New Zealand Government

The New Zealand Emissions Trading Scheme

A guide to landfill methane in the New Zealand Emissions Trading Scheme

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1 Background

Purpose of this guide

Regulations for reporting landfill methane emissions under the New Zealand Emissions Trading Scheme (NZ ETS) come into force from 1 January 2011. Voluntary reporting also starts from that date.

This guide is intended to help waste disposal facility (ie, landfill) operators as well as territorial local authorities and contractors to meet the mandatory reporting and surrender obligations that these regulations will eventually place on them.

The information in this guide may also help people

- make use of the available lead time, and the option of voluntary reporting, to develop systems and minimise future NZ ETS costs, both by improving the accuracy of emissions reporting and by monitoring and managing actual emissions
- identify and provide feedback to officials on areas in which the regulations and methodologies may need improving in the future.

It contains information on:

- the legislative requirements placed on landfill operators by the Climate Change Response Act 2002 (the Act) and regulations, and requirements of the reporting systems used in the NZ ETS
- the basic methodology used for emissions reporting
- the options for non-default emissions reporting
- background on how the emissions factors used are calculated.

This guide is intended to provide information to waste disposal facility (ie, landfill) operators as well as territorial local authorities and contractors in relation to their obligations for reporting landfill methane emissions under the Act and relevant regulations.

It is intended as general guidance only and is not legal advice. For more detailed information you should read the Act and the regulations referred to in this guide. For information about your specific legal obligations, please consult your legal advisors.

2 Legislation and regulations affecting waste sector

What the legislation says

The Act specifies that coverage of the NZ ETS will be extended to waste disposal facility operators in three stages, so that they:

- may voluntarily report information about their methane emissions from 1 January 2011
- must collect and report this information from 1 January 2012
- must surrender New Zealand Units (NZUs) to match their emissions from 1 January 2013.

A *disposal facility* is defined by the Act, broadly as a landfill or other site where waste is disposed of by long-term placement in the ground or by incineration – but only when the facility is operated, at least in part, as a business and where some part of the waste disposed is from household sources. This means that all municipal landfill facilities are included in the NZ ETS. Industrial fills, cleanfills, or any facilities that accept no household waste, are excluded by the definition in the Act and are not part of the NZ ETS.

This definition mirrors the Waste Minimisation Act 2008, so that disposal facility operators who currently have responsibilities under the Waste Disposal Levy will also be mandatory participants in the NZ ETS.

In principle, operating a facility at which waste is incinerated (other than for generating electricity or industrial heat) is also included and would make the operator an NZ ETS participant. However, currently such an activity is not considered likely to occur in New Zealand, and no regulations have been issued for it.

Closed landfill sites are not covered by the definition of a disposal facility in the Act, and are not part of the NZ ETS. However, this applies only to facilities that are closed entirely. If a disposal facility that is still accepting waste has cells, layers, or other parts that are no longer used, NZ ETS obligations still relate to emissions from the site as a whole.

Legacy emissions from closed landfill sites, and emissions from sites with no household waste, will continue to be reported internationally as part of New Zealand's emissions inventory although they are outside the NZ ETS.

About the regulations

The NZ ETS regulations affecting waste disposal facility operators are in two parts:

- the Climate Change (Waste) Regulations 2010
- the Climate Change (Unique Emissions Factors) Regulations 2009, as amended in 2010 to include coverage of the waste sector.

The Climate Change (Waste) Regulations (the waste regulations) establish the basics of the mass balance method used for reporting methane emissions, and provide a simple default

methodology for disposal facility operators who may operate smaller facilities, and prefer a straightforward reporting method. This option will allow them to meet their ETS reporting obligations with minimal compliance costs, using data that they already collect for calculation of the Waste Disposal Levy, as required by the Waste Minimisation Act 2008.

The amended Climate Change (Unique Emissions Factors) Regulations (the UEF regulations) provide options for operators to use more complex methodologies which account for factors that the default methodology assumes to be standardised. These are:

- the composition of the waste disposed, if this is shown to be different from the default assumptions
- the capture and destruction of methane, by flaring or for energy production
- both non-default waste composition and methane capture at the same site.

Disposal facility operators wishing to use a non-default methodology will need to apply for approval to use a Unique Emissions Factor (UEF) incorporating the relevant composition data, collection and destruction rate, or both.

3 Reporting landfill methane emissions

Registration and reporting process

All NZ ETS reporting is done through the New Zealand Emission Unit Register (or Registry)[1] operated by the Environmental Protection Authority (EPA). NZ ETS participants are required to report their emissions for each calendar year, by 31 March of the following year.

When mandatory reporting obligations begin, for the 2012 calendar year, every disposal facility operator will need to open a holding account in the Registry, and apply for registration as a participant. The deadline to open an account and register as a participant is 20 working days from the time you first become a mandatory participant. Waste disposal facility operators will become mandatory participants from 1 January 2012, so the deadline is 20 working days from that date, ie, 31 January 2012.

An online reporting tool, customised for each participant, will be used for reporting emissions. The NZEUR plans to start the development of the online reporting tool for disposal facility operators from the second quarter of 2011. Templates for voluntary reporting (not online) will be available for recording data before the online tool is completed.

Disposal facility operators intending to carry out voluntary reporting for the 2011 calendar year, or considering it, should open a holding account with the NZEUR and register as participants. The participant notification forms to allow registration as waste sector participants are available on the NZEUR website.

Registering is a simple process. Registering early does not create any extra obligations for disposal facility operators. It will ensure that NZEUR staff are aware of likely early users and will be able to involve them in the development and testing of the online reporting tool for the waste sector.

Basics of reporting waste data

The Climate Change (Waste) Regulations require you to measure and record the gross tonnage and diverted tonnage of each 'class' of waste disposed at a facility in each calendar year. If you intend to use only the default methodology, all waste disposed at the facility will be taken to be a single class. Therefore, the total gross and diverted tonnages for the year at the site are reported.

The same information also has to be reported under the Waste Minimisation (Calculation and Payment of Waste Disposal Levy) Regulations 2009, through the Online Waste Levy System (OWLS). The only difference is that the Waste Levy is reported monthly (for most facilities) and calculated for a July to June financial year. Calendar years are used for all NZ ETS reporting and surrender purposes.

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1 http://www.eur.govt.nz

Calculation using default methodology

The emissions are calculated as:

$$E = (A - B) \times C$$

Where: E is the emissions in tonnes of CO_2-equivalent
A is the gross tonnage of waste entering the site in the year
B is the tonnage of waste diverted in the year
C is the emissions factor

The default value of C is 1.10 tonnes of CO_2-equivalent per tonne of waste. If you do not intend to account for either non-default waste composition or methane collection, this 'default emissions factor' or DEF is always used, and no further calculation is needed. The reporting for each year's emissions return will simply consist of entering the tonnages (A and B) in the online reporting tool.

This calculation for methane emissions is based on a 'mass balance' approach in which emissions are attributed to waste in the year that the waste is disposed to the facility. The method is described (as Tier 1) in the 1996 IPCC Guidelines.[2]

[2] http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm#4

4 Applying for and using a Unique Emissions Factor

For all NZ ETS activities where a non-default option is available, a Unique Emissions Factor (UEF) is a user-specific emissions factor which replaces the relevant default emissions factor (DEF). As indicated above, the DEF for waste is 1.10 tCO_2-equivalent per tonne of waste disposed. A facility operator wishing to use one of the three non-default options (chapters 5, 6, and 7 below) will need to have approval to use one or more UEFs. The required documentation for applying for UEFs is available on the NZEUR website.

The necessary steps to develop, apply for and use a UEF are:

- carry out monitoring and analysis as required over a full year (the base year) to determine the emissions factor
- do the necessary analysis and planning to determine how long the UEF is expected to remain valid, and/or what future conditions would mean that it is no longer fit for use and what monitoring is required to identify them
- incorporate this work in an application and an ongoing test plan which specifies the monitoring that will be done to validate the UEF over time
- have the application, its underlying data and calculations, and the ongoing test plan, verified by a recognised verifier
- submit the application, ongoing test plan, and verification statement to the manager, Emissions Trading Registry
- when approval is granted, use the UEF for all emissions reporting – on approval of the UEF, the Registry will incorporate it in your reporting tool
- as emissions reporting is done over time, do whatever monitoring or checks are specified in the ongoing test plan to ensure the UEF remains valid
- when the UEF is no longer valid, either re-apply to be granted a new one or notify the Registry so that the relevant DEF will be put back in the reporting tool.

If a UEF application is submitted by 31 January in a particular year, and is approved, it can be incorporated in the participant's reporting tool and used to report data for the preceding calendar year. Therefore, if you wish to use a UEF for the first mandatory emissions report, covering the 2012 calendar year, you will need to submit the UEF application before 31 January 2013. The new UEF will go into the reporting tool immediately, and can be used for the calendar 2012 emissions report which will be submitted by 31 March 2013.

It is possible that some disposal facility operators may be in a position to apply for and use UEFs, particularly for methane collection and destruction, based on historic data which is already available. A UEF application may be based on data that was collected before the regulations came into force, and can be submitted at any time after 1 January 2011.

The form for making a UEF application, and a list of recognised verifiers, are available at the NZEUR website.[3]

[3] http://www.eur.govt.nz/how-to/ets-application-forms

5 UEF for non-default waste composition

The composition of waste going into a landfill affects the amount of methane it is expected to generate. You can apply for approval to use one or more UEFs relating to waste composition. These need to be based on surveys using the methodologies described in Procedure 2 of the Solid Waste Analysis Protocol[4] (the SWAP protocol). Two SWAP surveys have to be carried out during a single year (the base year), each at least a week in duration and done at least three months apart. The aim of these surveys is to determine the proportions of the particular components in waste that contribute to its Degradable Organic Carbon (DOC) content and consequently to emissions.

The simplest approach to using the UEF approach for composition is to carry out the two required SWAP surveys in the base year, for all waste, and apply for a single UEF to be used for all waste accepted at the site while it remains valid. This means that if there is a material change in the average composition of waste in a future year, you will have to either re-apply for approval to use a new UEF or go back to the DEF.

Classes of waste

Changes in the composition of waste over time can occur as a result of more or less waste coming from particular sources, for example demolition waste or waste from industrial sites. In order to increase the chance that UEFs can be used over a reasonable period of time without a need to re-apply, the regulations allow you to apply for separate UEFs for different sources or 'classes' of waste.

The idea behind this option is that UEFs can be determined for classes of waste that are expected to have relatively stable composition, and then the changing tonnages of these waste classes are reported over time. The average composition at the site might change substantially, but the UEFs can still remain valid.

Disposal facility operators can define a set of classes to suit their own requirements. A class of waste may be:

- all waste accepted at the site, which means that a single UEF is approved and will simply replace the DEF, or
- waste from one or more particular sources, and
- if the classes based on source categories do not cover all waste accepted at the site, a catch-all class must also be defined to include all other waste disposed at the facility.

This means that the application, and the set of UEFs when approved, must cover all waste accepted at the facility. It is not acceptable to use UEFs for some classes and the DEF for others. However, if UEFs have already been approved and are in use, a new application does not need to cover all of them – it may update some UEFs but leave the others unaffected.

Disposal facility operators can choose to use source categories that are commonly referred to in the industry, such as construction and demolition waste or kerbside waste collections. If you

[4] http://www.mfe.govt.nz/publications/waste/solid-waste-analysis-mar02/index.html

decide to apply for a set of UEFs based on such general classes, it is a good idea to make use of consistent class definitions that will generate useful comparative data. These might include:

- municipal waste from kerbside collections
- construction and demolition waste
- industrial waste.

Alternatively, or in addition to classes of this type, you may wish to define classes based on waste sources that are specific to your own activities. For example, a facility that accepts municipal waste from two different collection areas, directly or through transfer stations, might report them as two classes. Industrial waste from a specific industry might be a class, and have its own UEF.

There is no specified limit on the number of classes that may be defined and used. However, the cost of carrying out SWAP surveys, their limitations, and the small quantities of some waste types mean that a few carefully chosen classes are likely to be appropriate.

Analysis of waste using SWAP

The UEF regulations say that the two required SWAP surveys, during the base year, are to be carried out for each class of waste for which a UEF will be calculated. This does not imply separate surveys need to be done for every class. Normally, a survey would cover all waste for the facility, and would need to be planned and carried out in such a way that it generates adequate data for each proposed class.

For each class, sampling and analysis is done to determine the fractions of each of the components[5] that are assumed to contribute to the DOC content and therefore to methane emissions.

Calculation of UEF based on composition

For each class of waste, the UEF has to be calculated using this equation:

$$UEF = (1.26 \times GW) + (1.512 \times NSW) + (0.945 \times OPW) + (2.52 \times PW) + (0.315 \times SSW) + (2.709 \times TMW) + (1.512 \times TXW)$$

Where
GW is the fraction of garden waste
NSW is the fraction of nappy and sanitary waste
OPW is the fraction of 'other putrescibles', ie, all putrescibles other than garden waste
PW is the fraction of paper waste
SSW is the fraction of sewage sludge
TMW is the fraction of timber waste
TXW is the fraction of textile waste.

[5] Note that waste 'components', in the NZ ETS terminology, are referred to as 'classifications' in the SWAP Protocol.

Each of these quantities is expressed as the fraction of the component in the waste of the relevant class that has been analysed.

The SWAP protocol defines a number of other components such as metals and plastics, which are not relevant to estimating methane emissions. It is a good idea to incorporate these in SWAP surveys so that the results will be useful for other purposes. The NZ ETS regulations can only specify the collection of information that is required for emissions reporting. Any waste that does not belong to one of the specified components is assumed not to contribute to DOC. It needs to be included in the UEF application, but only as a total 'other waste' fraction.

When the set of UEFs is approved, the class definitions and the UEF for each class will be incorporated in your online reporting tool for use in reporting emissions each year.

6 UEF for methane collection and destruction

Disposal facility operators, who collect and destroy methane by flaring it or for energy production, need a methodology to estimate and report only the net amount that is actually emitted. If you are carrying out collection and destruction you can monitor to estimate the collection rate achieved in one year (the base year) and apply for approval to use a UEF to recognise the estimated reduction in emissions.

Conceptually, the method for making this estimate involves:

- monitoring the amount of gas collected and passed to the destruction equipment in the base year, to determine the tonnes of methane destroyed
- estimating the gross amount of methane that the waste in the landfill, disposed up to the base year, is expected to generate during the base year
- dividing the two to calculate the efficiency of collection and destruction.

For subsequent emissions reporting with the UEF, the gross emissions in each reporting year will be reduced in proportion to the estimated collection and destruction efficiency.

Monitoring the amount of methane captured and destroyed

The amount of methane collected and piped to the destruction equipment (Q below) has to be determined by metering of the gas flow rates, and sampling and testing to determine the methane concentration in the gas.

The regulations do not specify in detail how this metering and sampling has to be done. It is assumed that facility operators who have existing capture and destruction systems will also have the established ability to carry out this monitoring and will be able to demonstrate an acceptable level of accuracy. Given that there are very substantial uncertainties in the estimation of gross methane generation (G below), the uncertainties in Q are likely to be a second-order issue in the overall calculation.

Flow measurement and analysis of the gas (for methane content) have to be done to ensure that the results are representative of the base year. 'Representative' is defined in the UEF regulations, and requires that the data can be reliably used to estimate quantity and concentration for the year as a whole.

The destruction factor for the equipment used would normally be expected to be based on the equipment manufacturer's data. Conservative destruction factors are given in the Schedules to the UEF regulations for cases where no manufacturer's data is available.

Estimating gross methane generation

Estimation of the gross generation of methane requires data on the waste disposal history of the site, and application of a first-order decay (FOD) model to estimate how much methane is expected to be generated, in the base year, by the waste now in the landfill.

The IPCC waste model[6] is used for New Zealand's international reporting and is also suitable for this calculation. An alternative, and broadly equivalent, FOD model such as LandGEM[7] may be used if preferred.

Whichever model is used, it has to be run using consistent input data and assumptions, as specified in the UEF regulations. These requirements constrain the FOD model to produce results which are expected to be relatively consistent, regardless of the choice of model, for a particular disposal history. Currently, the regulations do not allow adjustments aimed at accounting for climate or other conditions that might affect decay rates in an individual site.

Requirements for model inputs

The full disposal history of the site, back to the date that it first started accepting waste, must be used in the model calculation. Detailed data is not likely to be available covering the full history of the site and the waste disposed, so assumptions have to be made as follows:

- actual data on the composition of waste disposed should preferably be used, based on historic waste surveys. The composition should be interpolated for intermediate years between surveys
- where there is no site-specific composition data available for the facility, default figures for composition must be used. The same applies for years prior to the first composition survey that was carried out for a site. The default composition figures are similar to those incorporated in the DEF
- the tonnage of waste disposed must be taken from weighbridge data when it is available, and gaps filled by interpolation
- if no weighbridge data is available (for the period before a weighbridge was installed, or for sites that have no weighbridge), the assumed tonnage is to be based on an average filling rate over the life of the facility.

Since historical composition surveys are likely to identify only the primary SWAP classifications, some assumptions similar to those incorporated in the DEF have to be made. The regulations require that if putrescible waste is only identified in the analysis as a single classification, it should be assumed to be half garden waste and half 'other putrescibles'.

As with all calculations done under these regulations, the assumed DOC content for each component remains the same. The assumptions that drive gross emissions per tonne of waste (eg, methane correction factor) are also fixed.

FOD models assume that, after waste is disposed, it first remains unreacted for a fixed period, and then decays according to a first-order reaction equation. The UEF regulations specify that:

- the delay time is assumed to be six months on average. In the IPCC model, this is the default assumption and works by having the waste disposed in each full year start to decay at the start of the next year.

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6 http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html

7 http://www.epa.gov/lmop/publications-tools/#three

- the decay rate constant (k-value) for each waste component is that given in the Schedules to the UEF regulations.

Calculation of UEF based on collection and destruction

The efficiency of methane collection and destruction is estimated as the lesser of either 0.90 or the value calculated as:

$$C = D \times Q/G$$

Where: C is the efficiency of the collection and destruction system
D is the destruction factor for the flare or other equipment used to destroy the captured CH_4, ie, oxidise it to CO_2
Q is the amount of methane collected and conveyed to the destruction equipment in the base year (tonnes)
G is the estimated gross generation of methane in the base year (tonnes).

Values of C greater than 0.90 are not accepted.

Then the UEF is calculated simply by reducing the DEF in proportion to the reduction in net emissions that is achieved:

$$UEF = 1.10 \times (1 - C)$$

When approved, the UEF will be incorporated in your reporting tool so that emissions reporting can be done by entering the gross and diverted tonnages for the year, and the UEF will be applied automatically.

7 UEF for non-default composition plus collection

A number of landfill sites will be in a position to do SWAP surveys and report non-default waste composition, and have methane collection and destruction in place. For these sites the regulations specify that the facility operator needs to apply for a UEF for each class of waste disposed at the facility, taking into account both the non-default composition and methane collection and destruction. The method for doing this is a straightforward combination of the two, each using the same data.

The UEF is calculated as:

$$UEF = UEF_{WC} \times (1 - C)$$

Where UEF is the UEF applied for
UEF_{WC} is the UEF calculated for composition only
C is the efficiency of the collection and destruction system, calculated as above.

The efficiency of collection and destruction (C) is capped at 0.90 in the same way as for collection and destruction only.

Either part of this calculation – the composition, or the collection and destruction rate – may change over time. When there is a material change, you will need to re-apply for approval of a new UEF for the class of waste. Such a new application should contain all relevant information to allow the new UEF to be specified, even if only one part of it (either UEF_{WC} or C) is being changed.

Appendix 1 Calculation of emissions factors

The methodology used to estimate disposal facility emissions in the NZ ETS is based on the methods for reporting New Zealand's emissions internationally using IPCC guidelines. Conceptually, the calculation used for IPCC reporting has the following steps:

1 estimating the DOC content of the waste disposed in a particular year ie, the amount of carbon that is expected to degrade, which indicates the maximum amount of methane that might be generated from the waste

2 multiplying the amount of DOC by various correction factors to estimate the total amount of methane that will actually be emitted by this mass of waste

3 calculating a first-order decay profile which approximates the changing rate at which the waste decays, to show how the methane from that waste emerges over its life in the landfill

4 summing these emission profiles from waste disposed in each year the landfill has accepted waste, to determine a total emissions profile for the site over time.

Only the first two steps, to calculate total emissions for a given amount of waste, are needed for the mass balance methodology. In the ETS context, first-order decay modelling (steps 3 and 4) is only relevant for estimating gross methane generation where methane is collected and destroyed.

Estimating DOC content of waste

To estimate the DOC content of waste, the components of waste that contain significant DOC need to be identified and their proportions in the waste stream estimated. For these regulations, the relevant components are those also used to calculate waste emissions for the national inventory. For each of these components a standard DOC fraction, as used in reporting to the IPCC, is assumed:

Components of waste contributing to emissions

Component	DOC fraction
Garden waste	0.20
Nappies and sanitary	0.24
Putrescibles other than garden waste	0.15
Paper	0.40
Sewage sludge	0.05
Timber	0.43
Textile waste	0.24

Gross emissions per tonne of DOC

Using the mass balance approach, an emissions factor is calculated as:

$$C = (MCF \times DOC_f \times F_{CH4} \times GWP \times 16/12) \times (1 - OX) \times DOC$$

Where:
MCF or methane correction factor = 1.0
DOC_f or fraction of DOC that degrades = 0.5
F_{CH4} or fraction of CH_4 in gas = 0.5
GWP for methane = 21
16:12 is the molecular weight ratio methane:carbon
OX or oxidation factor = 0.10
DOC is the fraction of degradable organic carbon in the waste.

So that:

$$C = 6.30 \times DOC$$

This ratio of total emissions to tonnes of DOC will always be the same for any calculations made under these regulations. In other words, the factors in the equation above are fixed and may not be altered in reporting emissions whether using the DEF or a UEF.

This includes F_{CH4} which must be entered as 0.5 in any calculation, even though the facility may be collecting landfill gas which has a different composition. This is in accordance with IPCC recommendations. Conceptually, F_{CH4} is the proportion of DOC in the waste that produces CH_4 rather than CO_2. It is not expected to accurately represent a measurable CH_4 concentration at any particular point. Also, actual concentrations can change between the point of generation and the collection system due to air infiltration.

Emissions in the NZ ETS are always reported as tonnes of CO_2-equivalent. Methane has a global warming potential (GWP) of 21; this means that one tonne of methane emitted to the atmosphere corresponds to 21 tonnes of reported emissions. The GWPs currently used in the NZ ETS are those agreed internationally for the purposes of the Kyoto Protocol first commitment period, which runs to 31 December 2012.

Calculation of the DEF

A substantial number of waste surveys have been carried out over the last 10 years or so, using the SWAP protocol[8] and its predecessor, and data from these is summarised on the Ministry for the Environment's website.[9] Waste Not Consulting (2006)[10] used data from 35 of these surveys, which had been carried out using the SWAP Procedure 2 methodology, to estimate the overall composition of waste currently going to landfill in New Zealand. This estimated composition is the basis for the Default Emissions Factor (DEF) used in these regulations.

8 http://www.mfe.govt.nz/publications/waste/solid-waste-analysis-mar02/index.html

9 http://www.mfe.govt.nz/issues/waste/waste-data/swap-baseline.html

10 Waste Not Consulting, 2006. *Waste Composition and Construction Waste Data* (unpublished)

However, these surveys were not designed to estimate methane generation. In general they have only determined the primary SWAP classifications, which do not distinguish all of the components above. Therefore, putrescibles have not been split into garden waste and other, and the amount of sewage sludge is not known from these results. These two items need to be assessed to estimate the total DOC.

For the draft regulations released for consultation in June 2010, a DOC fraction of 0.20 was used for all putrescibles, and no sewage sludge was allowed for. Following consultation, these assumptions were changed to:

- a more realistic split of garden and other putrescibles
- 5% of sewage sludge in the waste stream.

These composition figures are shown in the table below, with the resulting total DOC fractions for the waste stream.

Estimation of DEF for waste

Component	DOC fraction of component	Percent of component in waste (draft)	Percent of component in waste (final)
Garden waste	0.20	23.3%	9.2%
Nappies and sanitary	0.24	2.7%	2.7%
Putrescibles other than garden waste	0.15	0.0%	12.3%
Paper	0.40	14.9%	14.9%
Sewage sludge	0.05	0.0%	5.0%
Timber	0.43	13.9%	13.9%
Textile waste	0.24	3.9%	3.9%
DOC fraction in total waste stream	-	0.1818	0.1746

So that in the final regulations the DEF is:

$$C = 6.30 \times 0.1746$$

$$C = 1.10$$

Application to UEFs

In applying for a UEF based on composition for a class of waste, the equation given in the UEF regulations (chapter 5 above) is used. Each of the multipliers in this equation is simply 6.30 times the DOC fraction for that waste component.

This is indicated in the table below.

Calculation of UEF for a class of waste

Component	DOC fraction of component	Multiplier (6.30 × DOC)
Garden waste	0.20	1.26
Nappies and sanitary	0.24	1.512
Putrescibles other than garden waste	0.15	0.945
Paper	0.40	2.52
Sewage sludge	0.05	0.315
Timber	0.43	2.709
Textile waste	0.24	1.512
All other waste	0	0

The regulations do not, as discussed above, require analysis of any other SWAP classifications as these do not contribute to emissions. Only the total fraction of all 'other waste' which does not contribute to DOC has to be recorded and noted in the UEF application.

The same set of input assumptions – the component DOC fractions, and the factors that make the gross emissions equal to 6.30 × DOC – must also be used in applying for a UEF based on gas collection and destruction. However, in this case it is not possible to just incorporate the assumptions in a simple equation or set of rules. Instead, the regulations aim to specify that equivalent assumptions must be used as inputs when using a FOD model.

Appendix 2 Terms and symbols used

Components of waste

GW	Fraction of garden waste
NSW	Fraction of nappy and sanitary waste
OPW	Fraction of other putrescible waste, ie, all putrescibles other than garden waste
PW	Fraction of paper waste
SSW	Fraction of sewage sludge waste
TMW	Fraction of timber waste
TXW	Fraction of textile waste

Other symbols used in regulations

A	Gross tonnes of waste entering a facility
B	Tonnes of diverted waste
C	In the Climate Change (Waste) Regulations – the emissions factor in use, whether a UEF or the DEF
C	In the Climate Change (Unique Emissions Factors) Regulations – the calculated efficiency of methane collection and destruction
D	Destruction factor for equipment used to oxidise methane (flares, gas engines, turbines, or boilers)
DEF	Default Emissions Factor, equal to 1.10 tCO_2-e per tonne of waste disposed
E	Calculated emissions in tonnes of CO_2-equivalent
G	Gross generation of methane in base year
k	Rate constant in a first-order decay rate equation
Lo	Methane generation potential expressed in m^3 CH_4/tonne of waste

Q	Quantity of methane collected and transferred to destruction equipment (normally flares or gas engines)
UEF	Unique Emissions Factor
UEF_{WC}	Unique Emissions Factor based on waste composition only

Other terms and symbols used in this document

DOC	Degradable organic carbon (normally the fraction of DOC in a given quantity of waste)
DOC_f	Fraction of the DOC in waste that is assumed to be dissimulated as the waste decays
F_{CH4}	Fraction of dissimulated DOC that is released as CH_4 (the remainder is CO_2); equal to the volume fraction of CH_4 in gas as it is generated in the landfill
FOD	First Order Decay
GWP	Global warming potential, currently 21 for methane
IPCC	Intergovernmental Panel on Climate Change
MCF	Methane correction factor
NZ ETS	New Zealand Emissions Trading Scheme
NZEUR	New Zealand Emission Unit Register
OX	Oxidation factor; the fraction of CH_4 that is assumed to be oxidised to CO_2 as it passes through the upper part of the landfill cover material
SWAP	Solid Waste Analysis Protocol