The Resource Recovery Facility

Technology Options: **Gasification**

Two technology options are being evaluated for the proposed resource recovery facility: anaerobic digestion and gasification. Both are safe, well-proven technologies which offer significant benefits. The final decision on the choice of technology will be made after the tender process (approximately 2013-14).

WHAT IS GASIFICATION?

Gasification turns waste into an energy-rich fuel gas by heating the waste under controlled conditions.

Gasification involves the conversion of organic waste materials in a high temperature (between 400°C and 800°C), low oxygen environment to produce a synthesis gas (a mixture of methane, hydrogen, carbon monoxide and carbon dioxide).

The synthesis gas (syngas) can be cleaned and then fed directly into engines to produce electricity, or combusted with air to make heat and then steam which is then used to produce electricity, or used as a feedstock for other industrial processes.

GASIFICATION TURNS WASTE INTO AN ENERGY-RICH FUEL GAS.

WHY HAS GASIFICATION BEEN SHORTLISTED AS A TECHNOLOGY OPTION?

- Reduces greenhouse gas emissions and is capable of diverting around 90% (by volume) of council waste from landfill
- Produces a marketable product (electricity) and has a high recovery rate of resources. A 90,000 tonnes per annum facility would export an approximate surplus of 7MW, equivalent to powering around 10,500 homes.
- Minimal risk of health consequences
- Low risk of odours
- Low risk of water pollution
- Net energy producer
- Commercially proven technology used particularly in Norway, Japan and Sweden.

HOW WILL HOUSEHOLD WASTE BE COLLECTED FOR GASIFICATION TECHNOLOGY?

If gasification technology is selected for the resource recovery facility, a two-bin system will be used (as done by the majority of councils currently). A two bin collection system would comprise fortnightly collections of recyclables and weekly collections of general waste.

The contents of the general waste bin currently go to landfill. Using gasification technology, this waste will instead undergo a conversion process to turn it into syngas. The syngas is used to make heat (in the form of flue gas) and then steam and then electricity. The process produces two types of ash residue: bottom ash from the gasification furnace and fly ash from the flue gas cleaning and filtration system.

The fly ash will be disposed of in an appropriate class of secure landfill. The bottom ash may be reused in applications such as roadbase, or disposed of in landfill. Recyclables from the recycling bin will continue to be processed at a recycling facility.

Recycling Bin
(collected fortnightly)

Taken to a recycling facility for sorting, baling and sale for manufacture into new products.

General Waste Bin
(collected weekly)

Taken to the proposed resource recovery facility and processed using gasification technology.

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How does gasification technology work?

There are a number of different gasification technologies. The summary and flowchart (see following page) is based on EMRC's research and information from EMRC's Expression of Interest process for resource recovery technologies in 2009. Generally, there are five stages to the gasification process:

1. SORTING AND WASTE PRE-TREATMENT

Waste is unloaded from trucks into waste pits within a fully enclosed waste receival building. The waste is then transferred into a shredder. During the shredding process, metals can be removed via magnets and other separators. The main objective of the pretreatment is to remove hazardous materials, metals, reduce the size of the waste material and homogenise the waste to improve operation of the gasification chambers.

2. TREATMENT

The shredded waste is conveyed into the gasification reaction chamber through feed hoppers and an airlock to minimise air entering the gasifier and fugitive gases escaping. Often the gasification process has two stages: a primary gasification zone followed by a secondary oxidation zone. In the primary stage of the gasification chamber, the majority of organic material is converted into combustible syngas in the low oxygen environment at around 900°C. The inorganic materials are converted to a solid residue (bottom ash) and separated.

In the secondary chamber, full oxidation takes place at 900-1000°C by the addition of secondary air and recirculated flue gas, which limits the high temperature formation of harmful oxides of nitrogen (NOx) in the secondary chamber.

The purpose of fully oxidising the syngas is to produce heat and power through the steam cycle.

3. HEAT RECOVERY AND STEAM GENERATION

The heat recovery and steam generation section recovers heat from the hot flue gas downstream of the oxidation chamber and converts this heat into steam for use in a turbine. The heat exchanger detail will vary, depending on the steam pressure required. Typically there will be three connected heat exchangers – a superheater (for increasing the temperature of the steam to around 380°C before it is fed to the steam turbine), a boiler and connected steam drum for generating saturated steam and an economiser to preheat the boiler feed water to around 100°C before it enters the boiler.

The steam turbine is usually a condensing steam turbine designed to convert the energy in the steam to electrical energy by driving the turbine which is connected to an alternating current generator and a transformer to increase to the voltage of the electricity to the required level for use in the gasification plant and export to the grid system. The exhaust steam from the turbine is condensed back into hot water (known as condensate) which is recycled back to the boiler feed water tank.

4. AIR CLEANING

Flue gas is the exhaust gas exiting to the atmosphere via a flue and a stack after the heat recovery section. The flue gas has to be cleaned before exiting to the atmosphere which typically involves the addition of lime and activated carbon to the flue gas (high adsorption materials capable of adsorbing acid gases and toxic elements) followed by filtration through a bag house (fabric) filter. These processes remove particulates (dust particles), acid gases, metals and volatile organic compounds. The bag filter also plays an important part in the capture and neutralisation of furans and dioxins. The bag filter is followed by the flue gas fan (which provides the driving force to pull the flue gas from the gasification chambers through the heat recovery and gas cleaning systems), flue gas analysis and the stack. The flue gas analysis comprises a continuous emissions monitoring system which provides an early warning of any deviations in emissions, enabling corrective action to be taken. For other parameters that cannot be measured continuously, periodic testing is carried out (eg dioxins and furans).

5. ASH HANDLING

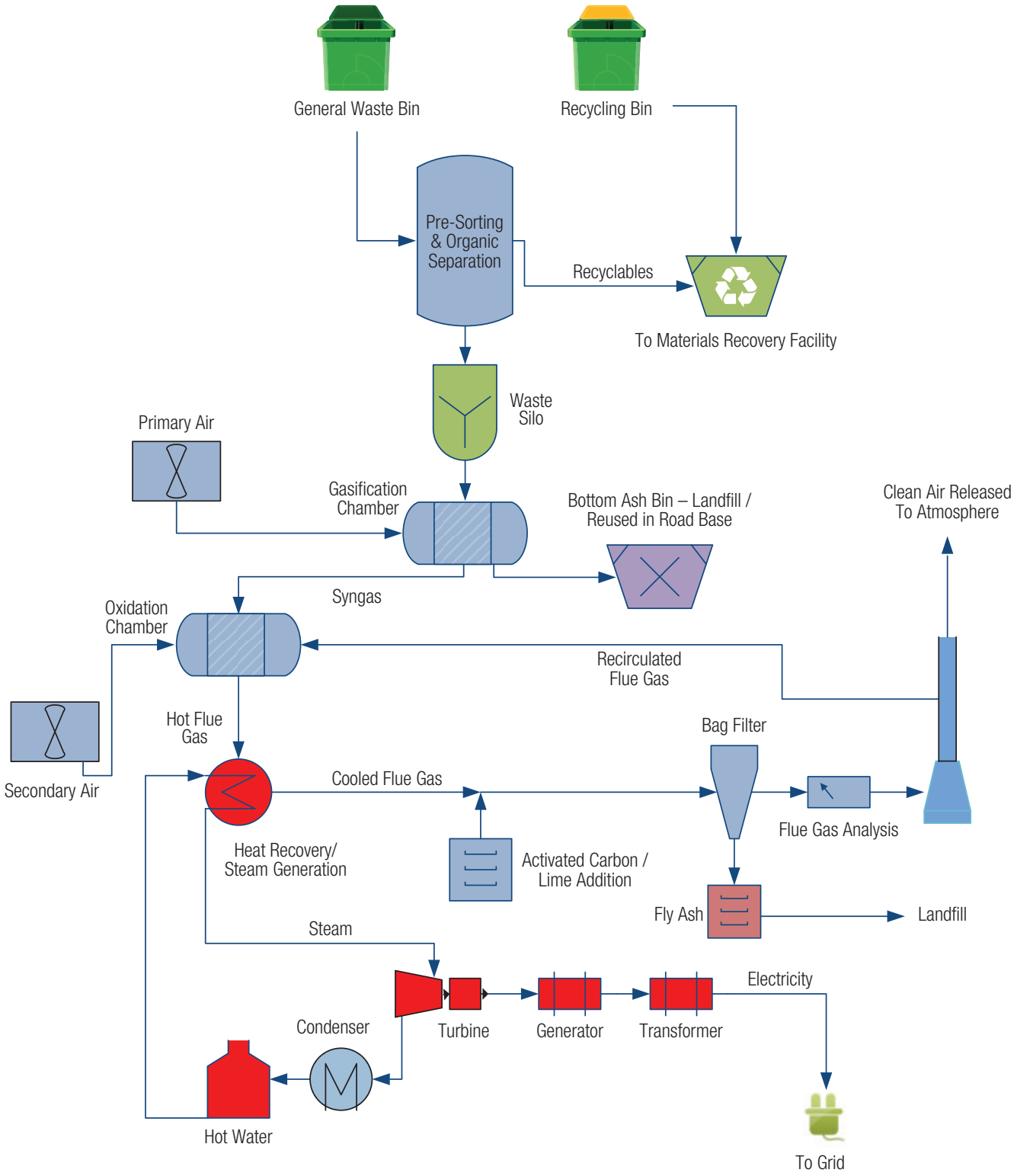
The ash generated in the primary gasification chamber is known as bottom ash and is the main residue from the gasification process. Ferrous metals are usually recovered from the bottom ash before it is recycled into road base or sent for disposal to landfill.

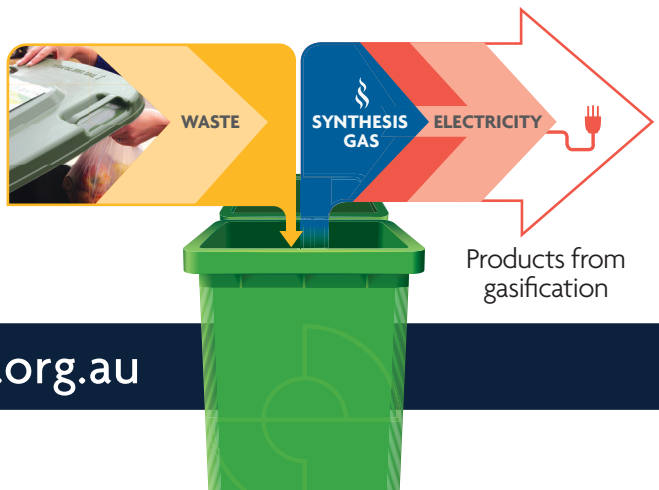
The residue from the flue gas cleaning system is known as filter ash or fly ash and requires disposal at an appropriately classified landfill facility. Depending on the concentration of metals in the ash and their potential for leaching, the landfill may need to be a Class IV landfill (which Red Hill currently operates). Testing of the fly ash will be undertaken to determine the appropriate method of disposal.

FOR AN **ILLUSTRATION** OF THE PROCESS, PLEASE SEE THE FLOW CHART FOLLOWING.

GASIFICATION PROCESS FLOW CHART

2 Bin System – General Waste Bin





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