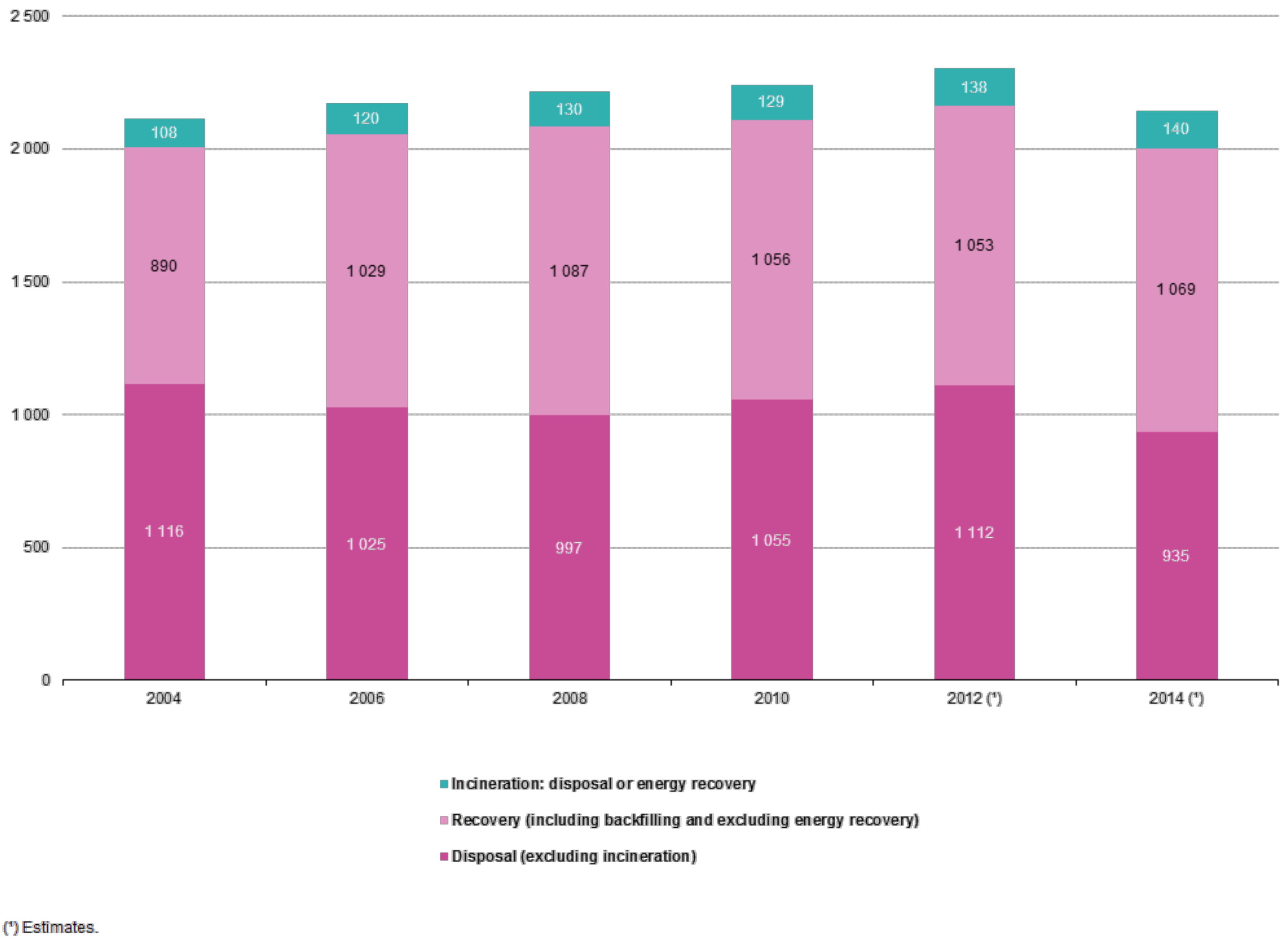


Figure 6 **The development of waste treatment in the EU (recovery/recycling, incineration including energy recovery), and disposal ie landfill from 2004 to 2014**

Major points of interest from Figure 6 are[45]:

- The quantity of waste landfilled in 2014 was 16% lower than it had been in 2004.
- The quantity of waste recovered (excluding energy recovery), in other words recycled or used for backfilling, grew by 20.1% from 890 million tonnes in 2004 to 1,069 million tonnes in 2014; as a result, the share of such recovery in total waste treatment rose from 42.1% in 2004 to 49.9% by 2014.
- Waste incineration (including energy recovery) saw an overall increase between 2004 and 2014 of 29.6% and its share of the total rose from 5.1% to 6.5%.

4.1.2 European Commission: EfW and the circular economy

The European Commission (EC) adopted an action plan for the circular economy in December 2015[46] which places an emphasis on increased action throughout a product's lifecycle to enhance opportunities to avoid producing waste and increase the reuse and recycling of secondary or waste-derived materials. The EC Communication Paper, *The role of waste-to-energy in the circular economy*[47] cautions against an over reliance upon direct combustion of waste within several EU countries because of the challenges this can create with regard to achieving ongoing circular economy objectives at the member state level. Circular economy agendas come with an inherent objective to increase material

45 European Commission (2016), http://ec.europa.eu/eurostat/statistics-explained/index.php/Waste_statistics.

46 *Closing the loop – An EU action plan for the circular economy*

47 European Commission (2017)

resource recovery rates which creates a risk of economic losses from stranded assets if new EfW facilities are developed without an appropriate planning regime. The EC communication paper also takes a holistic view of the entire EU by discussing that there is presently not an over-supply of direct combustion capacity across the EU as a whole. The paper provides advice for the two major groups; countries currently relying upon landfill with low direct combustion capacity and conversely, those with high direct combustion capacity such as Germany, France, Denmark, The Netherlands and Sweden.

The communication paper provides the following pertinent suggestions for countries with little or no installed direct combustion capacity and a reliance upon landfill as a primary means of waste disposal:

- These countries should seek to understand 'the impact of existing and proposed separate collection obligations (source segregation) and recycling targets on the availability of feedstock to sustain the operation of new incineration plants over their lifespan (20–30 years)'
- 'The available capacity for co-incineration[48] in combustion plants, and in cement and lime kilns or in other suitable industrial processes'
- 'Planned or existing capacity in neighbouring countries'.

The paper advocates that EU countries with low installed direct combustion capacity should prioritise source segregation schemes and recycling infrastructure, and suggests that the ongoing diversion of waste from landfill fits together with an increasing capacity for recycling. It is further iterated that high levels of direct combustion capacity are not aligned with high recycling targets and to combat this inconsistency with the waste management hierarchy the following can be undertaken:

- A direct combustion (incineration) tax is imposed.
- Support for combustion is phased out and redirected instead to reuse, recycling and avoidance schemes.
- Preventing the establishment of any new direct combustion facilities and decommissioning older less efficient ones.

An additional caution explains that circular economy proposals advocating for greater source segregation and recycling of wood, paper, plastic and biomass (combustible wastes) will likely reduce the amount of waste available for incineration (direct combustion) and co-incineration (refuse derived fuel).

4.2 Asia

EfW is used in many Asian countries and to a large extent in China and especially Japan. Landfill is the most common method of solid waste disposal in China, which produces more than 180 million tonnes of MSW per year in urban cities alone. Approximately 23 million tonnes of waste is processed annually in more than 100 EfW facilities[49]. The use of EfW technology in China is estimated to continue growing as space for landfill becomes an increasing problem. The need for volume reduction with the added benefit of electricity and heat production is often cited as the primary driver for EfW in China.

Due to the prevalence of EfW and the availability of information in English, EfW in Japan will be discussed in more depth. Japan has a long history of waste incineration as a primary means of disposal given the general lack of available space for landfill facilities. As a result, there is no need for a landfill disposal levy in Japan, and there is a surplus of thermal waste disposal capacity[50]. There are more than 300 thermal 'waste to energy' plants in operation in Japan[51]. Japan is

48 Co-incineration means the combustion of a waste or refuse derived fuel to substitute another existing fuel source such as natural gas or coal.

49 Themelis & Mussche (2013)

50 WSP Environmental (2013)

51 Themelis & Mussche (2013)

broadly considered the global leader in gasification technology with approximately 130 plants from 17 different technology providers currently in operation[52].

4.2.1 Policy: relevant laws in Japan

The *Waste Management and Public Cleansing Law 2001* was first established in 1970 and sets out regulatory requirements for waste disposal facilities including incineration facilities without energy recovery. The primary focus of incineration in Japan in the 1970s was volume reduction and ease of disposal, resulting in the establishment of many small facilities for individual municipalities. This law does not apply to energy recovery facilities as they are not considered as 'disposal'.

The *Basic Law for Promoting the Creation of a Recycling-Oriented Society 2000*, administered by the Ministry of the Environment, sets out the Japanese government's 'priority order' which promotes reducing, reusing and recycling waste in an equivalent manner to the EU Waste Hierarchy[53]. Further, the *Law for the Promotion of Effective Utilization of Resources 2001*, aims to promote integrated initiatives of the 3Rs (reduce, reuse, recycle) by designating 10 industries and 69 product categories that should include 3R policies at the design, manufacturing and end-of-life stages through the use of recycled components and voluntary collection and recycling by manufacturers.

4.3 Australia

There are limited examples of EfW facilities currently in operation within Australia, although there are several industrial facilities using anaerobic digestion, refuse derived fuel, or direct combustion technology with some form of waste utilised as a sole or major feedstock. Environmental authorities and regulators in Western Australia, Victoria, New South Wales, and South Australia have all undertaken some form of investigation into energy from waste technologies or published industry guidance or policies relating to the development of EfW facilities. Thermal EfW tends to be discussed to a much larger extent due to its distinctive juxtaposition to landfill disposal and the need to differentiate thermal EfW from thermal waste disposal – a practice which is currently only undertaken on any significant scale for the disposal of medical waste in Australia.

4.3.1 Jurisdictional policy settings

Each Australian state has taken a distinct approach to EfW regulation depending on several factors such as the immediate need, scale of the existing waste disposal sector and potential EfW sector, legislative framework, political and community interest, and level of development pressure.

TAS, NT and QLD have all discussed EfW to some extent within their respective state waste strategies but have not published any further specific advice or guidance on the topic. The *Draft Queensland Waste Avoidance and Resource Productivity Strategy 2014–2024* reports approximately 450MW of installed EfW capacity from bagasse (sugarcane waste) projects, landfill gas, and biogas production from manure, meat processing and sewage treatment processes.

NSW EPA has published a policy covering thermal EfW technology and sets out a regulatory framework for new proposals including resource recovery criteria, a list of eligible (low-risk) waste fuels, technical criteria and thermal efficiency criteria requiring the demonstration of 25% thermal efficiency. The NSW policy provides regulatory certainty to industry when considering the development of EfW facilities and is written in mandatory language as minimum requirements to be addressed during the development assessment process.

VIC EPA has published guidelines for EfW facilities with a focus on thermal treatment technology, setting out minimum expectations for proponents of EfW facilities. Major themes addressed include siting, design, operation, low-risk waste fuels, RDF, thermal efficiency criteria (EU R1 indicator), and technical criteria in line with that of the NSW EPA policy.

The WA EPA and Waste Authority provided a report to the WA Minister of the Environment in April 2013 detailing recommendations for the assessment of EfW development proposals. These recommendations are based upon the

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[52] City of Sydney (2014)

[53] EU waste hierarchy as per the *Waste Framework Directive 2008/98/EC*

contents of a three-stage technical research report prepared by WSP Environmental[54], published in January 2013 examining the environmental and health performance of EfW facilities globally. The report and its summary component reviews EfW technologies, examines case studies in Australia and internationally, and investigates potential risks and related management strategies. The report fundamentally concludes that EfW technologies utilising best available technology (BAT) are unlikely to produce any measurable impact upon land users surrounding EfW facilities.

Further reading

- NSW EPA, *Energy from Waste Policy Statement 2015*, www.epa.nsw.gov.au/resources/epa/150011enfromwasteps.pdf
- EPA Victoria, *Energy from Waste Guideline 2013*,

  www.epa.vic.gov.au/~/media/Publications/1559.pdf
- WA EPA & Waste Authority, *Environmental and health performance of waste to energy technologies, 2013* www.wasteauthority.wa.gov.au/media/files/documents/Rep_1468_Waste_to_energy_s16e_040413.pdf

4.3.2

NSW and VIC refer to 'eligible waste fuels' and 'acceptable feedstock for energy recovery' in their respective EfW policy and guidelines. These particular residual waste streams are considered sufficiently low risk to the environment and to human health, that they may be used directly in purpose-built boilers, or as fuel replacement in existing facilities. Low-risk waste fuels include biomass from agriculture, residues from plantation forestry and sawmilling, untreated wood waste, residue from paper pulp production, landfill gas, biogas and recovered waste oil.

The difference between the two jurisdictions is that NSW has a regulatory system requiring the assessment of such low-risk proposals including the requirement for the user and producer of the eligible waste fuel to obtain a resource recovery exemption and resource recovery order respectively. In VIC there is no further regulation provided these wastes are fully characterised, uncontaminated, homogenous, emissions to air are consistent with the its Air Quality Management Policy, and no thresholds are triggered for licensing as a 'waste to energy' or 'composting' facility.

Although the VIC and NSW regulatory approaches acknowledge low-risk homogenous and chemically consistent waste streams that may be used as a fuel or to generate electricity, they are not given 'product' status at any point. Rather these combustible materials are described as waste streams acceptable from an environmental risk standpoint to be used for energy recovery as an alternative to disposal or other forms of reuse.

South Australian examples of low-risk or eligible waste fuel reuse include the use of sawdust as a boiler fuel in timber mills, landfill gas capture and combustion and gas production from the anaerobic digestion of organic wastes producing biogas. Further opportunities for biomass energy production have been identified in SA by the *Waste Biomass Opportunities Map for the South East* (2014) and *Renewables SA Bio-energy Roadmap for South Australia* (2015). However there are few current examples of low-risk or 'eligible waste fuel' reuse currently occurring in SA, with the exception of landfill gas combustion.

The RDF standard (2010) addresses the use of some low-risk waste fuels including raw untreated timber, sawdust, and recycled oil meeting the specifications and standards set out in the *Product Stewardship (Oil) Regulations 2000* and also expresses the possibility of other similar low-risk waste fuels being exempted from the application of the standard.

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[54] WSP Environmental (2013)

5 Considering Energy from Waste in South Australia

5.1 South Australia's regulatory context

The principal legislation addressing pollution in South Australia is the *Environment Protection Act 1993* (EP Act) with the *Environment Protection (Waste to Resources) Policy 2010* (W2R EPP) providing more specific requirements for waste management activities. The objective of the W2R EPP is to achieve sustainable waste management by applying the waste management hierarchy consistently with the principles of ecologically sustainable development.

While discussing the potential for the development of EfW in SA, it is important to ensure that thought has been given to the relevant sections of the EP Act and W2R EPP. In particular, the following relevant pieces of legislation should be considered:

- EP Act Section 10 – Objects of the Act:
  - To promote the principles of ecologically sustainable development,
  - To ensure that all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment having regard to the principles of ecologically sustainable development.
- EP Act Section 25 – General Environmental Duty
  - A person must not undertake an activity that pollutes, or might pollute, the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.
- EP Act Section 47 - Criteria for grant and conditions of environmental authorisations
  - In determining—

    whether to grant or refuse an environmental authorisation; or

    what should be the term or conditions of an environmental authorisation,

    the Authority must—

    have regard to the waste strategy for the State adopted under the Green Industries SA Act 2004 (if relevant).
- W2R EPP Clause 7 – Waste Management Objective
  - The objective of this policy (the waste management objective) is to achieve sustainable waste management by applying the waste management hierarchy consistently with the principles of ecologically sustainable development set out in section 10 of the EP Act
  - Promote best practice and accountable waste management, taking into account regional differences within the State; and
  - Include effective recording, monitoring and reporting systems with respect to waste transport, resource recovery and waste disposal; and
  - Promote environmental responsibility and involvement in waste avoidance, waste minimisation and waste management within the community.
- W2R EPP Clause 4 – Certain Material Declared to be Waste
  - For the purposes of the definition of waste in section 3(1) of the EP Act, waste or material resulting from the treatment of waste continues to be waste except insofar as–
    - it constitutes a product that meets specifications or standards published from time to time or approved in writing by the Authority; or
    - if no specification or standard published or approved in writing by the Authority applies to such waste or treatment of waste—it constitutes a product that is ready and intended for imminent use without the need for further treatment to prevent any environmental harm that might result from such use.

5.1.1 Development Act 1993 – requirement for Development Approval

An EfW proponent would be required to obtain Development Approval from the relevant planning authority, either council or the Development Assessment Commission, as required by the *Development Act 1993*. The EPA as a referral body will be referred a copy of any EfW development proposal involving the conduct of a *prescribed activity of environmental significance*, as listed in Schedule 1 of the *Environment Protection Act 1993* (EP Act) to assess and to provide comment or direction upon appropriately depending upon the specific nature of the development referral. Among other legislated requirements, the EPA is notably required to have regard to the waste management hierarchy in accordance with clause 9 of the W2R EPP while undertaking an assessment of any development proposal and the Waste Strategy.

It should also be noted that approval is required by the Office of the Technical Regulator for all electricity generation proposals of 30MW or greater prior to any application for Development Approval.

5.1.2 Requirement for licence – Environment Protection Act 1993 (EP Act)

Environmental authorisations (in the form of a licence) are a fundamental tool under the EP Act to control risks and reduce environmental impacts. Licensing provides the EPA with the power to regulate activities undertaken by South Australian businesses or industry that pose significant risk to the environment. A full list of these industries can be found in Schedule 1 of the EP Act – 'Prescribed activities of environmental significance'. These activities range from large cement manufacturers, electricity generators and wastewater treatment plants to foundries, abattoirs and shipyards. Licensing enables the EPA to work actively with industry to safeguard against harm to public health and the environment.

A licence aims to control and minimise pollution and waste by setting conditions that the licensee must meet to minimise potential harm to the environment and people who live nearby. Licence conditions may relate to outcomes including discharge limits, management plans or environment improvement programs, infrastructure construction and maintenance such as stack heights and bunding, prohibitions and process or procedural requirements (eg not accepting toxic wastes).

A licence is also a public document, holding the licensee accountable for their environmental performance, both to government and the community.

A dedicated EfW facility receiving waste for an EfW process will require a licence as follows:

- 3(3) Waste or Recycling Depots:
  - …the conduct of a depot for the reception, storage, treatment, or disposal of waste….

Many EfW processes, particularly those generating and burning biogas or syngas will also trigger activity 8(2):

- 8(2) Fuel Burning:
  - the conduct of works or facilities involving the use of fuel burning equipment, including flaring... or incineration, where the equipment alone or in aggregate is capable of burning combustible matter–
    - (a) at a rate of heat release exceeding 5 megawatts….

A dedicated thermal EfW facility using technology such as direct combustion or gasification will also trigger activity 3(1):

- 3(1) Incineration:
  - the conduct of works for incineration by way of thermal oxidation using fuel burning equipment, being– …
    - (d) works for the destruction of solid municipal waste
    - (e) works for the disposal of solid trade waste with a processing capacity exceeding 100 kilograms per hour.

Other activities that may be triggered by an EfW process could include:

- 1(2) Chemical Works:
  - the conduct of—

(a) works with a total processing capacity exceeding 100 tonnes per year involving either or both of the following operations:

(i) manufacture (through chemical reaction) of any inorganic chemical, including sulphuric acid, inorganic fertilisers, soap, sodium silicate, lime or other calcium compound;

(ii) manufacture (through chemical reaction) or processing of any organic chemical or chemical product or petrochemical, including the separation of such materials into different products by distillation or other means….

- 3(4) Activities Producing Listed Wastes:
  - an activity in which any of the substances or things listed in Part B of [Schedule 1 of the EP Act] are produced as or become waste….

5.2 Achieving genuine resource recovery and the role of the waste levy

The SA waste depot levy applies to all waste disposed at a waste or recycling depot including landfill and liquid waste disposal facilities. The levy is an additional cost to market-based pricing mechanisms (landfill gate fees) which is intended to provide a true cost reflecting the social and environmental cost for the disposal of waste to landfill. The waste levy is also representative of the desire to minimise the production of waste and increase recycling. Clause 70(1) of the *Environment Protection Regulations 2009* states:

> [the waste levy is] …payable by the holder of a waste depot licence in respect of waste that is received at the depot for the purpose of being disposed of at the depot…

Within the context of the waste management hierarchy, the waste levy is intended to act as an incentive to divert waste from landfill into 'higher order' avoidance, reuse, recycling and energy recovery activities. An increasing levy on landfill waste disposal is likely to be the key driver towards the development of EfW facilities within SA and nationally.

It is difficult to accurately assess the level of demand for EfW within any Australian state given that most proposals will be subject to commercial-in-confidence unless details have been made publicly available. As shown in Table 5, NSW with the highest levy, anecdotally appears to have the most development occurring with established advanced waste treatment plants, anaerobic digestion facilities and increasing interest in various other forms of EfW development. WA has issued development approval for a direct combustion EfW facility, an gasification EfW facility and a wood waste pyrolysis facility.

It is also difficult to directly correlate higher waste levy rates with a higher prevalence of EfW in Australia due to the WA levy (currently at $60 per tonne for metro MSW) being less than half that of NSW. It seems likely that other factors such as the availability of local landfill disposal options and cost of landfill development will also affect the mid to long-term financial feasibility and prevalence of EfW in Australia. The waste disposal levy rate in any particular jurisdiction will be a factor attributed to interest in the development of EfW in comparison to ongoing landfill disposal.

Based upon the projected steady increase of the SA waste levy, it appears likely that interest in the EfW sector within SA may grow as technologies and infrastructure become financially favourable compared to the total cost of landfill disposal in consideration of construction, operation and ongoing regulatory and environmental costs.

Table 5 **Waste levy in Australian states (as at 1 July 2017)**

State	Current metro waste levy ($ per tonne)	Current regional waste Levy ($ per tonne)	Other Information
NSW	$138.20	$79.60	The 2018–19 waste levy rates will again increase by Consumer Price Index (CPI) only[55].
SA	$87.00 Rising to $100 in FY 2018–19 & $103 in FY 2019–20	$43.50 Rising to $50 in FY 2018–19 & $51.50 in FY 2019–20	From 1 July 2017, no levy applies to the disposal of packaged asbestos waste
VIC	Municipal – $63.28 Industrial – $63.28	Municipal – $31.71 Industrial – $55.46	
WA	Putrescible – $65 Inert – $60	N/A	Five-year forecast provided to industry specifying levy will increase to $70/tonne by mid-2018
TAS56	The Northern Tasmania Waste Management Group (NTWMG) $5 The Cradle Coast Waste Management Group (CCWMG) $5 The Southern Waste Strategy Authority (SWSA) $2	The Northern Tasmania Waste Management Group (NTWMG) $5 The Cradle Coast Waste Management Group (CCWMG) $5 The Southern Waste Strategy Authority (SWSA) $2	Three local government authorities have introduced their own levy system as not yet supported by state government
NT	–	–	NT Government has considered implementing a $10/tonne levy in 2014 Waste Strategy
QLD	–	–	Legislation in place, currently prescribes $0 levy
ACT	–	–	–

There are of course many other incentives for EfW including other levies, taxes, and renewable energy tariffs in use around world. Case Study 2 provides examples of different fiscal drivers for EfW including the use of a similar landfill disposal levy/tax in Europe, combined with an 'incineration' tax and the use of renewable energy feed-in tariffs in Japan.

55 As per the *Protection of the Environment Operations (Waste) Regulation [NSW] 2014*

56 TAS figures provided as at December 2016

CASE STUDY 2: Fiscal drivers

France

The French government introduced a ‘General tax on polluting activities’ including a landfill tax which came into effect in 2000 at a rate of €9.50/tonne. The goal of the landfill tax is to promote waste minimisation and increase recycling rates. Up until 2008 the landfill tax did not increase, however, as at 2015 the landfill tax had been incrementally raised to €40/tonne. Landfill facilities with ISO14001 or EMAS accreditation are entitled to a discount.

In 2009 an incineration tax came into effect at a rate of €7/tonne, applying to incineration facilities including energy recovery (EfW) facilities. The current incineration tax rate is levied at €14/tonne. Discounts are available, with a maximum applicable discount applied where an incineration facility meets two of the following three criteria:

- ISO14001 environmental certification.
- A thermal efficiency ratio achieving R1 recovery status.
- Nitrogen oxide emissions below 80 mg/Nm^3.

Of the approximately 110 operational French EfW facilities, all meet the EU *Industrial Emissions Directive* requirements for particulates, metals and dioxins and furans except in the case of nitrogen oxide which was on average 20% higher than the EU IED requirement as at 2006 (WSP Environmental, 2013), hence the inclusion of a tax incentive to reduce nitrogen oxide emissions. There are fewer than 10 EU member states with current incineration tax regimes in place, however, not all of those provide incentives for incineration facilities undertaking some form of energy recovery.

Notably, all EU member states with incineration taxes also have landfill taxes in place which are levied at a higher rate than the incineration tax (EC DG ENV 2012). Further, within an European context, there is a trend that higher incineration costs lead to higher rates of MSW recycling and composting, which indicates that higher incineration costs have channelled waste higher up the waste management hierarchy.

Japan

The Japanese Ministry of Economy, Trade and Industry (METI) commenced a Renewable Portfolio Standard (RPS) scheme in 2003 which ended in 2012 upon the commencement of a renewable energy feed-in tariff. An RPS scheme places an obligation upon electricity generators to produce or purchase a mandated amount of energy from renewable sources such as solar, wind, geothermal or biomass each fiscal year. An RPS scheme is market-based in terms of generally favouring the purchase of the lowest cost renewable energy sources in order to meet the required renewable energy generation targets.

A feed-in tariff scheme differs from an RPS as a tariff is mandated per kilowatt of energy produced which must be purchased by electric utilities regardless of the cost of the energy produced. This provides support for emerging technologies and less cost-competitive technologies. The METI through its Agency for Natural Resources and Energy states:

> Under the feed-in tariff scheme, if a renewable energy producer requests an electric utility to sign a contract to purchase electricity at a fixed price and for a long-term period guaranteed by the government, the electric utility is obligated to accept this request (METI 2012).

The feed-in tariff currently sits at approximately 40 JPY/Kwh for biogas, 13 JPY/Kwh for wood waste, and 32 JPY/Kwh for forestry residue with a purchase period of 20 years. The cost of the scheme is paid in part by the electricity utility and electricity users through a nationwide surcharge for renewable energy which is proportional to energy usage.

To facilitate discussion regarding genuine resource recovery and the role of the waste levy, Table 6 provides a suggested framework for the application of the waste levy to EfW in SA. The applicability of the waste levy as per the Environment Protection Regulations 2009 will depend on whether-or-not an EfW facility is considered to be undertaking disposal vs resource recovery.

Table 6 Suggested waste levy applicability with regard to EfW

	Energy recovery	Refuse derived fuel	Waste disposal
Waste undergoes pre-treatment in preparation of EfW process	✓	✓	✓ / ✗
Waste undergoes EPA approved resource recovery process	✓	✓	✗
Waste is processed into a fuel replacement product and meets an EPA approved product specification standard	✗	✓	✗
EfW technology applied to waste	✓	✓	✓
EfW licence required by facility	✓	✗	✓
Waste levy applies	✗	✗	✓

Questions

12 Considering the waste management hierarchy and the role of the waste levy, should a levy apply to an EfW activity? Would any such levy be higher, lower or equal to that associated with landfill disposal?

13 What other fiscal considerations could be applied to EfW in SA?

14 Given the complexity of EfW proposals and the nature of regulatory assessment that would be required, what methods of cost recovery could be used by government when responding to EfW development and ongoing operations?

5.2.1 Energy recovery vs disposal – R1 Recovery Status

The European Commission, through its Waste Framework Directive, has developed an efficiency indicator based upon an empirical formula to determine whether or not an 'incineration' facility involves the use of waste '…principally as a fuel or other means to generate electricity' (EC DG ENV 2011) as opposed to being regulated as a thermal disposal facility.

The R1 indicator is the most widely used regulatory method for determining the thermal efficiency of an EfW plant, however it must be noted that the R1 indicator was developed specifically for use in determining the efficiency of facilities that combust MSW, which happens to be the most common type of EfW facility in global terms.

Further reading

- *Guidelines on the interpretation of the R1 energy efficiency formula for incineration facilities dedicated to the processing of municipal solid waste according to Annex II of Directive 2008/98/EC on waste*, European Commission DG ENV 1022, *http://ec.europa.eu/environment/waste/framework/pdf/guidance.pdf*

There is no criteria currently mandated by legislation in SA to differentiate disposal by incineration from energy recovery. The European R1 indicator is the only generally available criteria that could be applied at present for this purpose and has been adopted by WA and VIC for determining thermal efficiency of such facilities. The NSW EPA has stipulated thermal efficiency criteria where it must be demonstrated that 25% of the energy generated by thermally treating a waste will be captured as electricity. According to EfW policy in VIC, NSW and WA any proposed EfW direct combustion facility that meets the relevant state's energy efficiency criteria would not be considered as a disposal operation and the relevant waste disposal levy would not apply.

5.2.2 Resource recovery criteria for thermal EfW processes

All Australian jurisdictions with published EfW sector-specific policy or guidance iterate that thermal EfW technology (particularly direct combustion and gasification) must only be used for residual waste streams that would otherwise be disposed to landfill and for which no viable higher order alternative recovery option exists. The waste management hierarchy has been adopted by each state within overarching strategic policy and is discussed within specific EfW advice and guidance documents. SA's Waste Strategy discusses EfW within the context of the waste management hierarchy:

> …energy from waste should support and not disregard any viable options for higher order beneficial uses and have regard to impacts to businesses and supply chains that compete for the same feedstock materials. (GISA 2015).

The issue of suitability when describing the case for EfW is highly dependent upon analysis of a proposed feedstock for alignment with energy recovery, as it is ranked higher than landfill disposal, while having regard to the higher order reuse and recycling categories. The case for EfW of suitability of waste streams as feedstock should be addressed by EfW development proponents.

MSW and C&I waste streams are already being subjected to some measure of resource recovery prior to the disposal of residuals to landfill across most jurisdictions. In order to maintain higher order waste pathways as per the waste hierarchy, such as well-established recycling, composting and resource recovery sectors, the NSW EPA has taken an empirical approach in setting 'resource recovery criteria' by restricting the total volume of residual waste streams that may be used as feedstock for a thermal EfW facility by waste type and level of segregation treatment process.

For example, a thermal EfW plant in NSW may receive limitless mixed MSW from an approved processing facility where the waste is received from a council with separate collection systems for dry recyclables, food waste, and garden waste. However, the plant may only receive up to a maximum of 40% by weight of the waste stream received at an approved processing facility where the waste is derived from a council with separate collection systems for only dry recyclables and garden waste. The restrictions that have been placed upon EfW waste feedstocks in NSW were developed in collaboration with industry representatives and relevant non-government organisations.

Any specific resource recovery criteria should be approached carefully with regard to EfW feedstock and higher order reuse and recycling options. Numerical criteria should be based upon the potential impacts to or risk of adverse economic impacts upon higher order resource recovery markets. Conversely, the WA EPA recommends that all proponents of EfW facilities have regard to the security of waste feedstock for the operational life of an EfW plant especially with regard to improvements that are likely to occur in collection and processing technologies over time, as this will reduce future EfW feedstock availability (residual wastes available for energy recovery).

5.2.3 Resource recovery criteria for biological EfW processes

No Australian states or territories have set resource recovery criteria for biological EfW processes. This likely to be due to the fact that resource recovery criteria is not so pertinent when discussing biological EfW processes such as anaerobic digestion where neat (source segregated or individual feedstock) organic waste streams such as food waste are required as feedstock and the technology does not allow much scope for indiscriminate thermal destruction as might be the case for a direct combustion facility.

It is generally a requirement for a food waste digester to have incoming feedstock that is highly organic, high in moisture content, and free of contamination such as plastic, foam and glass enabling the process to operate efficiently. Further, in the case of residual MSW, inorganics must be removed from the waste feedstock as much as is practicable for the process to function at optimal levels and reduce ongoing maintenance costs. It is therefore inherent within the design of anaerobic digesters that the waste feedstock is appropriate for the facility, whereas a thermal treatment facility might be more easily able to utilise the calorific value present within a waste stream even though it has not been appropriately subjected to resource recovery processes to remove recyclable materials.

5.2.4 Pre-treatment of EfW feedstock

The pre-treatment of a waste stream prior to an EfW process can be undertaken for a variety of reasons including resource recovery, homogenisation and moisture adjustment (to improve calorific value and combustibility/digestibility), and the removal of non-combustible/non-digestible materials (metals and glass, minerals). Figure 7 provides an overall view of major potential EfW feedstocks and suggests pre-treatment of those wastes prior to undertaking an EfW process.

The primary regulatory reason for mandated pre-treatment of waste in general terms is to ensure that any resources are recovered from the waste to the maximum extent achievable. It is a legislated requirement of the *Environment Protection (Waste to Resources) Policy 2010* that all waste is subjected to pre-treatment for resource recovery prior to the final disposal of the residual wastes from approved resource recovery processes to landfill. This approach supports the waste management hierarchy.

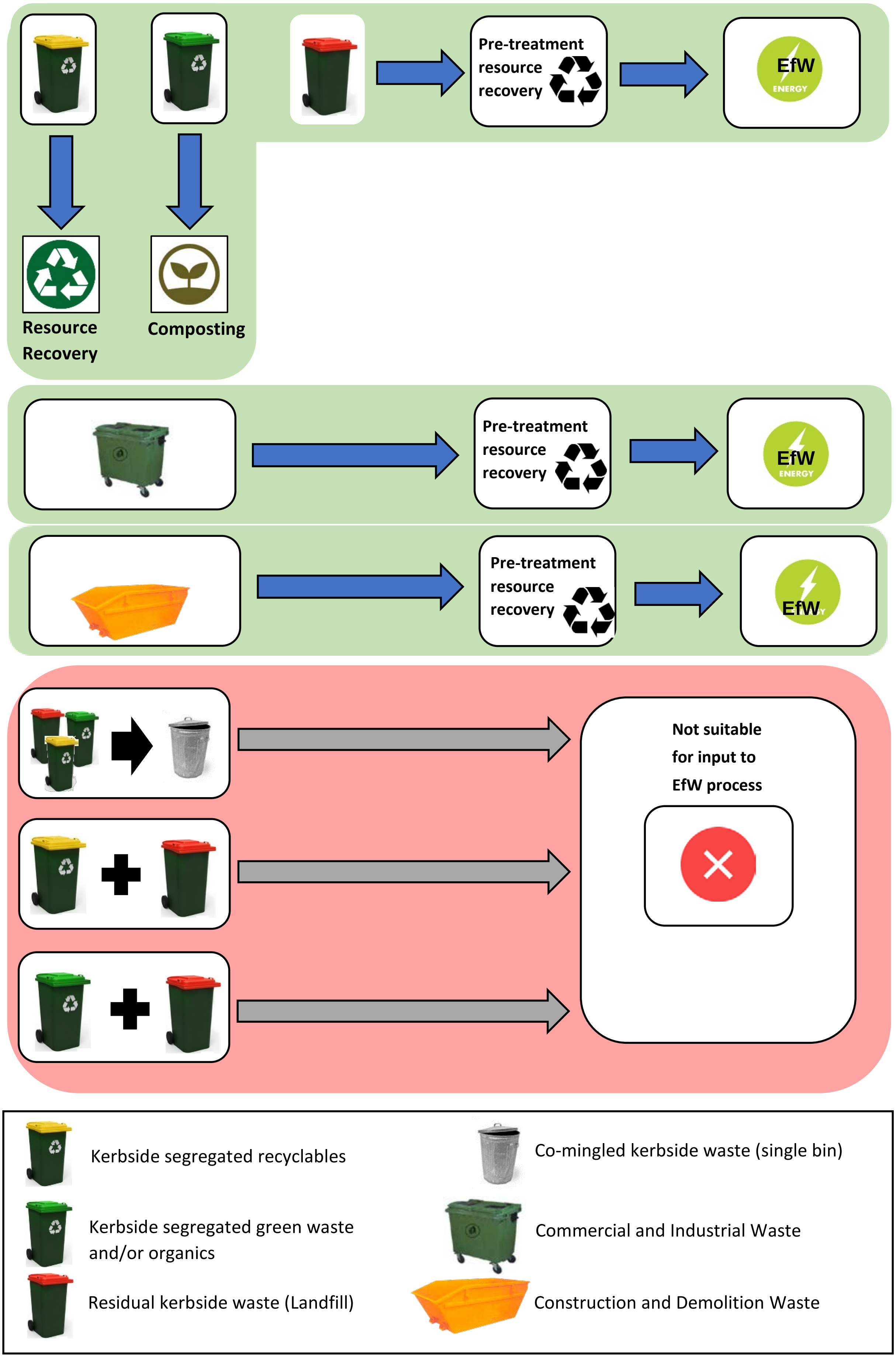

Figure 7 **Potential EfW input framework for SA**

Questions	
15	Is a three-bin kerbside collection system a sufficient method of resource recovery prior to undertaking EfW on the residual component?
16	Would it be necessary to require mandatory resource recovery criteria to be met for residual kerbside waste prior to EfW?
17	In a similar manner to the existing requirement of the *Environment Protection (Waste to Resources) Policy 2010* to treat waste in order to recover resources prior to the disposal of waste to landfill, should the EPA consider mandating that resource recovery is undertaken prior to an EfW process?
18	Should a mechanism be considered requiring minimum resource recovery criteria to be met by local government before they can be eligible to put residual waste to EfW (ie criteria that are consistent with the future SA Waste Strategy landfill diversion targets)?
19	What level of resource recovery should be required eg, a blanket minimum standard vs waste-stream-specific targets and would this change depending upon the source and/or type of any particular waste stream?
20	How prescriptive should the EPA be in pursuing resource recovery criteria applying to EfW, how could market forces assist or not assist in determining resource recovery outcomes for EfW?
21	Should SA look to adopt an energy efficiency criteria (such as the EU R1 indicator) as a means of assessing energy recovery vs disposal for thermal EfW proposals?
22	How far into the future should we consider new recycling and reuse technologies improving to the extent that EfW is no longer economically viable and the likelihood of stranded assets becomes a significant risk?
23	Do EfW facilities have the potential to hamper ongoing innovation in resource recovery?

5.3 Managing potential impacts from Energy from Waste facilities

In general terms, the potential environmental impacts associated with EfW facilities are similar to those associated with waste transfer stations and landfills such as general operational noise, odour, litter and vermin. Air emissions from the thermal treatment of waste is a distinctive additional potential environmental impact that must be appropriately managed. This section of discussion will address the major potential impacts of EfW facilities with a focus on the management of air emissions.

5.3.1 Siting

The siting of an EfW facility must have regard to the *Guideline: Evaluation distances for effective air quality and noise management* (EPA 2016). The minimum recommended evaluation distance for an EfW facility is dependent upon the type of treatment proposed and the activities triggered under Schedule 1 of the EP Act.

Appropriate facility siting will have regard to the recommended evaluation distances and should prevent impacts upon sensitive receptors. The application of evaluation distances is not seen as a substitute for the use of best-practice technology or as an alternative to controls at the source and utilisation of cleaner production methods. Furthermore, the use of evaluation distances is not an alternative to compliance by industry with its statutory obligations. If an evaluation distance is not listed in the guideline for a particular proposed activity, an individual assessment will be required.

5.3.2 Noise

The potential for noise to be generated by a proposed EfW facility should be addressed by a proponent. It is a requirement for all new development and operational activities to meet the requirements of the *Environment Protection (Noise) Policy 2007*. The *Position Statement: Noise and the South Australian Planning System* (EPA 2016) is also available to proponents at the development application stage.

Potential sources of noise associated with EfW facilities include, low frequency rumbles from combustion processes, the movement of vehicles to/from and within a site, loader buckets scraping hard surfaces, reversing alarms, and impulse noises caused by moving or dropping materials. Low frequency noise can travel across long distances, penetrate buildings and can become more problematic in the quiet of night when other ambient noise subsides.

5.3.3 Odour

The potential for odour to be caused by the receipt, loading, unloading, storage, sorting, treatment and processing of waste should be addressed by a proponent. The *Position Statement: Air Quality and the South Australian Planning System* (EPA 2016) is relevant to EfW facility proponents.

5.3.4 Community consultation and ongoing engagement

The siting of an EfW facility has the potential to generate interest or concern within neighbouring community and other non-government organisations or interest groups. All EfW projects that require development approval will be subject to community consultation and/or notification as required by section 38 of the *Development Act 1993*, and section 39 of the EP Act during the development assessment and licensing processes respectively.

Proponents of EfW processes could consider publishing any available real-time emissions monitoring data on the web as best-practice community engagement, in a similar manner to many European facilities and as recommended by the WA government. The conduct of regular public community forums or the establishment of an ongoing consultative committee with agreed terms of reference where significant community interest exists are also encouraged, and would actively demonstrate the commitment of a proponent to ongoing corporate citizenship.

5.3.5 Air quality and emissions management – SA's regulatory approach

The EPA uses a range of regulatory instruments for assessing environmental authorisations, development authorisations and monitoring with regard to air quality. This includes assessing applications against maximum non-mandatory stack emission levels and ground level concentrations (GLCs). It should be noted that the *Environment Protection (Air Quality) Policy 2016* (AQ EPP) requires background pollutant levels to be assessed and also provides the EPA with the ability to take a 'whole-of-air-shed'[57] approach to managing specific areas of concern where existing local background air quality is also taken into account through the setting of a localised ambient air quality objective under the AQ EPP.

A number of factors determine the risk to communities from exposure to air pollution, including the amount of pollutants emitted, the emission sources and locations, weather, topography, natural events and the size of the airshed. The *l*ocalised ambient air quality objective provision of the AQ EPP provides the EPA with the ability to declare that localised air quality objectives apply for a specific area. This process results in a person or body corporate carrying on an activity in such an area ensuring that any pollutants do not exceed any ambient concentrations declared for that pollutant.

In this way, SA's air emissions monitoring and management framework is similar to that of the EU whereby member states may set licence-specific emission limit values (ELVs), and of Japan where individual prefectures[58] may set limits derived from regional airshed quality. There are however some differences in measurement methodology, reporting, and also with regard to the demonstration of the use of BAT as required by the EU BAT Reference document (BREF). Appendix 1 provides a detailed summary of the management of air emissions from thermal EfW facilities in the EU and Japan and explains how ELVs are set.

There are also some major differences between applying stack emission limits, which have regard to the concentration of a pollutant in a stack but not the volume of the pollutant being emitted, vs applying an assessment of potential GLCs of pollutants based upon a thorough understanding of potential emissions from a point source, fugitive sources, local topography, weather patterns and ambient air quality.

57 A geographical area where local topography and meteorology limit the dispersion of pollutants away from the area

58 A Japanese 'prefecture' is a form of government administrative division

GLCs are generally accepted as being more representative of the actual environmental impact of emissions from an air pollution source. GLCs are used to conduct the risk-based assessment of air emissions impacts, usually through modelling which can be used to guide the setting of appropriate licence conditions requiring monitoring of air emissions at the point source (stack) to ensure compliance with the AQ EPP.

The AQ EPP provides a robust regulatory framework for the management and monitoring of potential air emissions, however it should be noted that the stack emission limits or ELVs set out by the EU IED are much lower than many of those set out by the AQ EPP. On face value this might appear to suggest that the EU legislation is more stringent, however stack emission limits do not have regard to the receiving ambient air quality nor the total volume of pollutants emitted and should not be examined for comparison in isolation of other regulatory factors. It must be noted that individual EU member states have some flexibility through the EU IED in how they manage emissions and set ELVs due to local airshed concerns. It must also be noted that the EPA does not currently regulate greenhouse gas emissions, however identifying the greenhouse gas emissions intensity of a proposed EfW facility compared to other energy sources, waste pathways, and generation methods and any associated offsets may influence attaining a 'social licence'[59] to operate.

5.3.6 'Proof-of-concept' and reference facilities

EfW comprises several technologies with a variety of potential applications to different waste streams. Furthermore, many EfW technologies have not been commercially applied within Australia to date and some are not necessarily easily scalable for industrial application. Therefore it will be necessary for proponents of EfW to demonstrate 'proof-of-concept' with a particular emphasis upon the extent to which the proposed technology is proven. It will be important to understand that the technology proposed for an EfW process will perform as expected especially with regard to the outputs, emissions and residual wastes produced by the process.

Most Australian states require proponents to demonstrate that EfW technology has been successfully applied elsewhere. There are instances where advanced waste treatment technologies have failed in Australia for both technical and economic reasons. The adoption of existing and proven technology will assist in addressing the potential technical and/or financial risks associated with the development of new facilities in SA. It is natural that markets will seek to avoid such outcomes and regulators will seek sufficient detail on the conceptual proof behind an EfW proposal.

The EPA or equivalent authority in VIC, WA and NSW have all published guidance to assist proponents of EfW with regard to proof-of-concept, largely based upon the ability to refer to existing and established 'reference facilities' which also importantly addresses the anticipated environmental performance of any development proposal for an EfW facility including clarity on feedstocks and detailed specifications in relation to emissions .

The VIC EPA requires a thermal EfW to demonstrate best practice in accordance with published guidance, meet the *Environment Protection Policy (Air Quality Management) 2001,* and the emissions standards and monitoring requirements of the EU IED.

WA, through its 2013 report has effectively adopted the EU IED with regard to emission limits and monitoring requirements and advocates that EfW plants are designed with regard to best practice using best practicable measures (BPM), meeting all relevant environmental quality standards and controlling hazardous pollutants such as dioxins to the maximum extent achievable. It is however unclear whether or not WA's adoption of the IED infers that BAT discussed within the EU BREF is also intended to apply due to the use of differing terms with reference to BPM as opposed to BAT specifically.

NSW has selected some specific technical design and monitoring requirements consistent with that of the EU IED. Additionally NSW requires that EfW (specifically thermal processes) demonstrates 'current international best practice techniques' using proven technology with reference to fully operational facilities adopting the same technology and similar waste streams, while emission limit values are required to comply with the NSW *Protection of the Environment Operations (Clean Air) Regulation 2010*.

59 'Social licence' means broad and ongoing local community and other relevant stakeholder acceptance of a proposal

Similarly, the VIC EPA requires that '…proposed technologies must be proven, well understood and robust. This should be demonstrated through reference to other locally or internationally established plants using the same technologies, and, if possible, treat comparable waste streams on a similar scale[60]'.

The WA Waste Authority and EPA make perhaps the strongest recommendation of any Australian environmental regulator that:

> Waste to energy [EfW] proposals must demonstrate that the waste to energy and pollution control technologies chosen are capable of handling and processing the expected waste feedstock and its variability on the scale being proposed. This should be demonstrated through reference to other plants using the same technologies and treating the same waste streams on a similar scale, which have been operating for more than 12 months. (WA EPA and Waste Authority 2013).

Questions

24 How might a 'social licence' be applied to a proposal for an EfW facility? What would the process be for proponents in securing a 'social license'?

25 What role will air quality modelling data play in securing a social license?

26 Should the EPA develop and publish minimum evaluation distances specific to different groups or types of EfW facilities which would be used to decide how to proceed with scientific investigations into potential environmental impacts during the planning process?

27 WA, VIC, and NSW all require proposals for EfW to demonstrate proof-of-concept through direct comparison of the proposal to a suitable reference facility already in operation within Australia or overseas. Should this requirement also be considered in SA?

28 With a view to achieving a net environmental benefit, are there opportunities for coordinating the cross-jurisdictional movement of waste feedstock for EfW facilities?

60 EPA VIC (2013)

6 Summary of questions

Section	Topic	Question
2	Why is Energy from Waste being considered for South Australia?	1 Is there an opportunity to expand EfW in SA? If so, with what source material (waste feedstock) and technologies? 2 Could the EfW sector be further developed through public or private investment and ownership or as a partnership? 3 Is EfW technology best applied at a site-specific or district level, or at a larger scale? 4 Could EfW make a significant contribution to the baseload energy grid and the national energy market going forward? 5 Could the uptake of EfW assist in the reduction of the use of high greenhouse gas emissions intensity fuel contributing to a low carbon future? What are the factors that could assist with displacing high intensity fuels? What are the factors that could lead to EfW displacing renewables? What regulatory mechanisms or policy could be applied to EfW to reduce the extent of any displacement of renewables? 6 What is the EPA's role in safeguarding the waste hierarchy with regard to EfW eg ensuring that wastes with high calorific value such as plastics are not diverted to thermal EfW potentially undermining higher order recycling, reuse and reduction activities? 7 Could EfW as an alternative to landfill deliver net environmental benefits to SA in the form of greenhouse gas emission reductions, management of fugitive air emissions, and ensuring the environmental quality of waters? What regulations and policy could reduce the extent of any net cost in one or more of these factors? 8 If an EfW proposal is to be grid-connected what opportunities and challenges might lie ahead with regard to EfW energy end-user agreements, ie with regard to securing agreements and feedstock material, accessing infrastructure and the cost of bringing this energy to the market? 9 Is it feasible and necessary for proponents of EfW to demonstrate the greenhouse gas emissions intensity and lifecycle emissions of their proposal? What range of data and what level of evidence should be required? How would it be validated? 10 Should proponents of EfW be required to demonstrate that the greenhouse gas emissions intensity is less than that of currently utilised baseload and peaking energy fuels while the state transitions to its target of zero net greenhouse gas emissions by 2050?
3	What are the different types of Energy from Waste?	11 Is there a role for the further development of some EfW technologies or processes vs others? Why, and under what circumstances?

Section	Topic	Question
5.2	Achieving genuine resource recovery and the role of the waste levy	12 Considering the waste management hierarchy and the role of the waste levy, should a levy apply to an EfW activity? Would any such levy be higher, lower or equal to that associated with landfill disposal? 13 What other fiscal considerations could be applied to EfW in SA? 14 Given the complexity of EfW proposals and the nature of regulatory assessment that would be required, what methods of cost recovery could be used by government when responding to EfW development and ongoing operations?
5.2~5.2.4	Achieving genuine resource recovery and the role of the waste levy	15 Is a three-bin kerbside collection system a sufficient method of resource recovery prior to undertaking EfW on the residual component? 16 Would it be necessary to require mandatory resource recovery criteria to be met for residual kerbside waste prior to EfW? 17 In a similar manner to the existing requirement of the *Environment Protection (Waste to Resources) Policy 2010* to treat waste in order to recover resources prior to the disposal of waste to landfill, should the EPA consider mandating that resource recovery is undertaken prior to an EfW process? 18 Should a mechanism be considered requiring minimum resource recovery criteria to be met by local government before they can be eligible to put residual waste to EfW (ie criteria that are consistent with the future SA Waste Strategy landfill diversion targets)? 19 What level of resource recovery should be required eg, a blanket minimum standard vs waste-stream-specific targets and would this change depending upon the source and/or type of any particular waste stream? 20 How prescriptive should the EPA be in pursuing resource recovery criteria applying to EfW, how could market forces assist or not assist in determining resource recovery outcomes for EfW? 21 Should SA look to adopt an energy efficiency criteria (such as the EU R1 indicator) as a means of assessing energy recovery vs disposal for thermal EfW proposals? 22 How far into the future should we consider new recycling and reuse technologies improving to the extent that EfW is no longer economically viable and the likelihood of stranded assets becomes a significant risk? 23 Do EfW facilities have the potential to hamper ongoing innovation in resource recovery?

Section	Topic	Question
5.3	Managing potential impacts from Energy from Waste facilities	24 How might a 'social licence' be applied to a proposal for an EfW facility? What would the process be for proponents in securing a 'social license'? 25 What role will air quality modelling data play in securing a social license? 26 Should the EPA develop and publish minimum evaluation distances specific to different groups or types of EfW facilities which would be used to decide how to proceed with scientific investigations into potential environmental impacts during the planning process? 27 WA, VIC, and NSW all require proposals for EfW to demonstrate proof-of-concept through direct comparison of the proposal to a suitable reference facility already in operation within Australia or overseas. Should this requirement also be considered in SA? 28 With a view to achieving a net environmental benefit, are there opportunities for coordinating the cross-jurisdictional movement of waste feedstock for EfW facilities?

7 Next steps

During the consultation period, the EPA will host:

- Stakeholder workshops/information sessions in the Adelaide CBD, Mount Gambier and Port Pirie.
- Meetings with WMAA and Waste Industry Reference Group.
- Direct discussions with major stakeholders as requested, including in regional areas.

Views and submissions received on the options and questions presented in this paper will then be reviewed by the EPA, along with resourcing considerations, to determine the options to be pursued for the development of further EfW policy and other broader regulatory framework considerations.

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Appendix 1

1.1 European Commission Industrial Emissions Directive

The Industrial Emissions Directive (IED) aims to achieve significant benefits to the environment and human health by reducing industrial emissions and sets out upper limits for air emissions in the form of emission limit values (ELVs). Annex VI of the IED sets out ELVs for 'Waste Incineration' which includes direct combustion, gasification and pyrolysis EfW technologies. The IED is based upon several core concepts as follows:

- An *integrated approach* to managing industrial emissions covering the management of emissions to air, water and land, generation of waste, use of raw materials, energy efficiency, noise, prevention of accidents and restoration of the site upon closure.
- The setting of permit[61] conditions that are based upon best available techniques (BAT). BAT is defined by experts from government, industry and environmental organisations within the EU and formalised by the publication of recommendations and conclusions in BAT reference documents (BREFs) which must be used as a reference in setting permit conditions including ELVs.
- Authorities are also given some flexibility to set less strict ELVs than those set out in the BAT as BAT-associated emissions levels or BAT-AEL. This is only to be undertaken where there would be disproportionately higher costs associated with achieving the BAT-AELs compared to the environmental benefits, eg due to the location and local environmental conditions.
- Mandatory environmental inspections, conducted by the relevant government authority, must be undertaken in accordance with inspection plans every 1–3 years using risk-based criteria as justification for the inspection frequency.
- Public participation is mandated by the IED to ensure that permit (licence) applications are available to the public for comment. Once issued, the permits themselves and results of monitoring of emissions must also be available (EC 2016).

It is important to iterate that the IED sets out upper ELVs for EfW facilities, however it also mandates that Authorities use BAT when setting final ELVs for permit (licence) conditions. The consultatively developed waste incineration BREF, is mandated when determining what constitutes BAT, and therefore to some extent, how a facility must be designed and perform in terms of air emissions. The BREF sets out Associated Emission Levels or BAT-AELs which are essentially the emissions that are expected to be generated by a modern thermal EfW facility based upon a robust analysis of the actual emissions from facilities already using the best emissions control technology.

1.2 National and prefectural-based emission limits in Japan

The *Air Pollution Control Law 1968*, and *Law Concerning Special Measures against Dioxins 1999* apply to emissions from EfW facilities in Japan. The Ministry of the Environment prescribes emission standards by ordinance, which are published on its website. However, it is important to note that prefectural or municipal governments may set their own relevant emission limits for industrial source air emissions based upon regional airshed quality or community and human health concerns. This results in significant differences in air emissions limits for a variety of pollutants across the country (WSP Environmental 2013).

It is generally understood that emission limits for EfW facilities in urban areas are higher than those located in rural areas. However with 47 prefectures in Japan and limited availability of English information it is difficult to find and present precise data. The type of EfW technology used in different prefectures may also differ due to difficulty in meeting local air emission limits. It is generally believed that in most cases Japanese air emission limits are less stringent than those of the EU (WSP Environmental 2013).

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61 Permits, equivalent to environmental licenses, are issued by individual countries of the EU and must have conditions set as per the principles of the IED, including in the setting of ELVs for individual facilities.