1. Executive Summary

Background

Waste generation in Victoria continues to grow with currently more than four million tonnes disposed annually to landfills. Landfills generate nuisance odours and complaints from nearby residents and even best practice landfills generate fugitive methane emissions in considerable quantities, which is a significant contributor to environmental greenhouse gas production. Over the last 10 years many of the metropolitan and regional landfills in Victoria have closed, forcing councils to rely on fewer, larger landfill facilities typically located further from council collection areas. This has imposed a greater transport burden on these councils. It has resulted in additional greenhouse gas production through transit and contributes to growing congestion across Melbourne’s major transport corridors.

In response, REA is proposing to construct a WtE facility in Laverton North (Figure ES-1) which will process a nominal 200,000 tonnes per annum of residual waste collected from the kerb side municipal collection system and residues from materials recovery facility (MRF) separation plants. This proposed facility will be based on well tested gasification technology and will generate approximately 17.2 MW of electricity. After allowing for the parasitic load (2.1 MW) required to operate and manage the MSW processing operation, the facility will dispatch approximately 15.1 MW of base load power into the grid and/or to nearby industrial energy users. Provision has been made in the early design to allow the supply of steam and heating to surrounding industry as demand for these commodities develop in the surrounding industrial zone.

REA’s Laverton North proposed gasification facility, if accepted, will be the first in Australia to provide a localised solution for managing locally generated residual municipal waste. The site was specifically selected for its planning zone and proximity to a heavily industrialised area that demonstrates a continuously growing demand for energy. The energy produced by the REA project offers a ready supplement to local energy demand through direct grid connection and/or direct supply of steam or hot water to adjacent industry.

The REA WtE project is based on recovering energy primarily from residual waste which has been sorted by the householder. Whilst it is recognised that recoverable/recyclable materials do occur in residual waste, the SWRRIP study highlighted that “improved source separation and a reduction in the contamination at the point of generation” were key to improving recovery of recyclable materials from the residual bin collection system. The REA proposal foresees and allows for a reduction of up to 50% in food waste entering the MSW stream. Furthermore, it facilitates the recovery and recycling of metals and inert material, such as glass, for reuse in products like road construction materials.

It is REA’s view that recovering energy from this residual waste stream is a better outcome for the community, environment and public health than the alternative, disposal to landfill. In this context, REA believes the proposal is consistent with the objectives of the Statewide Waste and Resource Recovery Infrastructure Plan (SWRRIP).
Figure ES-1: Map Showing the Location of the Proposed REA WtE Facility
It should be noted that the proposed WtE project is currently in the preliminary design phase and there is the opportunity to vary aspects of the design to accommodate and include recommendations of stakeholders in the detailed project design.

**Project Benefits**

The proposed project if licensed and then successfully implemented will result in benefits for the local community, region and the State. These will include:

- Providing an additional 40 full time equivalent jobs during operation and approximately 400 jobs during construction;
- Localised state of the art renewable energy generation (that can support local industry and community) that diverts around 195,000 tonnes of MSW from landfill per annum;
- Improved environmental waste management outcomes;
- A localised operation that will reduce waste haulage distances and is expected to be cost comparable with landfill gate fees;
- Delivering a significant reduction in net greenhouse gas (GHG) emissions with a net annual emissions reduction over business as usual of 237,007 tCO2e/annum. This is equivalent to the removal of 100,000 cars from the road;
- Increased energy security by delivering around 15.1 MW of base load electricity into Western Suburbs grid with the potential to deliver steam and hot water to industry in the Laverton North industrial area.

**Choice of Technology**

REA has spent considerable time and resources investigating alternative processes and suppliers for managing the disposal of MSW. REA’s directors have an extensive history evaluating a range of pathways including conventional incineration, gasification, pyrolysis, mechanical biological treatment (waste sorting with anaerobic digestion) and combinations of these processes to identify options capable of meeting the specific financial and environmental conditions necessary to secure the support of Melbourne’s communities, financiers and regulators. The positive and negative aspects of each technology were assessed against the criteria listed below:

- The technology needed to be the best available for the treatment of household mixed residual waste. Its working specification had to be capable of accommodating the compositional variations in waste expected over time as household recycling habits change and consumer expectations evolve (i.e. the introduction of Food organics and garden organics combined collection (FOGO) or reduction in packaging);
- Specifically, the technology needed to be able to effectively process the entire residual waste stream with relatively low energy values (as low as 6.6MJ/kg);
- The technology needed to demonstrate best practice environmental performance and clearly offer a significant improvement on the environmental performance of Victoria’s best practice landfills. In this context, operation of the system at temperatures exceeding 1100°C was important as this would minimise the potential for precursor hydrocarbon generation and restrict the potential for the formation of complex organic molecules such as dioxin and furan;
- Be scalable to accommodate small groups of councils, providing an opportunity for councils to take responsibility for their own residual waste and reduce their transport and handling requirements;
- Be financially viable within the context of the existing and projected landfill gate fees and wholesale energy prices in Victoria;
The technology needed to demonstrate a history of technical and operational reliability processing MSW to energy at full scale production to requisite specifications with sufficient reference sites operating over at least five years to demonstrate reliability and credibility;

- The technology provider needed to show an association/partnership with a credible third-party Engineering, Procurement and Construction (EPC) contractor capable and willing to validate and underwrite the integrated facility performance necessary to facilitate cohesive design and construction.

This evaluation identified gasification as the most suitable for the treatment of mixed residual wastes comparable to that of Melbourne’s household residual bin waste. Importantly, the technology was scalable to accommodate small groups of Councils and it offered the best opportunity to generate energy from waste with a viable financial return at gate fees consistent with those expected in Melbourne. This technology generated only minimal residual waste thereby optimising diversion from landfill and significantly mitigated the associated current and legacy environmental impacts associated with MSW disposal to landfills. An example of the gasifier technology is shown in Plate ES-1.


This internal evaluation has subsequently been validated by a recently completed independent third-party technical review of the proposal which has confirmed the suitability of the EcoWaste vertical rotating gasifier for the processing of mixed residual waste in Victoria.

Overview of Technology

REA is proposing to install a gasifier waste treatment system with heat recovery and electricity generation which is capable of operating on relatively low energy value MSW (6.6MJ-13.2MJ/kg) originating from Metropolitan Melbourne’s source separated residual household waste bin collections. The treatment system proposed is modular with the current design incorporating six individual gasifiers which, based on the compositional analysis of the residual household waste
predicted in 2021 (11.3MJ/kg), will provide for the treatment of a nominal 600 tonnes per day of residual MSW (200,000t/annum).

The key elements of the design are summarised in Table ES-1. A diagrammatic overview of the chosen gasifier technology is shown in Figure ES-2. The WtE system includes the following major components:

- MSW feeding system;
- Gasification system;
- Waste heat recovery (power generation) system;
- Flue gas cleaning and emission control system;
- Automated operational control system and the online monitoring system.

<table>
<thead>
<tr>
<th>Throughput Volume</th>
<th>200,000 (±20%) – Maximum 240,000, Minimum 160,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedstock</td>
<td>Residual municipal waste including residual waste destined to landfill from MRF’s</td>
</tr>
<tr>
<td>Number of Process Lines</td>
<td>3 processing lines</td>
</tr>
<tr>
<td>Auxiliary Fuel</td>
<td>Hot commissioning and start-up of gasifier with clean waste wood suitable for use as boiler fuel, Syngas oxidation chamber commissioned using diesel, after temperature reached no requirement for additional fuel. Emergency – diesel generator</td>
</tr>
<tr>
<td>Acid Gas Abatement</td>
<td>Semi-dry lime and caustic soda injection</td>
</tr>
<tr>
<td>NOx Abatement</td>
<td>Selective Non-catalytic Reduction (SCNR) using urea</td>
</tr>
<tr>
<td>Water Consumption</td>
<td>100 ML/annum</td>
</tr>
<tr>
<td>Flue Gas Recirculation</td>
<td>System fitted with flue gas return after boiler to the secondary oxidation chamber for use in temperature control</td>
</tr>
<tr>
<td>Dioxin/Furan Abatement</td>
<td>Effective destruction of precursor compounds in gasifier (≥850°C) and high temperature secondary oxidation chamber (temperatures 1100°C - 1200°C) ensure almost complete destruction of precursor chemicals. De Novo reforming abated by rapid cooling in the heat recovery section and injection of powdered activated carbon into the cooled flue gas stream. Carbon and particulates are then removed in a baghouse filtration system</td>
</tr>
<tr>
<td>Reagent Consumption</td>
<td>Lime ~ 2768 t/a; Urea ~ &lt;800 t/a; Activated Carbon ~ 157 t/a</td>
</tr>
<tr>
<td>Stack</td>
<td>Height 38m; Diameter 2m</td>
</tr>
<tr>
<td>Flue Gas</td>
<td>Flow - 47.14 m/sec; Velocity – 15m/s</td>
</tr>
<tr>
<td>Energy Production</td>
<td>17.2MW electricity. Design includes ability to export steam or hot water when demand from local industry is apparent.</td>
</tr>
</tbody>
</table>
Calculated Efficiency | R1 factors of >0.73 for the scenarios modelled for electricity only generation. Should local industry development allow use of steam or heat then the R1 factor will increase.

**Table ES-1: Key Features of the Proposed WtE Facility**

REA proposes to install six gasifiers combined into 3 trains with the throughput varying according to the calorific value of the MSW. It is expected that the calorific value of MSW will gradually rise over time as households increasingly remove organics from the residual bin as the current FOGO programs and supporting education improve householder adoption of this source separation program. As food waste becomes a smaller percentage of the overall MSW composition the net calorific value of the residual waste bin is likely to rise. At lower calorific values the process throughput will trend toward the maximum design capacity while at higher calorific values maximum throughput will fall.

MSW is delivered to the site by refuse collection vehicles that will enter an enclosed arrival zone. The refuse collection vehicles will back up to the pit and discharge directly into the waste pit. There is no pre-treatment of the MSW prior to entering the waste pit. Oversize waste that meets the selection criteria will be picked up by the grab crane from the pit or the step feeder system and processed through a shedder to minimise the risk of blockages in the gasifier feed system.

The arrival zone is maintained under negative pressure to prevent odour escape. Negative pressure in the arrivals hall and waste pit is maintained as the air required to operate the gasifiers and syngas combustion chambers is drawn from this area. The vehicles turn and then back up to the MSW waste pit where proximity switches operate a second set of doors and tip waste into an enclosed waste pit. Overhead cranes mix the waste and deliver it to a step feeder that progressively directs waste into the gasifiers.
Figure 6-14: Overview of a Typical Gasifier System Treating MSW
The waste is dropped into feed hoppers with chutes that feed the 6 vertical rotating gasifiers from above. The waste moves down through double rollers that control the flow rate of the waste as it passes into the opening of the gasifiers where the levels of oxygen are controlled to ensure insufficient oxygen is available for combustion. The MSW progresses downward through the gasifiers and passes through various heating zones where it is dried, undergoes pyrolysis and then gasification at progressively higher temperatures which chemically decompose the contained organic materials in the waste.

An important qualification in the selection of this technology is that this process does not combust the MSW (due to the absence of sufficient oxygen). Rather it heats it to a high temperature where the organic molecules break down and produce a synthesis gas (syngas) which is then directed to an attached oxidation chamber where the syngas is combusted to generate heat which produces the steam required to operate steam turbines and generators to realise the recovery of dispatchable energy from the waste.

Non-organic materials in the MSW move downward to gasifier grates (grates rotate relative to the gasifier) where they are partially cooled by the incoming air and discharged as slag into a quench pool. The slag is periodically removed to a slag storage tank and it is expected that it will be consigned off site for recycling into road base. Sampling of the slag during operations will be required to allow appropriate classification prior to recycling occurring. In the unlikely event that analysis of the slag indicates that it cannot be recycled it will be consigned to an appropriately licensed landfill.

The Syngas generated in the 6 gasifiers is directed to 3 process lines each of which contains a secondary oxidation chamber. In the secondary oxidation chambers, air addition is increased to allow combustion of the syngas at temperatures 1100°C – 1200°C. At this temperature the system also provides for near complete destruction of residual organics in the flue gas stream. The hot gases of combustion are then directed to the heat recovery boiler system. The boiler initially includes empty zones which allow partial cooling to reduce the risk of deposits building up on the heat recovery elements. Heat recovery is achieved by passing the hot flue gas over super heater tube bundles and other convective heat recovery tube elements which efficiently convert heat from the flue gas to steam within the tube bundles.

The high pressure steam created is directed to 2 steam turbines where the energy in the steam drives the turbine blades converting the mechanical energy to electricity in the generator. The steam turbines are rated to accept steam from the 3 boiler trains operating at their maximum continuous rating. Steam leaving the turbines is condensed in an air-cooled chiller system and returned to the steam circuit. A small percentage of the electricity generated is used to operate the plant with the majority of the output being passed through transformers that step up the voltage to make it available for dispatch through the electricity grid or directly to adjacent industrial energy users.

The secondary oxidation chambers and boilers are maintained under safe vacuum conditions to prevent the escape of hot combustion gases to the atmosphere. The vacuum conditions are maintained by the induced draft fans in each of the 3 processing trains. The fans draw the flue gases after cleaning up the stack. Each train has a separate fan and flue inside the stack to allow monitoring of the individual trains and the stack height has been designed to achieve effective dispersion to achieve the ambient air State Environment Protection Policy (SEPP) requirements.

Flue gas leaving the heat recovery boiler system is directed through an acid gas removal tower where alkali (lime and caustic soda) is sprayed into the gas stream. This removes acid gases such as sulphur dioxide, hydrogen chloride and hydrogen fluoride. This system also removes a portion of the semi-volatile intermediate metals such as arsenic (As), lead (Pb), tin (Sn), zinc (Zn) should they be present in the waste. Powdered activated carbon is injected into the flue gas stream following acid
gas removal to absorb volatile metals or potential residual or reformed organic contaminants such as dioxin and furan.

Oxides of nitrogen emissions are minimised by the low air to waste ratio, the low oxygen environment in the gasifier and the operating temperatures in the secondary combustion chamber. Ecowaste gasifier reference plants operating on MSW have successfully achieved European Union 2010/75/EU Industrial Emissions Directive (IED) emission guidelines for nitrogen oxides without additional flue gas treatment. However, as a risk mitigation measure, and in recognition that the nitrogen levels in Melbourne residual MSW are generally higher than those processed in the reference facilities, REA will install a Selective Non Catalytic Reduction system (SNCR) for nitrogen oxide control on each processing line. These will be operated if nitrogen oxide levels exceed the required operational levels.

Particulates, acid gas treatment residues and powdered activated carbon entrained in the flue gas stream are captured in the filter bag house. Cooled flue gas is then directed to a stack which is sufficiently high to ensure appropriate dispersion of the exiting gases.

Particulates and flue gas treatment residues removed in the filter bag house are periodically discharged onto a closed conveyer system which conveys the residues to a storage silo. This material can contain metals and organic molecules and is likely to require stabilisation prior to disposal to an appropriately licensed landfill.

Operating the gasifier in a depleted oxygen environment, the high combustion temperature in the syngas combustion chamber, acid gas removal in the acid tower, volatile metal and organic molecule removal on activated carbon and removal of particulates in the filter bag house ensures that the emissions will meet ambient air quality criteria specified in the State Environment Protection Policy (SEPP), the emissions standards set out in EU Industrial Emissions Directive (2010) and the EU Best Available Technology Guidelines (2006 and Draft 2017).

**Best Practice**

The environmental best practice assessment for the proposed WtE project was undertaken with reference to EPA Publication 1517.1 Demonstrating Best Practice – Guideline (October 2017). The proposed REA WtE facility complies with the wide range of best practice guides and processes. These include:

- Premising the project on the treatment of residual waste which may divert more than 97% of the waste from landfill securing significant greenhouse gas savings and elevating the residual waste stream to a higher value outcome within the waste hierarchy;
- Compliance with the State Environment Policy and EU IED emission levels and monitoring requirements;
- Installation of a certified CEMS for continuous monitoring flue gas characteristics;
- The use of negative pressure in the arrival hall and waste pit as the major mechanism for odour control;
- Installation of best practice flue gas treatment systems and equipment including alkali injection, activated carbon injection and baghouse filtration.

Consideration of the source and nature and management of the waste to be fed to the WtE facility is also important when demonstrating best practice. This is embodied in the eleven principles of environment protection contained in the Environment Protection Act 1970. The relevant principles have been addressed and are summarised below:
• Economic, social and environmental considerations have been evaluated in the development of this proposed Project. The benefits of the Project in this context include:
  o Only residual waste will be processed in the facility.
  o Reduced dependence on landfill, particularly for putrescible organic wastes, by diverting 195,000 tonnes per annum from landfill.
  o Plant design and flue gas scrubbing techniques are best practice and will ensure that emissions from the Project meet State Environment Protection Policy (Air Quality Management) and European Union Industrial Emissions Directive (IED), 2010/75/EU;
  o Generation of base load electricity supplying 120,800 MWh into the grid which is sufficient to power around 24,000 homes;
  o Increased employment opportunities with a projected construction workforce of 400 and long term direct operational workforce of around 40;
  o Net reduction in greenhouse gas emissions of approximately 237,007 tonnes per year compared to current disposal to landfill which is approximately equivalent of removing 100,000 cars from the road.

• The Principle of shared responsibility was evaluated. The proposed REA facility has been sized to only accommodate the residual household waste generated by local municipalities under the principal that the facility provides a local solution to a local problem.

• The waste hierarchy suggests that wastes should be managed in accordance with the following order of preference; (a) avoidance; (b) re-use; (c) re-cycling; (d) recovery of energy; (e) treatment; (f) containment (g) disposal. With regard to recovering energy from waste the EPA indicates that “It should be considered where generation of the waste cannot be avoided or the waste cannot be recovered for productive purposes through reuse and recycling. EfW should be considered for ‘residual waste’ and other wastes for which energy recovery represents the most feasible option, due to the absence of a market for the waste”

The REA Project proposes to primarily source MSW from the household residual bin source separated municipal waste collection system (separation of recyclables and green waste by householder) operated by Councils. Currently the residual bin waste is wholly disposed to landfill. At present there are no materials recovery facilities (MRF’s) operating in Victoria on the residual waste stream. A high level evaluation assessed the potential for further separation of recyclables from residual waste kerbside collection at the WtE facility. This high level evaluation showed that increased separation at the WtE facility was unlikely to be economically viable in the foreseeable future.

Under the current waste management system operating in Melbourne residual waste is all disposed to landfill. The wastes hierarchy indicates that landfilling is the least preferable option and redirecting this waste for energy production will result in a higher order use of wastes.

Community Consultation

REA is committed to meaningful engagement with all stakeholders to ensure they are adequately informed and consulted regarding the proposed waste to energy (WtE) project.

From commencement of project development in September 2016 to submission of the Works Approval Application in June 2019 a range of engagement activities have been undertaken, and will continue through the development phases of the project.

To inform this proposal REA has reviewed and assessed community and regulator responses to a variety of alternative waste treatment proposals from around Australia and has modelled the
Since submission of the EPA Approvals Pathway Form in November 2017, REA has continued to engage with key stakeholders, community members and community organisations, individually and collectively. The Community Engagement Plan (CEP) described in the EPA Approvals Pathway Form has been implemented, and engagement with a wide range of community members and stakeholders has been ongoing. Further, statutory processes throughout both the development and operational phases of the project provide opportunities for stakeholders to log their issues, concerns and viewpoints with a range of government authorities, including EPA.

REA engagement with the local community suggests that it is supportive of the proposal and is looking for this type of project to initiate change in waste disposal practices in the western metropolitan Melbourne region. Of the questions and issues raised by stakeholders through the range of engagement activities undertaken to date, REA has rarely met with negativity, strongly contrary opinions or viewpoints, aggressive attitudes or behaviour, or outright objection to the proposal. To the contrary, REA has received consistent endorsement for its proposed residual waste gasification plant as providing a local solution to a local problem.

Predominantly, the oft-repeated concerns, questions and issues raised by stakeholders relate to the timing of the legislative process, the responsibility for approval to proceed with the facility, and whether it will reduce the need for what they refer to as the “waste mountain” at Wyndham Landfill.

Planning and Other Approvals

Development of land in Victoria is controlled by the Planning and Environment Act 1987. The purpose of this Act is to establish a framework for planning the use, development and protection of land in Victoria in the present and long-term interests of all Victorians. Each local Government municipality manages development through the Planning Scheme which defines land use zones. The proposed Project land is located within an Industrial 2 Zone within the Wyndham Planning Scheme. Much of the surrounding area is undeveloped industrial land with the closest neighbour the Alex Fraser Group which operates an asphalt plant, road base and aggregate materials recycling centre.

The proposed use of the land triggers the need for a planning permit and the purpose of the zone identifies the need to ensure there is adequate provision and opportunities for industrial land uses that require a substantial threshold buffer distance for sensitive land uses.

The Planning Approval documentation was completed and submitted to the Wyndham City Council in July 2018. Planning approval was granted in March 2019, subject to standard permit conditions such as the issuance of an EPA Works Approval.

The Project will require a number of other approvals prior to commencement of site operations. While these other approvals are not directly related to the WAA they have been mentioned to position the Project within the broader regulatory framework. Approvals for commissioning of the WtE facility, clearing of the scattered native plants of Windmill Grass Chloris truncata and Kidney-weed Dichondra repens, fire plan and approvals for the storage of dangerous goods will be required.

Feedstock

The feedstock for the proposed WtE facility is residual municipal waste. Municipal waste has been defined “as waste collected by, or on behalf of, municipalities and includes ‘household waste originating from households (i.e. waste generated by the domestic activity of households) and similar waste from small commercial activities, office buildings, institutions such as schools and government..."
buildings, and small businesses that treat or dispose of waste at the same facilities used for municipally collected waste”.

The REA WtE facility will accept residual non-hazardous MSW from the following sources:

- Waste disposed to the residual bin by householders at kerbside collections by or on behalf of Councils and specifically excluding source separated recycling collections;
- Residual waste derived from waste transfer stations operated by or on behalf of councils;
- Organic waste collected on behalf of councils from small commercial businesses;
- Residual waste generated by materials recovery facilities (MRF’s) that cannot be recycled and which were destined for landfill.

The WtE plant will only produce energy from residual waste. It will not process wastes such as:

- Large electrical equipment;
- Polychlorinated compounds;
- Asbestos and other insulation materials;
- Herbicides, insecticides or fungicides;
- Paints, solvents and their residues;
- Gas cylinders;
- Batteries;
- Clinical or medical waste;
- Hazardous waste.

Health Risk Assessment

The Health Risk Assessment has considered the operation of the proposed WtE facility and the potential health impacts to the off-site community. A range of outcomes (both positive and negative) which relate to changes in air quality, odour, noise, water, traffic, hazardous materials, economic and social environment have been assessed in relation to health impacts. Based on the assessment undertaken, the following has been concluded:

- **Air emissions**: Where the facility is operating under normal operating conditions there are no risks to the health of workers in adjacent industrial areas or residents in the surrounding community. Even where upset operating conditions are considered, there are no risks to the health of workers in adjacent industrial areas or residents in the surrounding community.
- **Odours**: There are no odour impacts from the proposed facility for residents in the surrounding community. There is the low potential for odours to be noticeable on the southern site boundary, which would not affect local industry.
- **Noise**: There are no noise impacts from the proposed facility that would impact on the health of the community.
- **Water**: There are no water impacts that would affect the health of the community.
- **Transport**: There are no impacts on community health and safety.
- **Safety**: There are no safety or hazard risks that would affect the local community.
- **Employment**: The project has some benefits to health in terms of employment, with these benefits to be enhanced through encouraging employment from local areas at the facility.
- **Social**: The project has the potential to provide enhancing feelings of wellbeing for aspects such as sustainability.
Emissions to Air from the Stack

An air quality impact assessment was undertaken for the Project which modelled various stack heights, diameters and flue gas flow rates. These studies resulted in modifications to the early design increasing stack height from the originally proposed 31m to 38m. The impact assessment was compliant with the SEPP(AQM), European Union Industrial Emissions Directive 2010/75/EU (IED) and EPA guidelines for the use of the regulatory model, AERMOD, Version 16216r (version 5) when this modelling project began in 2017 and updated with later Version 18081 (version 7) where required.

The stack emissions from the facility originate from the total process involved in the treatment of residual MSW. The predicted MSW composition in Melbourne has been analysed by HRL based on residual bin audits conducted in 5 council areas in every season over a 12 year period. The chemical characteristics of the average MSW were evaluated by HRL with results showing that carbon, oxygen and hydrogen form the greater part of the waste (98.7%) with Nitrogen0.88%, Sulphur 0.08% and Chlorine 0.32%.

Sampling data for dust (PM$_{10}$), nitrogen oxides (NO$_x$), sulphur dioxide (SO$_2$) and carbon monoxide (CO) data was provided for municipal waste conversion facilities at six reference facilities which use similar technology to the WtE facility proposed for Laverton North. Additional data was also provided from several medical waste, hazardous waste and industrial waste treatment facilities all of which use similar gasifiers and flue gas treatment systems. Data used in the modelling included two sets of online stack emission data (covering periods of greater than 12 months) together with individual stack sampling tests for NOx, SO$_2$, CO, hydrogen chloride (HCl), hydrogen fluoride (HF), lead (Pb), mercury (Hg) and dioxin/furan. Emissions data of a further seven (7) parameters (Cadmium, Antimony, Arsenic, Chromium, Copper, Manganese and Nickel) were obtained from reference sites using identical gasifier technology to the proposed WtE facility. Ammonia was modelled using the maximum emission limit specified in the IED.

These facilities did not include the Selective Non-Catalytic Reduction (SNCR) for NOx management, the larger acid gas scrubbers or the larger baghouse filters which will be included in the proposed REA WtE Facility at Laverton. The data therefore represents a conservative case for emissions impact assessment. Further details on the data are shown in Section 6.3.1.3 and Appendix 21.

The data provided only included NO$_x$ values (not NO$_2$) and that there was no known NO$_x$ EPA SEPP (AQM) Design Criterion, the impact assessment compared the NO$_x$ modelled result against the NO$_x$ SEPP (AQM) Design Criterion. Comparing the predicted NO$_x$ concentrations from the source model to the Victorian NO$_x$ design criterion is conservative as in reality; a NO$_x$ criterion (if there was one) would be higher than the current Victorian NO$_x$ limit. Similarly, the data did not contain any PM$_{2.5}$ values and as such, for modelling purposes and to be conservative, it was assumed that all particulates were PM$_{2.5}$.

Dioxins and Furans data were obtained from thirty-four (34) different tests sampled from each of the six reference plants all of which use identical gasifier technology to that proposed for the WtE facility in Laverton North.

The data chosen for modelling used average concentrations (based on the entire data set including all outliers) representing steady state operations and the maximum recorded concentrations from the reference plants indicative of upset conditions. The maximum values used were substantially higher than all other data and were for the most part defined as outliers using the statistical interquartile range rule. They were generally associated with the commissioning of the various WtE facilities when out of specification/upset conditions are not uncommon. For consistency, all
maximum measures were adopted in the modelling to ensure a conservative approach to the likely impacts of emissions at the sensitive receptors.

The report assumes the following:

- The maximum measured values are representative of the upset conditions of the proposed facility defined;
- The average concentrations are representative of the normal steady state operating conditions of the proposed facility.

The air quality impact assessment concludes that the impact of the emissions is minimal with modelling demonstrating no predicted exceedances of any parameter at the sensitive receptors. The State Environment Protection Policy (SEPP Air Quality Management) Schedule A primary pollutants (i.e. NOx, SO2, CO, PM10, PM2.5, F, Pb, HCl, Hg, Dioxins & Furans) were compliant with maximum concentrations only reaching up to 6% of the SEPP limits under normal operating conditions at the nearest sensitive receptor (i.e. 6% being for modelled NOx when conservatively compared against the NO2 criterion) (Table ES-2). The balance of the Schedule A parameters were modelled with the highest concentration at the sensitive receptor of 8.4% of the SEPP limit for arsenic.

Table ES-2: Modelling of Emissions Concentrations at Sensitive Receptors relative to the SEPP (Air Quality Management) Limits.

<table>
<thead>
<tr>
<th>Receptor Type</th>
<th>Receptor ID</th>
<th>PM10 % of SEPP limit</th>
<th>PM2.5 % of SEPP limit</th>
<th>NOx % of SEPP limit</th>
<th>CO % of SEPP limit</th>
<th>SO2 % of SEPP limit</th>
<th>HCl % of SEPP limit</th>
<th>Fluorine % of SEPP limit</th>
<th>Lead % of SEPP limit</th>
<th>Mercury % of SEPP limit</th>
<th>Dioxin / Furan % of SEPP limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>CDR1</td>
<td>0.50%</td>
<td>0.80%</td>
<td>1%</td>
<td>0.004%</td>
<td>0.30%</td>
<td>0.03%</td>
<td>&lt;0.01%</td>
<td>0.10%</td>
<td>0.10%</td>
<td>0.04%</td>
</tr>
<tr>
<td></td>
<td>CDR2</td>
<td>2.20%</td>
<td>3.40%</td>
<td>5%</td>
<td>0.02%</td>
<td>1.10%</td>
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<td></td>
<td>CDR3</td>
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<td>0.02%</td>
<td>1.40%</td>
<td>0.10%</td>
<td>&lt;0.03%</td>
<td>0.40%</td>
<td>0.10%</td>
<td>0.20%</td>
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<td>Residential</td>
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<td>0.001%</td>
<td>3.80%</td>
<td>0.10%</td>
<td>0.01%</td>
<td>0.002%</td>
<td>0.30%</td>
<td>0.001%</td>
<td>&lt;0.9%</td>
<td>0.90%</td>
</tr>
<tr>
<td></td>
<td>CDR2</td>
<td>0.10%</td>
<td>0.003%</td>
<td>8.40%</td>
<td>0.30%</td>
<td>0.03%</td>
<td>0.70%</td>
<td>0.002%</td>
<td>&lt;3.6%</td>
<td>2.00%</td>
<td>2.00%</td>
</tr>
<tr>
<td></td>
<td>CDR3</td>
<td>0.20%</td>
<td>0.003%</td>
<td>11%</td>
<td>0.40%</td>
<td>0.04%</td>
<td>1.00%</td>
<td>0.003%</td>
<td>&lt;4.6%</td>
<td>2.60%</td>
<td>2.60%</td>
</tr>
</tbody>
</table>

REA has committed to implementing a continuous emission monitoring system (CEMS) across all lines within the gasification system to monitor all parameters required under the IED monitoring protocol. This will include temperature, pressure, humidity, oxygen concentration, CO, SO2, NOx, HCl, NH3, VOC’s and dust. The CEMS data will be fed back into the operations to allow automated adjustments of parameters such as urea injection in the SNCR, NOx control system and alkali addition to the acid gas scrubbing tower. Continuous monitoring of mercury and monthly measurement of dioxin/furan and dioxin like substances will also be undertaken. For other parameters where continuous measurement is not currently feasible or sufficiently accurate, samples are planned to be collected on a regular basis in consultation with the EPA and tested at certified laboratories to confirm compliance with environmental standards and to confirm the operational performance of the facility.

WtE facilities commonly report emissions data on a quarterly basis. Following recent works approval decisions by the EPA which have determined that it is appropriate to make monitoring data available as close to real time as possible, REA commits to posting continuous emissions monitoring data averages on a daily basis on a publically accessible website.

Odour Generation

The proposed WtE facility includes the following strategies and mechanisms to control odour:
- MSW collected in closed vehicles (compactor trucks);
- Unloading of MSW in an entirely enclosed building;
- Automated roller door for truck access to receival area;
- Automated doors at tipping point from receival area to refuse pit, which open and close with proximity switches to ensure minimum exposure to odours in refuse pit; and
- Receival area and refuse pit under negative pressure as air is drawn from these areas to supply the gasifier and the secondary combustion chamber.

Modelling of odour impact from the proposed facility has assumed that one roller door will be open during delivery times. Although it’s not expected that vehicles will be dropping off MSW every hour of the day, the model was set up assuming that the roller door will be open 30 minutes of every hour for 24 hours, which is considered to be very conservative.

The odour prediction at sensitive receptors is below the Design Criteria of odour. Compliance has been demonstrated for all five meteorological years 2012 to 2016. The predicted odour at the nearest sensitive receptor for the worst meteorological year is 0.01 OU, which is 1% of the SEPP limit of 1 OU.

### Noise

Noise associated with the proposed development was evaluated in accordance with the State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1 1989 (“SEPP N-1”). The recommended maximum noise levels were calculated for noise sensitive areas (NSA’s). Noise emissions were modelled for NSA’s for all time periods in both neutral and with breeze assisted noise propagation.

The main noise sources at the proposed facility are noise associated with:

- Noise associated with the arrival and exiting of trucks supplying the MSW;
- Noise associated with operation of the plant and in particular steam relief valves.

Noise management derived from vehicular movements will be managed by ensuring that all vehicles delivering MSW, equipment and reagents to site comply with the noise limits specified in the Vehicle Standard (Australian Design Rule 28/01 (ADR 28/01) – External Noise of Motor Vehicles) 2006. Speed limits will be strictly enforced on the arrival ramp and reversing of vehicles will occur within the enclosed MSW receival building where noise from reversing beacons will be mitigated by fast acting roller doors and the sound insulating building structure.

The noise associated with the power plant is derived from a number of sources. Gas dynamic noise is generated by the draft fans, blowers, steam turbine and high pressure pipeline and boiler exhaust steam. Mechanical noise is generated from a variety of pumps and air cooling fans while electromagnetic associated noise is derived from electrical equipment (generator, transformer etc.). Enclosure of the entire processing area inside buildings reduces noise into the surrounding area considerably.

Noise control is achieved by:

- Specifying that equipment suppliers meet noise control standards;
- Isolation of noisier components of the plant behind sound proofed walls and doors;
- Installation of specific sound insulation covers on the steam turbine;
- Installation of mufflers on the air blowers;
- Silencers on the boiler safety valves;
- Installation of anti-vibration engine mounts.
Noise modelling was undertaken using the following scenarios to determine the potential noise impacts associated with the proposal:

- Proposed plant layout with breezes assisting propagation in the direction of the noise sensitive receivers;
- Proposed waste to energy plant propagation in the direction of the noise sensitive receivers.

A summary of the predicted noise levels during each of the scenarios, at each of the noise sensitive areas is described in Tables ES-3 and ES-4. These show compliance with SEPP-N1 limits in all circumstances.

<table>
<thead>
<tr>
<th>Assessment Location</th>
<th>Area A (SEPP N-1)</th>
<th>Area B (SEPP N-1)</th>
<th>Area C (SEPP N-1)</th>
<th>Area D (SEPP N-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted noise level $L_{eq}$ dB(A)</td>
<td>31-41 Yes</td>
<td>34-43 Yes</td>
<td>26-36 Yes</td>
<td>35-38 Yes</td>
</tr>
</tbody>
</table>

**Table ES-3: Standard Assessment Methodology (EPA Night Period Assessment) based on the Scenarios above**

<table>
<thead>
<tr>
<th>Assessment Location</th>
<th>Area A (SEPP N-1)</th>
<th>Area B (SEPP N-1)</th>
<th>Area C (SEPP N-1)</th>
<th>Area D (SEPP N-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted noise level $L_{eq}$ dB(A)</td>
<td>31-49 Yes</td>
<td>34-47 Yes</td>
<td>26-36 Yes</td>
<td>35-41 Yes</td>
</tr>
</tbody>
</table>

**Table ES-4: Standard Assessment Methodology (EPA Evening Period Assessment) based on the Scenarios above**

The noise assessment concluded that:

- Residual noise levels at the relevant noise sensitive receivers are not impacted by the inclusion of light breezes assisting propagation of noise from the source;
- During calm conditions, compliance with the relevant SEPP N-1 standard operation noise limits at each of the relevant noise sensitive receivers has been predicted.
- Compliance will also be achieved during times when breeze conditions are blowing noise associated with the source away from the noise sensitive receiver, as well as times when breeze conditions are perpendicular to the noise sensitive receiver;
- Residual noise levels associated with the proposal will achieve relevant design objective values at commercial/industrial operations in the immediate vicinity.

**Greenhouse Gas**

The scope of this assessment includes the construction and operation of the proposed REA WtE facility in Laverton North and considers all material sources of emissions. The assessment contrasts the proposed operation with a business as usual scenario where the waste is sent to landfill in western Melbourne, and where the electricity generated would be generated at typical Victorian emissions intensity. The assessment has included Scope 1 (Direct Emissions), Scope 2 (Indirect Emissions) and Scope 3 (Other Indirect Emissions) emissions across the construction and operation of the facility over a nominal 25-year operational life.

During the construction phase the predominant source of emissions will be embedded emissions from the extraction and manufacturing of the construction materials. While final detailed design is yet to be completed, initial estimates of materials required for the project show that 15,786 tonnes of high strength concrete and 2,286 tonnes of steel will be required. Other significant sources of emissions during construction will include the transport of materials from their point of manufacture to the site, fuel consumed by construction vehicles throughout the construction phase and electricity required to operate the site office. It has been estimated that construction will result in a total of 7,385 tonnes of CO₂e being released to atmosphere.

Once operational the plant will generate an estimated 137,600MWh of electricity per annum. Of this the site will consume approximately 16,800MWh of electricity throughout the year to operate the plant, office and associated equipment, with the remaining 120,800MWh fed into the grid as renewable electricity. Using the conversion factors from the July 2018 National Greenhouse Accounts Factors the operation of the proposed facility will generate approximately 59,198 tonnes of CO₂ equivalent emissions per year of operations.

Two aspects of waste transport have been included in the GHG inventory of this project: Transport of MSW to the plant and transport of PIW generated by the plant to a suitable landfill. The transport distance of MSW to the proposed WtE facility will reduce transport distances and it is anticipated that operation of the facility will have a net positive impact on GHG emissions resulting from savings in transport, resulting in approximately 755 t.CO₂e of emissions being avoided.

Overall, the plant will result in a net reduction of CO₂ emissions. The operation of the plant will reduce the creation and emissions of fugitive methane to atmosphere from waste that would otherwise be sent to landfill, will reduce waste transport distances, and will generate over 120 MWh of electricity for the grid at less than half the current Victorian emissions intensity. Summing all GHG emissions avoided gives a gross total of 296,501 tonnes of CO₂e that will be saved by the project per year when compared to the business as usual (BAU) scenario of transporting waste to landfill and sourcing electricity from the grid. Subtracting emissions generated by the proposal from the emissions avoided by the proposal, the net impact of the project is an annual saving of just over 237,000 tonnes of CO₂e per year of operation of the plant. Which at a nominal 25-year lifespan, results in a net project benefit of over 5,925,000 tonnes of CO₂e emissions avoided.

**Water Use**

The quantity of water used on an annual basis is expected to be approximately 104 ML (311.3 m³/d) with approximately 2.7 ML captured from roof runoff. It is expected that the majority of the water will be obtained from the City West Water (CWW) mains supply. Domestic sewerage will be discharged to the CWW sewerage system.

Considerable effort has been made in the design to minimise mains water use. The gasifier consumes all the leachate from the MSW. All reject streams generated in the process including the UF/RO concentrate, back flush and CIP wash water, ion exchange regeneration solutions and boiler blowdown are also reused in appropriate areas within the process.
The technology chosen for the steam condensing system is air cooled rather than cooling through water fed cooling towers providing for considerable equivalent water savings. The acid gas scrubber is a semi-dry system also selected to minimise water use. As a consequence, no waste water is generated from the process and consequently a Trade Waste Agreement is not required.

Operational Wastes

The proposed project will generate a range of solid wastes. These will result from construction works and will be generated during operation of the proposed WtE facility. A waste assessment was undertaken to determine the likely composition of the solid waste generated and these were compared to the EPA Industrial Waste and Resource Guideline: Solid Industrial Waste Hazard Categorisation and Management (Publication 631). The waste assessment has then informed the ongoing design and management of these wastes in the proposed facility. Wastes generated will be categorised, handled and transported in compliance with the Guidelines.

During construction excavation will be required for building foundations, MSW pit, facilities such as car parks, road access and water runoff control. These excavations will generate around 13,000m³ of soil and rock which will be reused on site for the construction of the truck entry ramp to the WtE tipping area.

The construction phase will generate solid wastes typical of an industrial development site. These will include concrete and other building related material. Skips for recycling will be provided and contractors will be encouraged to sort waste for recycling. This will be a key discussion area during site inductions. A staff and contractor compound will be required during construction and small quantities of solid waste and putrescibles will be generated in this area. As in the construction area, provision for waste separation will be provided and encouraged through site induction training and the use of colour coded bins. Residual waste will be consigned to appropriate landfill.

Operation of the WtE facility will generate three solid waste streams. These are summarised below in Table ES-5. Solid wastes generated include:

- Gasifier Slag which leaves the gasifier through the bottom grate and contains the non-organic components of the MSW delivered to the process;
- Boiler Ash which consists of a proportion of the heavier particulates carried through from the gasification and secondary combustion process;
- Flue Gas Treatment Residues collected and then discharged from the filtration bag house to enclosed ash transfer systems.

<table>
<thead>
<tr>
<th>Waste Stream</th>
<th>Probable Waste Categorisation</th>
<th>Quantity Generated (t/a)</th>
<th>Proportion of Feed MSW (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasifier Slag</td>
<td>Industrial Waste</td>
<td>35,333</td>
<td>17.7</td>
</tr>
<tr>
<td>Boiler Ash</td>
<td>Category C PIW but may be Industrial Waste</td>
<td>1180</td>
<td>0.59</td>
</tr>
<tr>
<td>Flue Gas Treatment Residues (baghouse filter residues)</td>
<td>Category B PIW</td>
<td>3600</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Table ES-5: Solid Waste Generated During Operation of the WtE Facility

The contaminants in these residues are dependent on the composition of the MSW fed into the processing system. The initial assessment included investigations into the destination of the waste...
derived from the reference plants, a review of the international literature assessing the destination of wastes from WtE facilities and indicative chemical analysis of the wastes. Comparison of this information with the EPA Industrial Waste Hazard Classification suggests that:

- Preliminary testing has indicated that it is likely that the gasifier slag will be categorised as Industrial Waste but this will require confirmation by sampling and analysis during operations;
- Boiler ash may be categorised as Industrial waste and this is consistent with reference site gasifier WtE facilities where the boiler ash is combined with the gasifier slag. However, sampling and analysis of this waste stream is very limited. Consequently, this waste stream will be kept separate to allow sampling, and will until sampling confirms otherwise, be combined with the flue gas treatment residue and processed concurrently with this waste stream;
- Flue gas Treatment Residues (baghouse filter ash) will likely be categorised as Category B PIW. However, limited indicative testing has shown that some contaminants may exceed the total concentration thresholds to designate these wastes as Category A. It is expected that these residues will require immobilisation to minimise the potential for leaching of contaminants. This waste will require an application to the EPA for reclassification to allow disposal to PIW landfill.

Environmental Management

REA is committed to the development of an Environmental Management System (EMS) consistent with the ISO 14001 framework. The development of the EMS will be undertaken in parallel with the detailed design and will continue through the construction program so that key management and operational staff have the opportunity for input into the EMS and associated environmental management strategies, plans and procedures. This will include specific details referred from the Risk Assessment and HAZOP studies which will inform the procedures associated with non-routine plant shut down associated with equipment failure and emergency shutdown procedures associated with power failure, flue gas treatment failure and of the occurrence of fire.

The development of the EMS will include specific management plans to address and manage risks and ensure compliance with relevant Guidelines and statutes. Specific management plans will include the following:

- Construction Environmental Management Plan;
- Commissioning Management Plan;
- Operations Management Plan;
- Emergency Procedure Management Plan;
- Traffic Management Plan.

Monitoring of the environmental performance of the facility will utilise the data gained from the CEMS monitoring system which includes continuous monitoring of stack emissions. Regular additional sampling of stack emission will be undertaken together with sampling of the wastes generated from the process, noise levels and stormwater runoff from the site. These will be reported as required by the EPA.