Environmental benefits of recycling

Appendix 7 – Assumptions

Collection, treatment, material recovery and energy assumptions

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Table of Contents

List of tables and figures

Collection System Assumptions

Two different transport types have been modelled during this study, corresponding to two collections types.

A) C&I and C&D wastes use a normal transport model in tonne kilometre. It is based on the assumption that the truck will just be filled up at one site, and not stop and start frequently.

B) Kerbside collection system is a really different process. In fact, the emission produced from the frequent stop and start driving mode are much different from the emission of a normal transit. And the collection system does not only involve a truck transport. The model for kerbside has been using data from Grant (2001).

A) C&I/C&D

Two separate models have been used for transport of C&I and C&D waste.

A) Commercial collection recyclable: mostly materials that could actually go into kerbside but are collected from C&I sites.

B) Building waste collection for recycling: waste from building sites.

Commercial collection recyclables

The truck is modelled as a 28 tonnes load with 15 tonnes tare vehicle; with a backhaul rate of 1.2 (the truck is empty 40 per cent of the time).

Fuel consumption

Apelbaum Consulting Group has produced a report on the energy consumption and greenhouse gas emissions from the Australian transport task. (Apelbaum 1997) This report gives detail data on per unit energy usage and emissions for Australian freight task. It has been used to define the average fuel consumption per tonne kilometre. From this process, 2.14MJ of diesel is designated as the energy necessary per tonne kilometre, with 23.26 grams of diesel to reach 1 MJ LHV of fuel input to engine.

Emissions

The National Greenhouse Gas Inventory has greenhouse emission factors for each type of fuel used in each mode of transport (NGGIC 1997). CO_2 emission factors are basically directly related to the fuel consumption. However methane, N_20, NO_X, and non-methanic VOC vary depending on engine size and type. Larger engines tend to have lower emissions per unit of fuel consumed. Emissions that are not directly related to greenhouse gas and emission to water and soil are extracted from EcoInvent.

Collecting building waste for recycling

The inventory takes an average between urban and rural transport. The truck is modelled as a 28 tonne load average on 30 tonne vehicle; with a backhaul ratio of 1.2 (the truck is empty 40 per cent of the time).

Fuel consumption

Apelbaum Consulting Group has produced a report on the energy consumption and greenhouse gas emissions from the Australian transport task. (Apelbaum 1997) This report gives detail data on per unit energy usage and emissions for the Australia freight task. It has been used to define the average fuel consumption per tonne.kilometre. From this process 0.89 MJ of diesel is designated to the energy necessary per tonne.km, with 23.26 grams of diesel to reach 1 MJ of fuel input in the engine.

Emissions

The National Greenhouse Gas Inventory has greenhouse emission factors for each fuel used in each mode of transport (NGGIC 1997). CO_2 emission factors are basically directly related to fuel consumption. However methane, N_20, NO_X, and non-methanic VOC vary depending on engine size and type. Larger engines tend to have lower emissions per unit of fuel consumed. Emissions that are not directly related to greenhouse gas, emission to water and to soil are extracted from EcoInvent.

Development of estimated transportation distance

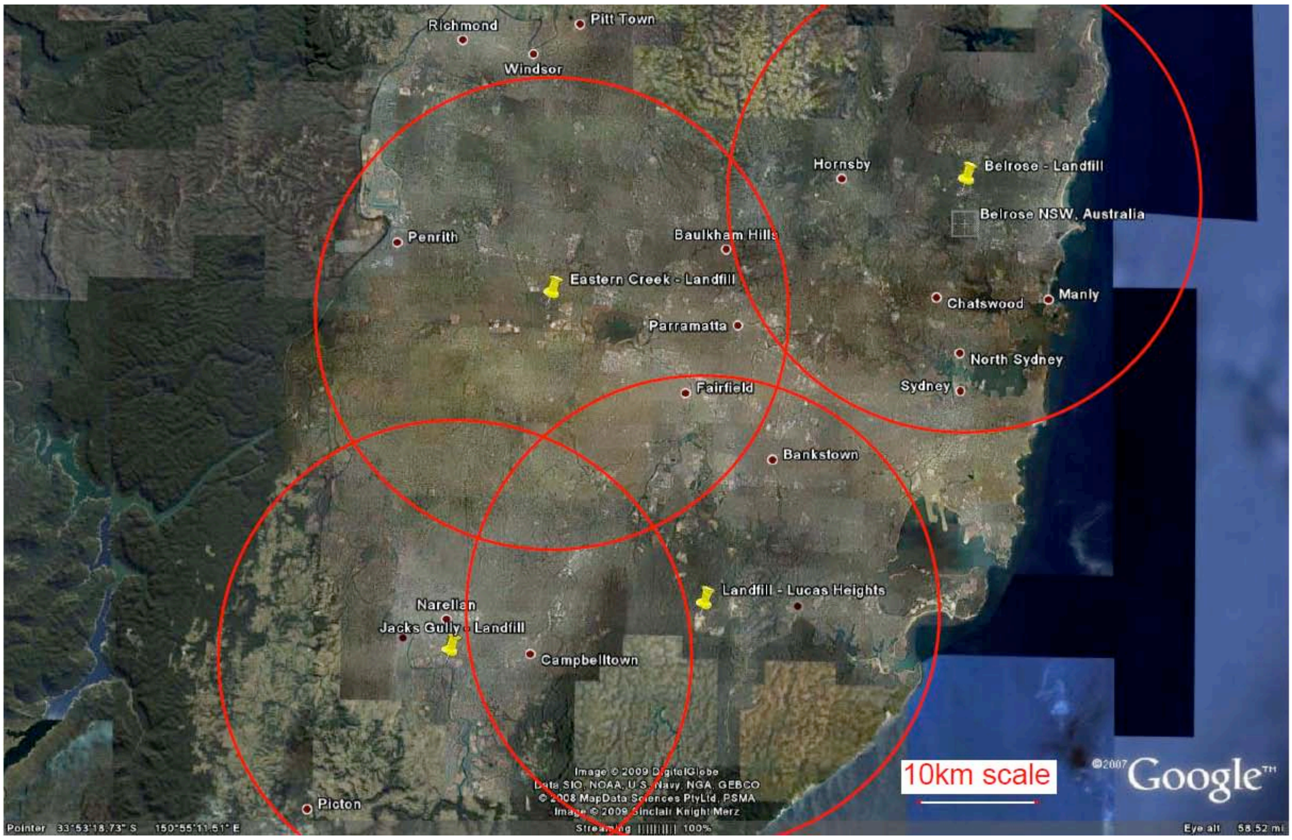
Transport distances for C&D and C&I waste generated in the Sydney metropolitan area have been estimated based on first principles. The basis of the transport estimates for movement to landfill and recycling are shown below. Sensitivity of the reported results to changes in these estimates has been tested in the Sensitivity Analysis section of the main report.

Transport distances estimated:

A) Transport from point of waste generation to reprocessing station: 20km on average

B) Avoided transport from point of waste generation to landfill: 20km on average

Figure 1: Basis of transport estimate. 20km radius collection areas around major Sydney metropolitan landfill sites



Other studies have used assumptions as follows:

A) Grant and James (2005) — 30 km to landfill

Grant et. al. (2001) — Total collection inventory is a time, fuel and distance based estimate. Weighted average distance to landfill (waste) was 17km (calculation by author).

Assumptions used to develop 20km estimate:

A) C&D and C&I waste material moves across a similar distance for both recycling and landfill.

Reprocessing sites are as geographically convenient as landfill sites (no extra transport is required).

4 major landfill sites considered for Sydney metropolitan area.

Collection of waste occurs evenly (by land area) across Sydney metropolitan area.

Weighted average trip distance equal to a radius whereby half the collection area is less than the radius and half the collection area is above the radius. Refer equation below.

$$r_c = \text{Collection radius}$$

$$r_a = \text{Average collection distance}$$

$$\pi r_a^{\ 2} = \pi r_c^{\ 2} - \pi r_a^{\ 2}$$

$$\pi r_c^{\ 2} = 2\pi r_a^{\ 2}$$

$$r_c^{\ 2} = 2 r_a^{\ 2}$$

$$r_c = \sqrt{2} \times r_a$$

$$r_c = 1.41 \times r_a$$

Non-linear nature of roads means that collection distances will be greater than the radial distance to the collection point. Increased travel distance is estimated to approximately offset weighting affect of 1.41 described above. Therefore average inbound transport journey can be considered equal to the collection radius (in this case 20km).

20km collection radii selected and overlayed on Sydney satellite image and found to approximately cover majority of urban area (refer Figure 1).

B) Kerbside

The model used for kerbside has been developed from data of a previous Centre for Design study (Grant, 2001) in m^3. The model is split across three inputs:

A) Collecting Recyclables: 9.1 minutes/m^3

B) Recyclables transit: 1.27 km/m^3

C) Bulk recyclables transit: 0.58 km/m^3

Collecting recyclables

It corresponds to the frequent stop-and-start collection mode. A common empirical approach to fuel consumption estimation is to multiply time in kerbside collection mode by a constant litre/hour consumption rate. For identical vehicles collecting similar weights of materials under similar conditions (driver behaviour, housing density, set out rate, gradient, street width etc) this method can be sufficient. Thus the unit used is time, instead of tonne.km.

Fuel consumption

The fuel consumption of the truck is consistent with what has been developed in previous studies (Grant 2001). For an hour of operation, making the assumption of an average speed of 20 km/h, the truck is assumed to consume 15 kg of diesel.

Emissions

The National Greenhouse Gas Inventory has greenhouse emission factors for each fuel used in each mode of transport (NGGIC 1997). Data from the NGGIC has been used for CO_2, N_2O, and SO_x emissions, AFDC data have been used for CH_4, NO_X, NMVOC, CO and particulates.

Recyclables transit

The transit of recyclables corresponds to the transport of waste from the collection area to the transfer station, or to the MRF. For the transport of material in the collection vehicle rigid truck inventories from (Grant 1999) were used, however they were used as distance (km) based inventories rather than tonne.kilometres. This is because trucks are likely to fill before they are overloaded, particularly for recyclables, so the volume of materials and number of return trips is a more significant factor in the determination of the overall fuel use and emission impacts. The truck is modelled as a rigid truck, with a 50 per cent backhaul rate, meaning that the truck is empty half of the time.

Fuel consumption

Apelbaum Consulting Group has produced a report on the energy consumption and greenhouse gas emissions from the Australian transport task. (Apelbaum 1997) This report gives detail data on per unit energy usage and emissions for the Australia freight task. It has been used to define the average fuel consumption per tonne.kilometre. This data has then been converted from tonne.kilometre to kilometres. From this process, 9.84 MJ of diesel is designated as the energy necessary per km., with 23.26 grams of diesel to reach 1 MJ LHV of fuel input to engine.

Emissions

The National Greenhouse Gas Inventory has greenhouse emission factors for each fuel used in each mode of transport (NGGIC 1997). CO_2 emission factors are basically directly related to fuel consumption. However methane, N20, NOx, and non-methanic VOC vary depending on engine size and type. Larger engines tend to have lower emissions per unit of fuel consumed. Emissions that are not directly related to greenhouse gas, emission to water and to soil are extracted from EcoInvent.

Bulk recyclables transit

This transport process corresponds to the occasional next stage between transfer station and MRF. For the transport of material in the collection vehicle articulated truck inventories from (Grant 1999) were used, however they were used as distance (km) based inventories rather than tonne.kilometres. This is because trucks are likely to fill before they are overloaded, particularly for recyclables, so the volume of materials and number of return trips is a more significant factor in the determination of the overall fuel use and emission impacts. The truck is modelled as an articulated truck.

Fuel consumption

Apelbaum Consulting Group has produced a report on the energy consumption and greenhouse gas emissions from Australian transport task. (Apelbaum 1997) This report gives detail data on per unit energy usage and emissions for the Australia freight task. It has been used to define the average fuel consumption per tonne.kilometre. This data has then been converted from tonne.kilometre to kilometres. From this process, 3.71 MJ of diesel is designated as the energy necessary per tonne.kilometre, with 23.26 grams of diesel to reach 1 MJ LHV of fuel input to engine. Conversion from tonne.kilometre to kilometre is done as follow: 1 kilometre is equivalents to 7.5 tonne kilometre (Grant 1999).

Emission

The National Greenhouse Gas Inventory has greenhouse emission factors for each fuel used in each mode of transport (NGGIC 1997). CO_2 emission factors are basically directly related to fuel consumption. However methane, N_20, NO_X, and non-methanic VOC vary depending on engine size and type. Larger engines tend to have lower emissions per unit of fuel consumed. Emissions that are not directly related to greenhouse gas, emission to water and to soil are from EcoInvent.

Development of estimated transportation distance

The collection and transport impacts have been estimated using the same methodology and assumptions as those by (Grant, 2001). This method used by (Grant, 2001) involved estimating collection time and transport distances based on data provided from five Sydney Councils (Holyroyd, Sutherland, Ryde, Leichardt, Lane Cove and Bega).

The impact of collection of recyclables and waste was determined using the following steps:

A) Modelling the time frequent stop start collection time, and point to point haul distances for garbage vehicles for each council area using the Solid Waste Integrated Management Model (Wang 1996).

Estimating average transport distance between collections points (MRF’s and Material processors). Where recyclables are collected within Sydney and transferred to reprocessors within Sydney, and cross town distance of 65km was used as default value.

Collection Times and Point to Point Transfers Estimated

Table 1 describes the collection time and transport distances for waste streams determined in Grant (2001b). In this study paper is assumed to be commingled with other recycling waste streams and therefore separate paper collection impacts have not been used (shown for reference only).

Table 1: Allocation of collection time per m^3 of collection averaged across five Sydney councils studied in Grant (2001).

	Time Collecting	Km's Rigid Truck Transport	Kms Bulk Hauls Transport
	min/m³	*km/m³*	*km/m³*
Garbage Collection per M3	8.34	0.85	0.41
Co mingled containers Time Allocation	9.1	1.27	0.58
Paper Collection (if not commingled)*	6	2.57	0.37

*Paper is assumed to no longer be collected separately. This data is not used in this study and is presented for reference only.

Transportation impacts for distances travelled are based on transport vehicle inventories derived from Apelbaum (2001) and other data sources. Fuel consumptions for collection time based on constant consumption rates per hour from Solid Waste Integrated Management Model (Wang, 1996).

To stay consistent with the assumption made for C&I and C&D waste, 20km is used as a default value for transport from MRF to reprocessing, and to landfill.

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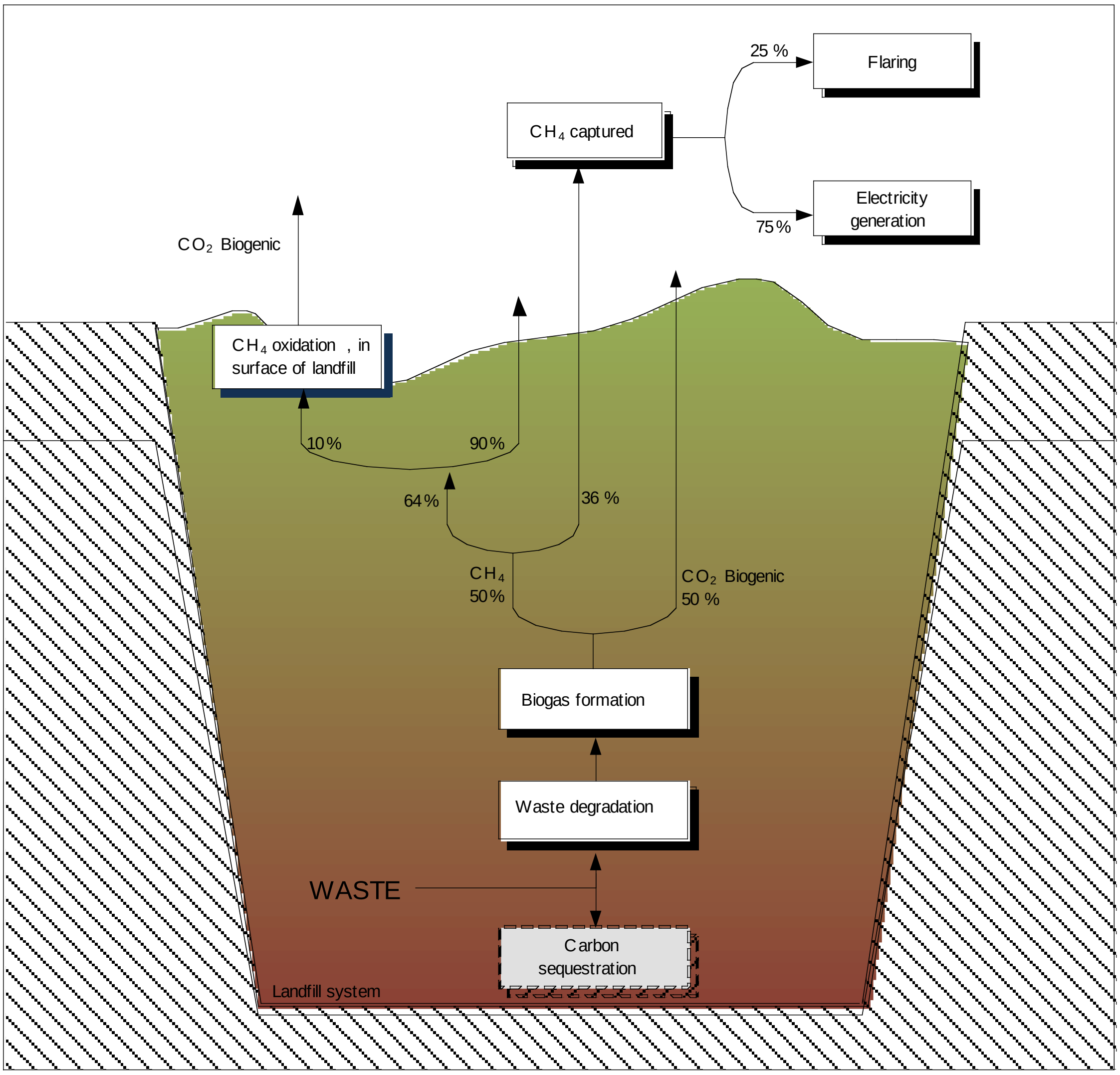
Treatment of Waste in Landfill

Introduction

When organic waste (food, garden clippings, paper, timber) is treated in landfill, gasses are emitted that contribute to green house gases emission. As organic matter breaks down in landfill both biogenic carbon dioxide (CO_2) and methane (CH_4) are emitted. Methane is the most important of these gasses from a green house gases perspective because it has a high global warming potential (21–25 times that of CO_2). Biogenic CO_2 is not considered a source of anthropogenic green house gases because it is derived from natural sources and would be produced as part of natural cycles in any event.

Methane generated from the degradation of organic waste has been determined theoretically in this study using a methodology published by the Department of Climate Change (2007). The methodology assumes that 50 per cent of the degradable organic carbon (DOC) in a waste material will breakdown in the landfill and be converted into biogas, the composition of which is assumed to be 50 per cent methane. 36 per cent of the methane in the biogas is assumed to be captured under the cap of the landfill and is either flared or used for electricity generation (Hyder, 2006). The remaining 64 per cent is assumed to pass through the surface of the landfill where 10 per cent is oxidised and the remainder is emitted to the atmosphere. A diagrammatic representation of this model is shown in Figure 2.

Figure 2: Main processes happening in landfill during degradation of organic wastes



The method for calculating the methane generated (prior to capture or oxidisation) in landfill is described by the Dept. of Climate Change (2007) as follows:

$$Methane\_generation = SW * DOC * DOCf * MCF * F * (16/12)$$

where:

SW :	The mass of waste landfilled, in this case 1 tonne.
DOC :	Degradable Organic Carbon; only a fraction of the carbon contained in organic matters is biodegradable, depending on the waste type. It is expressed as a proportion of the particular waste type (AGO, 2008).
$DOCf$:	From the degradable part of the waste, only a fraction will dissimilated, depending on the waste type produced. The default value used in the AGO workbook is 0.5 (AGO, 2008).
MCF :	Methane Correction Factor (assumed to be 1)
F :	Fraction of the gas produced that is methane. The default value used in the AGO workbook is 0.50 (AGO, 2008).
$16/12$:	Conversion rate of carbon to methane

Of importance in the methodology is the degradable organic carbon (DOC) of materials, which are prescribed as shown in Figure 3. The higher the DOC value, the higher the methane emission expected per tonne of waste deposited.

Figure 3: Degradable organic carbon values (DCC, 2007).

Waste Type	DOC
Food[a]	0.15
Paper and Textiles	0.40
Garden and Green	0.20
Wood	0.43

Carbon storage

As only 50 per cent of the DOC of a material is considered degradable, the balance is considered to be stored under the methodology. Although evidence exists that such ‘stored’ carbon will remain in the landfill for extended periods of time (up to 100 years or more), its fate in the long term is not fully understood. Should the carbon leak out of the landfill (through ongoing aerobic or anaerobic degradation), it will generate an impact on green house gases emission.

Although carbon storage has been considered in the ‘base case’ assessment undertaken in this study, the assumption is tested in a sensitivity analysis.

The Dept of Climate Change (2007) methodology calculates carbon stored in landfill as follows:

$$C\_Stored = SW * DOC * (1 - DOCf) * MCF * (44/12)$$

where:

SW : The mass of waste landfilled, in this case 1 tonne.

DOC : Degradable Organic Carbon; only a fraction of the carbon contained in organic matters is biodegradable, depending on the waste type. It is expressed as a proportion of the particular waste type (AGO, 2008).

$DOCf$: From the degradable part of the waste, only a fraction will dissimilated, depending on the waste type produced. The default value used in the AGO workbook is 0.5 (AGO, 2008).

MCF : Methane Correction Factor, if less than 1, then part aerobic decomposition takes place.

Sources

Dept. of Climate Change, 2007, Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks — Waste, Canberra, Dept. of Climate Change

Hyder, 2006, Review of Methane Recovery and Flaring from Landfills, Australian Greenhouse Office, Department of Environment and Water Resources

US EPA, 1998, Municipal Solid Waste Landfills, in Compilation of Air Pollutant Emission Factors. Fifth edition, US EPA

US EPA, 2006, Solid Waste Management and Greenhouse Gases, A Life Cycle Assessment of Emissions and Sinks, 3rd Edition, US EPA

Material Recovery Facility

The MRF process has been modelled according to prior studies at the Centre for Design.

Materials Recovery Facility Types

> Materials Recovery Facilities (MRFs) undertake sorting, packing and often sale of recyclables collected from kerbside and other sources. MRFs vary widely from small operations based mostly on manual sorting on a conveyor belt, through to highly mechanised and automated facilities. In Sydney and even in Country New South Wales the Chullora Material Recovery Facility processes a large proportion of recyclables in Sydney.

Two key issues for MRF operation are the quality of material being produced and the labour cost per tonne of recyclables. For the Life Cycle Assessment of recyclables the main consideration is the use of machinery for sorting and packing of the materials, while labour inputs are not considered as they are outside the scope of the study.

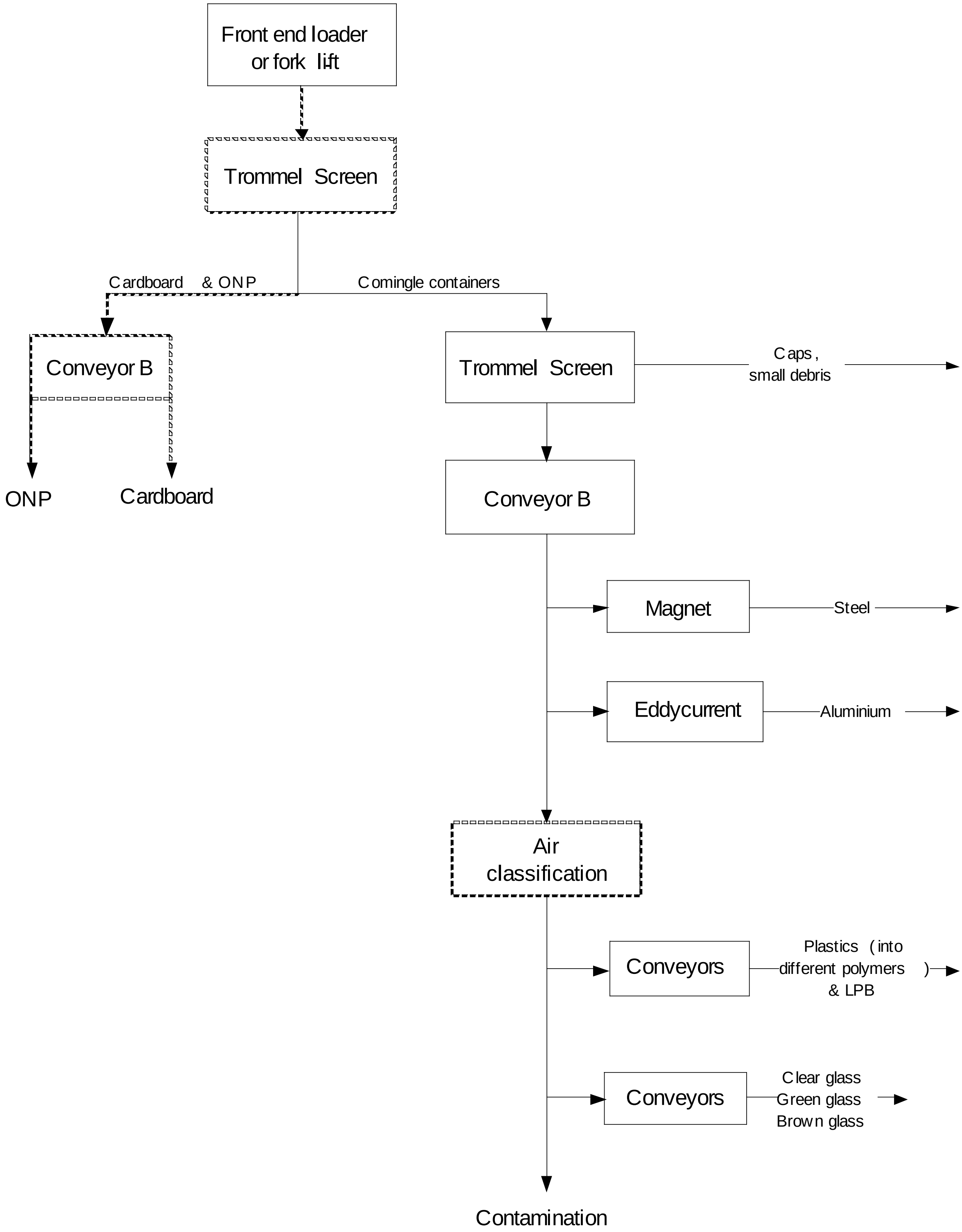
Approaches to MRF model

There are two possible approaches to determining the environmental flows of the MRFs. The first is a black box, or input/output method. In this method the total flows of material, electricity and fuel consumption are measured for the facility. Some simple allocation rule is then applied based on mass, volume or value of each component. This method relies on facilities providing information on electricity and fuel usage and material process over a period on a month, quarter or yearly basis.

The alternative approach is to model individual components of the MRF and determine actual or theoretical energy consumption and throughput of each device. From this information each MRF can be constructed from its components. Allocation can be made on the relationship of a piece of equipment and the sorting of particular materials, and otherwise allocation can be on mass, volume or value.

The modelling approach has been used for this study, with total input/output data being used to verify the model developed. Figure 4 shows the basic processes modelled in the generic MRF. Table 2 shows the assumptions for each of the processes.

Figure 4: Generic MRF model (dashed areas are less commonly used)



The rolling stock for the MRF, consisting predominantly of forklifts and front-end loaders also needs to be included in the MRF model. The use of rolling stock is allocated to all recyclables based again on volume. Emissions for these vehicles are available from (Nishtala, 1997). Alternate emission data could be taken from Pre Consultants inventory for Diesel under changing load. A comparison of the two data sources is presented in Table 3. While the overall difference is small, the preference at this stage is for the (Nishtala, 1997) data as it is specific to forklifts and front-end loaders. CO_2 emissions were not given in the (Nishtala, 1997) data so these were proportioned based on fuel use from the Pre Consultants data.

Table 2: Assumptions for daily sort operation of MRF Models

	Operating time per day	Power rating (kW)	Energy consumption per day (kWh)	Comments
Front end loader	2	58	116	Front-end loader assumed to operate for a total of two hours per day. Power rating from (Nishtala, 1997) — Equivalent to fuel consumption of 2.5l/hour (Automotive Diesel)
Conveyor	40	3	120	Assumed to be a minimum five conveyors of 3 kW running 8 hours per day.
Glass breaker	4	1.5	6	Assumed that only half of MRFs have a glass breaker,
Magnetic Separator	8	3	24	All MRFs assumed to have magnetic separator running all day. Power consumption from (Nishtala, 1997) — for a 50 tonnes per day mixed waste MRF.
Eddie current separator	4	3	12	Assumed that only half of MRFs have an eddie current separator from (Nishtala, 1997) — for a 50 tonnes per day mixed waste MRF.
Trommel Screen	8	3	24	One trommel assumed in MRF sorting paper and containers. Power Rating is for 40 Tonnes per day mixed recyclables MRF from (Nishtala, 1997)
Total (not including baler				
Volume sorted	150 m3			Equal to approximately 18 tonnes of material at approximately 8.3M3 per tonne
Baler	Done based on material type			Based on 25Hp baler operating capable of bailing a cubic meter is approximately 30 Seconds (Based on specification from (Presona Inc))

Overall electricity use in the MRF (excluding balers), using the data above, is 22 kWh/tonne. Data from a MRF operator on electricity costs suggests a figure of 20–30 kWh per tonne including balers. This suggests that the MRF model is a reasonable approximation for what is happening in actual MRFs. However, it should be noted that MRFs are highly variable in design and operation and the energy use will reflect this.

Table 3: Inventories for MRF rolling stock.

	Unit	Simapro	Research Triangle Institute	
		Front end Loader	Fork Lift	Front-end Loader
Automotive Diesel Fuel (Ave)	kg	4.9*	8.5	8.5
CO2	kg	15.7	27.1**	27.1**
SOx	g	10.4	39.5	40.9
NOx	g	183.5	606.4	436.4
CO	g	189.6	263.6	409.1
CxHy	g	130.3	68.5	95.5
dust	g	80.2	56.9	53.5
Aldehyde	g		7.9	8.2

*Fuel consumption taken from (Nishtala, 1997) power rating for Front-end loader

**CO2 emissions not provided in RTI data– these values have been calculated based on SimaPro data proportional to the fuel usage.

Source: (Nishtala, 1997)

Contamination and Yield through MRF

Yields and contamination through MRF's are difficult to determine and vary depending on the type of collection system, seasonal variation in material mix and market variations, which affect the incentive to separate different materials. After discussion with stakeholders the following assumption were made regarding contamination and yield through MRF's.

A) 10 per cent of all material coming into the MRF in not recyclable material. (as distinct form contaminated recyclable material)

B) Of the recyclable material

C) 10 per cent of recyclable plastics are contaminated or inappropriate for recycling and slips through the MRF are discarded to landfill.

D) 5 per cent of steel and aluminium slips through the sorting system and is sent to landfill.

E) 33 per cent of LPB are sent to landfill due to poor markets

F) 10 per cent of paper products (other than LPB) slip through the MRF when they are included as a commingled mix. (15 per cent of recycling stream)

G) 27 per cent of Glass is lost through the MRF due to broken glass that cannot be soughted.

References

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Nishtala, S., Solano-Mora, E., (1997), Description of the Material Recovery Facilities Process Model: Design, Cost, and Life-Cycle Inventory, Research Triangle Institute and North Carolina State University

Presona Inc, www.presona.com

Assumptions on Energy Production

Electricity

Electricity production data is taken from data by the Electricity Supply Association of Australia (ESAA, 2003) and the National Greenhouse Gas Inventory Project (Australian Greenhouse Office and National Greenhouse Gas Inventory Committee 2004). Power from the grid in Queensland, New South Wales, Victoria and South Australia is deemed to derive from the interconnected grid for these four States, and an average of 2002 supply data is used. Where onsite power generation is used, the local data for that power station has been collected where available, supplemented with default data from the grid supply in the absence of specific data.

Electricity inventory data has been taken from work undertaken in the Australian Data Inventory Project (Grant, 1999) and subsequent updates to this data. More than 75 per cent of the Australian electricity production comes from brown or black coal. It seems today that a number of significant new projects in natural gas production are going on, so the balance might change slightly in the future. The actual electricity model mix is shown in Table 4. The data includes fuel production (pre-combustion), electricity generation, transmission and distribution.

Table 4: Australian electricity model mix

Electricity type	Percentage of mix
Hydropower	7.9%
Bagasse	0.4%
Landfill gas	0.3%
Electricity waste	0.3%
Wastewater gas	0.1%
wind power	0.1%
solar	0.0%
black coal nsw	29.2%
brown coal victoria	22.4%
black coal qld	25.7%
brown coal SA	2.0%
black coal WA	4.2%
natural gas (steam)	2.3%
oil (internal combustion)	0.2%
natural gas (turbine)	1.6%
natural gas (cogeneration)	3.4%

Figure 5 5 shows the potential environmental impact of the consumption of 1 kWh of electricity in average in Australia.

Figure 5: Environmental impact for the production of 1 kWh of electricity

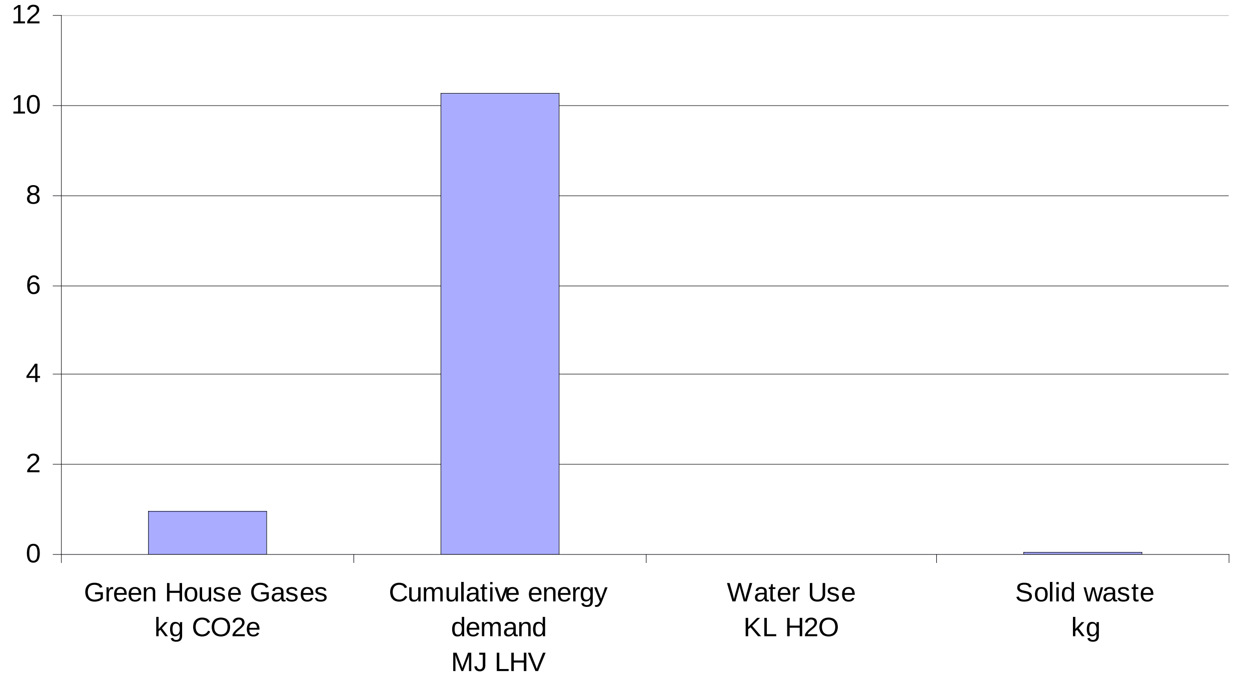

Table 5 illustrate a comparison between the factors used in the National Greenhouse Accounts (NGA) Factors workbook, a recent update (November 2008) of the AGO Methods and Factors workbook, and the results extracted from Simapro for the consumption of electricity.

Table 5: Comparison between NGA factors and factors used in the study for the consumption of 1kWh of electricity

	Emissions factors — consumption of purchased electricity by end users, extracted from NGA Factors and Methods (NGA, 2008)	Average emission by State from this study	Unit
New South Wales and Australian Capital Territory	1.06	0.94	kg CO_2e/kWh
Victoria	1.32	1.31	kg CO_2e/kWh
Queensland	1.04	0.94	kg CO_2e/kWh
South Australia	1.01	0.80	kg CO_2e/kWh
Western Australia — South-West Interconnected System (SWIS)	0.95	1.00	kg CO_2e/kWh
Tasmania	0.06	0.01	kg CO_2e/kWh

Natural gas

Data on emissions form the combustion of gas are taken from the National Greenhouse Gas Inventory (NGGI, 1998) and Environment Australia (Environment Australia, 1999). Figure 6 illustrates the potential environmental impact of the consumption of 1GW of heat from natural gas in Australia.

Figure 6: Environmental impact for the consumption of 1 GW of heat from natural gas

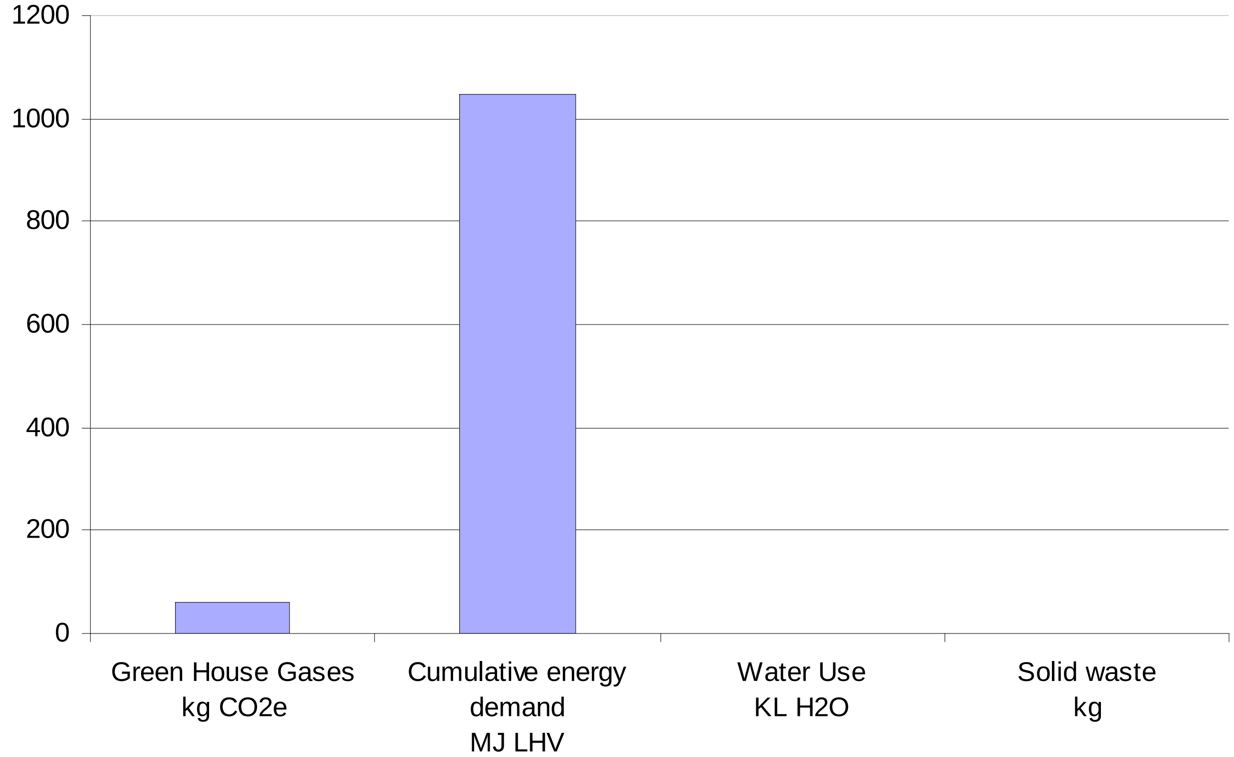

Table 6 illustrate a comparison between the factors used in the National Greenhouse Accounts (NGA) Factors workbook, a recent update (November 2008) of the AGO Methods and Factors workbook, and the results extracted from Simapro for the consumption of 1GW of natural gas.

Table 6: Comparison between NGA factors and factors used in the study for the consumption of 1GW of natural gas

	Emissions factors — consumption of purchased electricity by end users, extracted from NGA Factors and Methods (NGA, 2008)	Emissions factors — consumption of purchased electricity by end users, extracted from NGA Factors and Methods (NGA, 2008)	National average emission from this study	Unit
	Small User	Large User		
New South Wales and ACT	66.13	65.53	59.6	kg CO_2–e/GJ
Victoria	57.23	57.13		kg CO_2–e/GJ
Queensland	57.33	56.73		kg CO_2–e/GJ
South Australia	70.73	69.93		kg CO_2–e/GJ
Western Australia	58.93	7		kg CO_2–e/GJ
Tasmania	NE	57.13		kg CO_2–e/GJ
Northern Territory	57.03	57.03		kg CO_2–e/GJ

References

Electricity Supply Association of Australia (ESAA) (2003), Electricity Australia 2003

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