



Australian Government
Clean Energy Regulator

Clean Energy Regulator

Carbon Pricing Mechanism

Supplementary guideline

Estimating an emissions profile at a landfill

*National Greenhouse and Energy Reporting (Measurement) Determination as amended on 1 July
2012*



Contents

Contents	2
Introduction	3
Estimating an emissions profile	4
General principles for measuring emissions	5
Estimate of total solid waste received at landfill.....	6
Correct application of the Determination	6
Legacy and non-legacy waste.....	7
The criteria for estimating the tonnage of solid waste	7
Criterion A	8
Criterion AAA.....	8
Criterion BBB.....	8
Estimating the opening stock of degradable organic carbon.....	8
Composition of solid waste	9
Waste streams	9
MSW, C&I and C&D waste streams received.....	9
Non - putrescible or C&I and C&D waste streams received	10
Waste mix types.....	11
Degradable organic carbon content.....	11
Fraction of degradable organic carbon dissimilated	11
Methane generation constant	11
Estimating the amount of each waste mix type received.....	12
Using facility specific waste composition values	14
Industry estimation practices	14
Estimating the amount of waste disposed of in landfill.....	16
Waste received and waste deposited.....	16
Treatment of composting emissions	17
Estimating emissions from composting	17
Conclusion	19

Introduction

The methods and criteria for calculating direct (scope 1) greenhouse gas emissions from solid waste disposal on land are included in chapter 5 of the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* as amended to 1 July 2012 (the Determination). The Determination provides three methods for determining scope 1 emissions from solid waste disposed of on land. These are:

- a) Method 1 (default method): based on national average estimates
- b) Method 2 (facility specific method): uses industry practices for sampling and Australian or equivalent standards for analysis
- c) Method 3 (facility specific method): uses Australian or equivalent standards for both sampling and analysis

This guideline aims to assist landfill operators to understand their emissions profile using Method 1 as outlined in Chapter 5 of the Determination for the 2012/13 reporting year. It outlines the general principles and rules concerning how to measure and estimate emissions from different waste streams, waste mix types and climatic conditions and how to distinguish between legacy and non-legacy waste. It also provides guidance on the use of industry estimation practices for distinct waste stream sources.

In addition to this document, further guidance about the Determination is available in the [National Greenhouse and Energy Reporting \(Measurement\) Technical Guidelines](#).

The information in this guideline provides the parameters specified in Division 5.2.2 of the Determination required to be used to determine emissions in the [solid waste calculator](#) which is available on the Clean Energy Regulator's website. Default parameters which cannot be amended in the solid waste calculator are not included in this guide.

Estimating an emissions profile

For the purpose of this guideline, an emissions profile means emissions released over time from the disposal of solid waste at a landfill facility.

Persons who operate a landfill facility, particularly those that service a population of greater than 20 000 people, should consider whether they will be liable under the *Clean Energy Act 2011* for emissions released from waste disposed of in the landfill. However, for any given population, actual emissions will vary greatly based on a range of factors including:

- The amount of waste deposited
- The type of waste deposited, and
- The location of waste deposition.

Chapter 5 of the Determination details how these parameters can be determined. A [solid waste calculator](#) is available on the Clean Energy Regulator's website to assist landfill operators to determine emissions for each year of operation and predict emissions for future years based on parameters in the Determination for 2012/13 or earlier years.

General principles for measuring emissions

All reporters preparing estimates of emissions for the Clean Energy Regulator must develop such estimates in accordance with the following principles (as specified in section 1.13 of the Determination):

- a) **Transparency** — emission estimates must be documented and verifiable.
- b) **Comparability** — emission estimates using a particular method and produced by a registered corporation in an industry sector must be comparable with emission estimates produced by similar corporations in that industry sector using the same method and consistent with the emission estimates published by the Department in the National Greenhouse Accounts.
- c) **Accuracy** — having regard to the availability of reasonable resources by a registered corporation and the requirements of this Determination, uncertainties in emission estimates must be minimised and any estimates must neither be over nor under estimates of the true values at a 95 per cent confidence level.
- d) **Completeness** — all identifiable emission sources mentioned in section 1.10 must be accounted for.

In regard to the first part of the accuracy principle above, reporters must minimise the uncertainty of any estimates made and these estimates should not be biased. Reporters can consider the availability of reasonable resources to achieve the accuracy level described in the accuracy principle.

In relation to the second part of the accuracy principle, the *Technical Guidelines for the estimation of greenhouse gas emissions by facilities in Australia* (2012/13 reporting period) notes the difference in meaning between the common usage of the word 'confidence' and its statistical usage in relation to a '95 per cent confidence level or interval'. The uncertainty level (represented by the +/- percentages) is to be calculated so that there is a 95 per cent probability that the true value of the estimate is encompassed by the estimated uncertainty levels.

Section 8.10 of the Determination states that the aggregated uncertainty level for solid waste disposal on land is 35 per cent. Using this percentage for example, an emission estimate of 100kt +/- 35 per cent at the 95 per cent confidence interval means that the true value lies between 65kt and 135kt with a probability of 95 per cent. A 95 per cent confidence level does not mean that the estimate needs to be within 5 per cent of the true value.

Estimate of total solid waste received at landfill

Section 5.4A of the Determination sets out the estimates for calculating methane in landfill gas released from the landfill during the reporting year. To calculate the tonnage of total solid waste disposed of in the landfill during the year, landfill operators must include:

- a) tonnage of total solid waste disposed of in the landfill during the year
- b) composition of solid waste disposed of in the landfill during the year
- c) degradable organic carbon content of the solid waste disposed of in the landfill by waste type
- d) opening stock of degradable organic carbon in the solid waste at the landfill at the start of the first reporting period
- e) methane generation constants (*k values*) for the solid waste at the landfill
- f) fraction of degradable organic carbon dissimilated (DOC_F)
- g) methane correction factor for aerobic decomposition in the first year
- h) fraction by volume of methane generated in landfill gas
- i) number of months that have ended before methane generation at the landfill commences

These estimates must be calculated in accordance with requirements set out in the Determination. The solid waste calculator will calculate the total emissions from landfill from the tonnage of total solid waste disposed of in the landfill in accordance with the relevant equations set out in Division 5.2.2 of the Determination. It will also calculate the composition of this waste in terms of the volumes of legacy and non-legacy waste.

Correct application of the Determination

The Determination is amended annually, so it is important to ensure the correct version for each reporting year is used. There are material changes that occur in every iteration of the Determination, and in the 2012/13 iteration, a detailed method of distinguishing between legacy and non-legacy waste has been provided and some default parameters updated. Where these changes affect solid waste, they **must** be applied to all waste that has been received in the landfill since it opened. This will enable an estimate of emissions in the landfill to be estimated for the year in which the particular Determination is applicable.

For example, when estimating emissions in the 2012/13 reporting year, the applicable values/methodologies in the 2012/13 Determination would be applied to all waste that has been received in the life of the landfill.

Legacy and non-legacy waste

With the introduction of the *Clean Energy Act 2011* (Clean Energy Act) on 1 July 2012, landfill operators need to distinguish between legacy waste and non-legacy waste (waste deposited on or after 1 July 2012). Legacy waste is waste that was deposited at the landfill prior to the 2012/13 reporting year, i.e. before 1 July 2012.

Note: *in the 2012/13 reporting period, only legacy emissions will be produced.*

It is necessary to clearly identify whether emissions are legacy or non-legacy emissions since this distinction can mean the difference between a liability under the Clean Energy Act, or a credit under the Carbon Farming Initiative (CFI). The 2012/13 Determination includes a detailed method to determine this breakdown in Division 5.2.7.

The method works by breaking down the landfill into sub-facility zones. Each sub-facility zone may contain legacy waste, or non-legacy waste or a combination of the two. Gas emanating from each sub facility is deemed to be either completely legacy, or non-legacy, or a combination of the two according to waste types present.

For example, gas released from a zone that was entirely comprised of legacy waste would be deemed to only produce legacy emissions. Thus, if such emissions were flared, they would not reduce the landfills liability but would potentially be eligible under the CFI. Similarly, emissions that were drawn from a zone that contained only non-legacy waste would be entirely non-legacy emissions. If these emissions were flared, they would decrease the landfills liable emissions, but would not be eligible under the CFI.

A facility's emissions profile is the sum of all legacy and non-legacy emissions from each sub-facility zone, including other relevant emissions - including composting.

The criteria for estimating the tonnage of solid waste

Sections 5.5 to 5.8 of the Determination details criteria that can be used to estimate the tonnage of solid waste received at the landfill. These are criteria A, AAA and BBB (the Criteria).

These sections make a clear demarcation between waste 'disposed of in landfill' and waste 'received at the landfill'¹. Broadly, waste received at the landfill is waste that passes over the weighbridge at the landfill site entrance, and is often the same figure as that reported to the relevant state or territory government. Waste disposed of in a landfill is defined as waste received at the landfill minus waste diverted from disposal (i.e. the quantity of material that is composted, recycled or used onsite).

One of the Criteria described in section 5.6 through 5.8 of the Determination must be used to estimate the tonnage of total solid waste received at the landfill. The Criteria are:

¹ Please note: It is necessary to report in 'column B' of the Solid Waste Calculator the amount of waste received at the landfill. The quantity of waste disposed of in landfill is determined by subtracting waste diverted from waste received. This is explained in greater detail later in this document.

Criterion A

Under criterion A, the amount of solid waste received at the landfill during the year can be evidenced by invoices; or if the amount of solid waste received at the landfill during the year is measured in accordance with state or territory legislation applying to the landfill — that measurement.

Criterion AAA

Criterion AAA is the direct measurement of quantities of solid waste received at the landfill during the year using measuring equipment calibrated to a measurement requirement.

Criterion BBB

Criterion BBB is the estimation of solid waste received at the landfill during the year in accordance with industry estimation practices² (including the use of accepted industry weighbridges) and prepared in accordance with the principles of emissions reporting (referred to above).

Estimating the opening stock of degradable organic carbon

Correctly estimating the opening stock of degradable organic carbon ensures that estimates of emissions from landfill activities are accurate. Such estimates **must** be made in accordance with section 5.13 of the Determination.

Several common mistakes that reporters make when estimating the opening stock of carbon include:

- Using a combination of the details of the total tonnage of waste disposed of in the landfill, in each given year prior to the first reporting period (5.13(1)(a)) together with the estimated annual tonnage of solid waste disposed of in the landfill for the years when data is not available (5.13(1)(b)). Using a combination of these methodologies is not allowed, and
- When estimating the quantity in tonnes of waste disposed of in landfill by using a volumetric survey, use of a site specific density factor is only allowed where that figure was used during the most recent reporting year to comply with state or territory legislation (5.13(4)(a)). Where any of these conditions do not apply, a volume to mass conversion factor of 1.1 tonnes per cubic metre must be used instead (5.13(4)(b)).

² Industry estimation practices broadly encompass standard approaches adopted by similar industries in similar circumstances when estimating an emissions profile. Industry body guidance may be pertinent in this circumstance.

Composition of solid waste

The composition of solid waste received at a landfill is classified by both its stream and makeup of different waste mix types. It is necessary to classify both the waste stream and the waste mix types in accordance with the Determination.

Waste streams

Section 5.10 of the Determination describes the three waste streams by which the composition of solid waste must be classified, namely:

- Municipal Solid Waste (MSW)
- Commercial and Industrial Waste (C&I), and
- Construction and Demolition Waste (C&D).

The Determination outlines a series of decision points that need to be stepped through when determining how to report the quantities of each waste stream received at the landfill. These are as follows:

MSW, C&I and C&D waste streams received

- If the operator of the landfill is required under a state or territory law to collect data on tonnage of waste received at the landfill according to the waste streams MSW, C&I and C&D, then the tonnage of each waste stream must be estimated using that data. Note: data for all three waste streams is required for this option, or
- If such data is not required to be collected by law and there are no restrictions on the waste streams that must be received at the landfill, the tonnage of each waste stream must be estimated by using the following default values in table 1.

Table 1

Waste stream	NSW %	VIC %	QLD %	WA %	SA %	TAS %	ACT %	NT %
Municipal solid waste	31	36	43	26	36	57	43	43
Commercial and industrial	42	24	14	17	19	33	42	14
Construction and demolition	27	40	43	57	45	10	15	43

Non - putrescible or C&I and C&D waste streams received

In the event that the landfill is only permitted to receive non-putrescible waste or C&I and C&D waste, then the waste may be assumed to contain only C&I and C&D waste. In this case:

- If the operator of the landfill is required under a state or territory law to collect data on tonnage of waste received at the landfill according to the waste streams C&I and C&D, then the tonnage of each waste stream must be estimated using that data. Note: data for both waste streams is required for this option), or
- If such data is not required to be collected by law, the tonnage of each waste stream must be estimated by using the following default values in table 2.

Table 2

Waste stream	NSW %	VIC %	QLD %	WA %	SA %	TAS %	ACT %	NT %
Commercial and industrial waste	61	38	25	23	30	77	74	25
Construction and demolition waste	39	62	75	77	70	23	26	75

In the event that the second dot point above applies and the landfill is only permitted to receive either C&I or C&D waste, then that waste stream will be taken to constitute all of the waste received.

It has come to the attention of the Clean Energy Regulator that in some instances, the Determination has been interpreted in such a way as to allow for a lower emissions profile. This has occurred in states and territories where there are limited regulations and procedures on the transfer of waste, resulting in MSW waste being reclassified to C&I waste when transferred through a transfer station. This reclassification is not in accordance with the principles as specified in section 1.13 of the Determination.

Waste mix types

Section 5.11 of the Determination details nine different waste mix types which are listed in table 3. Emissions generated at the landfill will vary according to tonnage of each waste mix type deposited in the landfill as each waste mix type varies in relation to the amount of emissions released, and the rate at which these emissions are released. These variables are governed by the following three parameters:

- degradable organic carbon content
- the fraction of degradable organic carbon dissimilated, and
- the methane generation constant.

Degradable organic carbon content

The degradable organic carbon (DOC) of material defines the fraction of that material made up of organic carbon that can degrade biologically to form organic compounds including methane. DOC varies by waste type alone.

Fraction of degradable organic carbon dissimilated

The fraction of degradable organic carbon content dissimilated (DOC_f) describes the amount of organic carbon contained within a material that will readily decay and transform to either methane or carbon dioxide. DOC_f varies by waste type alone.

Methane generation constant

The methane generation constant (k value) determines the rate at which the breakdown of DOC occurs. The k value varies by both waste type and climatic conditions to reflect that organic decay is principally a biogenic process affected by ambient moisture and temperature conditions.

Landfill operators have two options for selecting k values under Method 1. The first option is to select k values based on climate zones established from the climatic conditions (mean

annual temperature, precipitation and evaporation) at or near the landfill site. The second option is to select k values based on the state or territory in which the landfill is located.

Using your own on-site data to establish applicable climate zone

The first option involves calculating mean annual temperature either from your own on-site weather stations or from the data available on the [Bureau of Meteorology \(BOM\) website](#).

The Determination requires on-site data to be used where possible to ensure that the data is most representative of site conditions. On-site records should be of sufficient quality to ensure the general principles of emissions estimation set out in section 1.13 of the Determination are met. Where it cannot be established that on-site data are representative of the climatic conditions experienced at the site, then BOM data should be used.

If on-site data are considered suitable to use but are incomplete, the landfill operator may use appropriate BOM data to ensure a complete 10-year record is available.

The BOM provides data on mean maximum and mean minimum temperatures over the entire time-series of weather station data.

The mean annual temperature can be calculated by averaging the mean maximum and mean minimum temperatures on the BOM website. Mean annual precipitation is available directly from BOM weather station data, with no additional calculations needed to derive this value. Where BOM records are missing for any of the previous years, landfill operators may use average values to fill in data gaps in order to undertake the required calculations.

Landfills in “temperate” zones will also need to estimate mean annual evaporation. Mean annual evaporation data are available from certain BOM weather stations. Under the provision of section 5.14 of the Determination, mean annual evaporation data should be obtained from the closest BOM weather station to the landfill for which evaporation records exist. Reporters should consult the BOM to obtain the appropriate evaporation records required for selecting climate-based k values. All temperature and precipitation data should be read to zero decimal places.

Section 5.14 of the Determination specifies how to use the climate data to determine the landfill facility’s climate region, and hence its k values as specified in sub-section 5.14 (6).

Using state or territory defaults

If you do not have suitable measuring equipment on-site or BOM data is unsuitable, k values for method 1, based on state or territory data, can be used as specified in sub-section 5.14(5) of the Determination.

Estimating the amount of each waste mix type received

Landfill operators will need to estimate the percentage of the total waste tonnage of each waste stream for each different waste mix type. Options for doing this are set out in section

5.11 of the Determination. It is important that the selection of options is carried out in accordance with the General Principles for Measuring Emissions (described previously).

The percentage of the total waste tonnage of each waste stream for each waste mix type must be estimated by using:

1. sampling techniques specified in waste audit guidelines issued by the State or Territory in which the landfill is located, or
2. if no such guidelines have been issued, sampling techniques specified in ASTM D 5231-92 (reapproved 2008) or an equivalent Australian or international standard, or
3. the tonnage of each waste mix type received at the landfill estimated according to the Criteria set out in section 5.5 (outlined previously), or
4. the default waste stream percentages in table 3 can be used (subject to the matters described at point 5 below).

Table 3

Waste mix type/ waste stream	Municipal solid waste default (per cent)	Commercial and industrial waste default (per cent)	Construction and demolition waste default (per cent)
Food	35.0	21.5	0.0
Paper and paper board	13.0	15.5	3.0
Garden and park	16.5	4.0	2.0
Wood and wood waste	1.0	12.5	6.0
Textiles	1.5	4.0	0.0
Sludge	0.0	1.5	0.0
Nappies	4.0	0.0	0.0
Rubber and leather	1.0	3.5	0.0
Inert waste (including concrete, metal, plastic and glass)	28.0	37.5	89.0

5. Under subsection 5.11(3) of the Determination, if the licence or authorisation allowing the operation of the landfill restricts the waste mix types that may be received at the landfill, the percentage of the total waste volume for each waste type mentioned in the above table must be estimated using a formula set out in that subsection.

Using facility specific waste composition values

If a landfill facility has specific waste stream and/or waste mix type data estimated in accordance with Section 5.10 and 5.11 of the Determination, then these figures may be used in lieu of the default figures. However, it is necessary to keep strict records of these figures, and the methodology used to develop them. Such records must be kept in accordance with the principles of emission reporting as outlined in section 1.13 of the Determination.

When making changes of waste streams in accordance with section 5.10 of the Determination, commonly made mistakes include:

- Reporting site specific waste mix breakdowns in jurisdictions that do not require details of Municipal Solid Waste and/or Commercial and Industrial Waste and Construction and Demolition Waste to be reported. This is not allowed under section 5.10 of the Determination, and
- Reporting default waste stream composition data where the operator of the landfill is required by law to report this data to the relevant state or territory government. This is not allowed under section 5.10 of the Determination.

Industry estimation practices

Where distinct waste stream sources producing homogeneous waste can be identified, it may be possible for reporters to more accurately estimate the waste mix proportion taking account of the waste streams from those sources using Criterion BBB (industry estimation practices). Such an approach would need to take account of the tonnage of each waste mix type received at the landfill using industry estimation practices that adhere to the general principles for measuring emissions outlined in section 1.13 of the Determination.

Acceptable industry estimation practices would be expected to involve the use of weighbridges and an appropriate sampling and analysis regime.

Waste streams can comprise of material from multiple diverse sources. Waste streams may also be derived from a number of limited sources, comprise material that is homogeneous in nature and be delivered in discretely quantifiable loads. Such waste could include recycled waste, contaminated soil and biosolids.

In these circumstances, it may be possible to use an industry estimation practice that enables the tonnage of discrete waste types from limited sources to be estimated based on appropriate sampling and analysis that incorporates default percentages for the remaining mixed waste from diverse sources. The default percentages could be based on those set

out in paragraph 5.11(2) (c) and subsection 5.11(3) but noting the industry estimation practice as a whole, including where it incorporates default elements, must comply with the general principles for measuring emissions in section 1.13. Those principles include the requirement that estimates using a particular method must neither be over nor under estimates of the true values at a 95 per cent confidence level (see page 2 of this guideline for an explanation of confidence level).

In meeting the requirement for estimates to achieve the above confidence level, the availability of reasonable resources by the relevant corporation and the requirements of the Determination should be considered. In some instances, the availability of reasonable resources may limit the ability of a landfill operator to fully verify that estimates using industry estimation practices are neither over nor under estimates of the true values to a 95 per cent confidence level. Nevertheless, it is expected that operators will make reasonable efforts in this regard and also verify that any industry estimation practice used to estimate tonnage of waste mix types is also consistent with the other principles of transparency, comparability and completeness detailed in section 1.13 of the Determination.

Landfill operators are subject to general obligations to keep records, and the Clean Energy Regulator has powers to seek and obtain information to ensure compliance. Where non-default compositions are used, landfill operators must keep records to demonstrate that any accepted non-default waste (e.g. recycled waste, contaminated soil and biosolids) is in fact homogeneous and arrives in defined loads.

The scenario below is an example of the use of an industry estimation practice where there are homogeneous waste streams.

A landfill accepts 100 000 tonnes of C&I waste per annum. This comprises:

- 30 000 tonnes of largely inert C&I waste of a homogeneous nature (stream one)
- 20 000 tonnes of largely inert C&I waste of a homogeneous nature (stream two), and
- 50 000 tonnes of C&I waste from a wide variety of sources.

The largely inert waste streams one and two are homogeneous and come over the weighbridge in defined loads. An industry estimation practice which uses an appropriate sampling and analysis regime is applied to these waste streams to determine the percentage of the total tonnage for the waste mix types in these waste streams.

The percentage of the C&I waste stream for each waste mix type is determined as follows:

- The percentage for the waste mix types in the largely inert waste stream one is determined through the industry estimation practice and applies to 30 per cent of the C&I waste stream.
- The percentage for the waste mix types in the largely inert waste stream two is determined through the industry estimation practice and applies to the remaining 20 per cent of the C&I waste stream.
- The percentage for the waste mix types in the remaining 50 per cent of the C&I waste stream coming from diverse sources and being mixed waste is determined through the application of default values in the industry estimation practice.

- The application of the industry estimation practices to determine the percentages of the C&I waste stream for each waste mix type outlined in this example is subject to those industry estimation practices meeting the general principles for Measuring Emissions in section 1.13 as referred to above.

Industry estimation practices are expected to be documented and should include guidance and record keeping requirements to support any decision based on the industry estimation practices.

Estimating the amount of waste disposed of in landfill

As described previously, there are three Criteria that can be used to estimate the amount of waste received at a landfill.

Section 5.11A of the Determination describes three separate situations where the tonnage of certain waste can be deducted from the estimates of waste received at the landfill. These are as follows:

- waste that is taken from the landfill for recycling or biological treatment
- waste that is received at the landfill for recycling or biological treatment at the landfill site, or
- inert waste that is used at the landfill for construction purposes, daily cover purposes, intermediate cover purposes or final capping and cover purposes.

Waste received and waste deposited

For all years up until the first reporting period for the landfill, it is only necessary to estimate and report the total tonnage of solid waste disposed of in landfill. However for the first and subsequent reporting periods of the landfill, reporters must determine the amount of waste disposed of in landfill by subtracting the amount of waste diverted from disposal (i.e. to be composted) from the amount of waste received at the landfill.

Waste received at landfill is generally all waste that passes over the landfill weighbridge. Waste diverted from landfill can be determined in accordance with section 5.11A of the Determination and includes waste that is composted onsite. This complete concept is best illustrated as follows:

Waste disposed of in landfill = waste received at the landfill – waste diverted from disposal (i.e. the quantity of material that is composted, recycled or used onsite).

Treatment of composting emissions

Emissions from composting are covered emissions under the carbon pricing mechanism if composting occurs at a landfill facility and forms part of the landfill facility. If composting occurs at a site that is not a landfill facility, such as a stand-alone composting facility that does not form part of a landfill facility, the emissions are not covered under the carbon pricing mechanism. Biological treatment of solid waste, such as composting, is covered in section 5.22 of the Determination and creates a liability in the year that the composting occurs.

Estimating emissions from composting

Methane emissions from the biological treatment of solid waste are estimated in accordance with [Volume 5, Chapter 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories](#).

Data on the amount and type of solid waste that is biologically treated should be collected separately to data from waste that is composted or anaerobically treated. The IPCC guidelines separate biological treatment into composting and anaerobic digestion at biogas facilities.

Estimating the amount of solid waste that is biologically treated is described previously in this guideline (page 7) in the section 'The Criteria for estimating the tonnage of solid waste'.

Methane and nitrous oxide emissions are estimated using the default methods given in equations 4.1 and 4.2 of the IPCC guidelines, and the amount of recovered gas is subtracted from the methane emissions generated to estimate the net annual methane emissions if applicable.

Emissions from composting and anaerobic digestion in biogas facilities will depend on factors such as the type of waste composted, the amount and type of supporting material (i.e. wood chips and peat) used, temperature, moisture content, and aeration during the process. The default emissions factors set out in Table 4.1 of the IPCC Guidelines (set out below) are applied to mechanical-biologically treated waste, where emissions from mechanical operations are assumed negligible.

Table 4

Type of biological treatment	CH ₄ Emission Factors (gCH ₄ /kg waste treated) on a dry weight basis	CH ₄ Emission Factors (gCH ₄ /kg waste treated) on a wet weight basis
<i>Composting</i>	10	4
<i>Anaerobic digestion at biogas facilities</i>	2	1

Table 5

Type of biological treatment	N ₂ O Emission Factors (gN ₂ O/kg waste on a dry weight basis)	N ₂ O Emission Factors (gN ₂ O/kg waste on a wet waste basis)
<i>Composting</i>	0.6	0.3
<i>Anaerobic digestion at biogas facilities</i>	assumed negligible	assumed negligible

Remarks: Assumptions on waste treated:

25-50% in dry matter, 2%N in dry matter, moisture content 60%.

Emission factors for dry waste estimated from those for wet waste assuming moisture content of 60% in wet waste.

Sources: Arnold, M (2005) Personal communication; Beck-Friis (2002); Detzel et al (2003); Petersen et al 1998; Hellebrand 1998; Hogg, D (2002); Vesterinen (1996)

All information used in estimating emissions from composting should be documented and retained for future reference. Worksheets for estimating the greenhouse gas emissions from biological treatment should include activity data and emission factors used to calculate the emissions estimates.

Conclusion

Accurately determining the amount and type of waste received at the landfill, and ultimately deposited into the landfill is critical to developing a representative emissions profile estimate. This document provides information that may assist in achieving greater accuracy of emissions reporting.

If further information is required, please contact the Clean Energy Regulator as follows:

Email: reporting@cleanenergyregulator.gov.au

Phone: 1300 553 542 within Australia

Web: www.cleanenergyregulator.gov.au

This document has been prepared to assist landfill operators estimating an emissions profile at a landfill. This document should be read in conjunction with relevant legislation in its current form at the time of reading. Changes to legislation may affect the information in this document. Landfill operators are responsible for determining their obligations under the law, and for applying the law to their individual circumstances. This document is not intended to provide legal advice and is not a substitute for independent professional advice. If you have any concerns, you should seek independent professional advice.