Ministry for the Environment
Manatū Mō Te Taiao

Guidance for voluntary, corporate greenhouse gas reporting

Data and Methods for the 2008 Calendar Year

New Zealand Government

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This is the third version of an annual publication.

Each year the Ministry for the Environment will update this guide with emission factors for the previous calendar year. It does not replace previous editions of this publication.

Changes to data and methodology for the 2008 calendar year

Scope 1

Stationary combustion – emission factors for stationary combustion have been updated based on new figures for the 2008 calendar year.

Transport fuels – emission factors for transport fuels have been updated based on new figures for the 2008 calendar year.

Refrigerants – detailed guidance has been removed. Please use the methodology contained in the 2008 guide, as it remains unchanged: http://www.mfe.govt.nz/publications/climate/guidance-greenhouse-gas-reporting-2008-09/guidance-voluntary-greenhouse-gas-reporting.pdf

Scope 2

Purchased electricity – emission factors for purchased gas and electricity have been updated based on new figures for the 2008 calendar year.

Scope 3

Transmission and distribution losses – emission factors for transmission and distribution losses from purchased electricity and natural gas have been updated based on new figures for the 2008 calendar year.

Taxis/rental cars – emission factors for travel in taxis/rental cars have been updated based on new figures for the 2008 calendar year.

Air travel – emission factors for air travel have been updated based on the latest data.

Waste – emission factors for waste to landfill with methane capture have been updated based on new projected methane capture data for the 2007 calendar year.

Note that this guidance publication is solely intended for use in voluntary greenhouse gas reporting, and should not be used for reporting under the New Zealand Emissions Trading Scheme.

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1 Guidance on reporting

1.1 Introduction

This publication has been prepared to meet demand for guidance on voluntary, corporate greenhouse gas (GHG) reporting, including emission factors to facilitate this.

It is intended to encourage best practice in GHG monitoring and reporting and to support voluntary GHG reporting initiatives. Its purpose is both to endorse the referenced reporting frameworks and to provide information (emission factors and methods) to enable organisations to apply them.

This guide will be regularly updated in order to maintain consistency with international best practice and the New Zealand Government's national greenhouse gas inventory reporting.

1.2 Who is this guide intended for?

This guide is intended to assist those who wish to voluntarily monitor and report greenhouse gas emissions on an organisational (sometimes called "corporate" or "entity" level) basis for their New Zealand operations.

Note that this guidance publication is solely intended for use in voluntary GHG reporting and does not represent, or form part of, a mandatory reporting framework or scheme.

The emission factors and methods contained in this guide are provided for emission sources deemed common for commercial organisations; however, this guide also applies to industrial organisations who wish to voluntarily report on the same emission sources.

These emission factors and methods are not appropriate for a full life cycle assessment or for the purposes of complying with the British Standards Institution PAS 2050 product carbon footprinting standard, or with the draft International Organization of Standardization (ISO) 14067 standard on the carbon footprint of products.[1]

1.3 Is this information for use in an emissions trading scheme (ETS)?

No. The information in this guide is intended to help organisations who want to monitor and report their greenhouse gas emissions on a voluntary basis. Organisations that are required to participate in a mandatory emissions trading scheme will need to comply with the reporting requirements specific to that scheme.

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1 The United Kingdom Department for the Environment, Food and Rural Affairs (DEFRA) publish emission factors for a number of emissions sources that take into account the life cycle of those activities.

Firms with obligations to report greenhouse gases under mandatory schemes (including emissions trading) or who choose to participate in voluntary greenhouse gas emission reporting schemes should check the rules and requirements of those schemes.

The information in this guide may, however, be useful to firms that have a reporting obligation under an emissions trading scheme for a particular activity within their business, but still wish to publish comprehensive emission reports for their organisation on a voluntary basis. Although this monitoring and reporting would not constitute compliance with an emissions trading scheme, it may be useful to help organisations prepare for, or understand how, an emissions trading scheme might impact on their business.

1.4 What rules should I follow to monitor and report emissions?

The Ministry for the Environment (the Ministry) recommends firms use the *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (The GHG Protocol) or *ISO 14064-1:2006 Greenhouse gases – Part 1 Specification* with guidance at the organization level for quantification and reporting of greenhouse gas emissions (ISO 14064-1).

The GHG Protocol is a standard developed jointly by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). It is available at http://www.ghgprotocol.org/standards

The ISO 14064-1 standard is published by the International Standards Organisation. This standard is closely based on The GHG Protocol.

The Ministry for the Environment endorses both *The GHG Protocol* and *ISO 14064-1* for voluntary corporate GHG monitoring and reporting.

1.5 What do The GHG Protocol and ISO 14064-1 cover?

These standards provide comprehensive guidance on the core issues of GHG monitoring and reporting, at an organisational level, including:

- principles underlying monitoring and reporting
- setting organisational boundaries
- setting operational boundaries
- establishing a base year
- managing the quality of a GHG inventory
- content of GHG reports.

1.6 What is the difference between these standards?

ISO 14064-1 is a shorter, more direct document than *The GHG Protocol,* which is more descriptive and discusses, for example, motivational reasons for monitoring and reporting greenhouse gas emissions. *ISO 14064-1* refers users to *The GHG Protocol* for further detail on some issues.

In general, those choosing to report against the ISO standard would usefully be informed by reading *The GHG Protocol* for context.

1.7 What other information do I need?

In order to report emissions, organisations require a method of converting data they gather about activities (eg, vehicle travel) in their organisation into information about their emissions (or tonnes of CO_2-equivalent). These methods involve using what are sometimes called "emission factors". An emission factor allows GHG emissions to be estimated from a unit of available activity data (eg, litres of fuel consumed).

Emission factors are available from a number of sources (including from the Greenhouse Gas Protocol Initiative website). However, there has been demand for the Ministry to publish a consistent list of emission factors and methods (how the emission factors should be applied) specifically for use in New Zealand, for common corporate emission sources.

This guide draws on technical information provided by New Zealand government agencies, and presents it in a form suitable for voluntary, corporate GHG reporting. It also uses some international data where New Zealand-specific information is not yet available.

> This guide provides emission factors and methods for common emission sources, for the most recent calendar year. The Ministry will update the information on emission factors annually.
>
> This guide also details how these emission factors were derived and assumptions surrounding their use.

1.8 Verification

1.8.1 Should I have my emissions inventory verified?

The term "verification" is generally used to refer to scrutiny by a suitably qualified, independent body or person to confirm the extent to which an emissions inventory is a fair representation of the actual situation.

Verification provides you and your stakeholders with confidence about the accuracy of an emissions inventory. If an emissions inventory is intended for public release then the Ministry for the Environment recommends that firms obtain independent verification of the inventory to confirm that calculations are accurate, and the correct methodology has been followed.

1.8.2 Who should verify my inventory?

An accreditation framework has been developed by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ) which accredits verifiers to the ISO 14065 standard. This confirms that these verifiers are suitably qualified and enables them to certify an inventory as being prepared in accordance with *ISO 14064-1*.[2]

The Ministry recommends that organisations use verifiers who:

- are independent
- are members of a suitable professional organisation
- can demonstrate they have experience with emissions inventories
- understand ISO 14064 and The GHG Protocol
- have effective internal peer review and quality control procedures.

Firms that have achieved the status of Designated Operational Entity (DOE) and/or Accredited Independent Entity (AIE) under the Kyoto Protocol framework will have experience in verifying greenhouse gas emission reductions on a project basis.[3] While verification of greenhouse gas emission reductions from projects is a different task than verification of organisation-level greenhouse gas emissions inventories, there are many similarities, and providers who have achieved DOE or AIE status will have many of the competencies required to verify emissions inventories.

Verification should be undertaken by independent organisations who can demonstrate they have experience with emissions inventories, *ISO 14064* and *The GHG Protocol*.

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[2] Accredited bodies under the JAS-ANZ Register may be found at: http://www.jas-anz.org/index.php?option=com_content&task=blogcategory&id=44&Itemid=1

[3] A list of DOEs can be found at http://cdm.unfccc.int/DOE/list/index.html

2 Emission factors and methods – context

The emission factors reported in this guide are intended to be default factors (ie, to be used in the absence of better information). They are designed to be consistent with the reporting requirements of *ISO 14064-1* and *The GHG Protocol*. The emission factors are also designed to be aligned with the emission factors used for the Ministry's national greenhouse gas inventory reporting.

The purpose of providing these emission factors is to:

- collate an official set of annually updated emission factors for voluntary corporate reporting
- present emission factors in an easy to use form which will facilitate reporting by organisations
- provide guidance on a consistent approach to choosing emission factors for financial-year and calendar-year reporting.

As explained previously, these emission factors are largely derived from technical information published by New Zealand government agencies.[4] The key source of information is the Ministry of Economic Development. Each section gives the particular source for each emission factor and how the factors are derived.

This guidance covers the six direct Kyoto gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) covered by *ISO 14064-1* and *The GHG Protocol.* This is also consistent with the reporting requirements for *New Zealand's Greenhouse Gas Inventory 1990–2007*.

Greenhouse gases (GHGs) vary in their radiative activity and atmospheric residence time. This means that different GHGs have different global warming potentials (GWPs). To enable a meaningful comparison between gases, GHG emissions are commonly expressed as carbon dioxide equivalent or CO_2-e. The emission factors in this guide therefore convert activity data into the equivalent estimate of CO_2-e per unit of activity data (eg, kg CO_2-e/litre of petrol).

Under the reporting requirements of *ISO 14064-1* and *The GHG Protocol,* GHG emissions should be reported in tonnes CO_2-e. This guidance presents emission factors in kg CO_2-e per unit. Division by 1000 converts kg to tonnes (see example calculations on the following pages).

In line with the reporting requirements of ISO 14064-1, the emission factors allow calculation of CO_2, CH_4 and N_2O separately, as well as the total CO_2-equivalent for Scope 1 emission sources (discussed in Section 2.2).

CO_2 emission factors are based on the carbon and energy content of a fuel. CO_2 emissions therefore remain constant regardless of the way in which a fuel is combusted. However, CH_4 and N_2O (ie, non-CO_2) emissions depend on the manner in which the fuel is being combusted. The emission factors for CH_4 and N_2O therefore vary depending on the combustion process.[5]

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4 For instance, the energy emission factors are largely sourced from the *Energy Greenhouse Gas Emissions (2009)* publication, produced by the Ministry of Economic Development. References for specific emission factors are included on the following pages.

5 For example, the CH_4 and N_2O emission factors for diesel used for industrial heating are different to the CH_4 and N_2O emission factors for diesel used in vehicles.

Separate CO_2-e emission factors for commercial and industrial users are presented in Table 1 on page 7. The relevant Ministry of Economic Development publication describes assumptions made.

As well as providing common emission factors, the Ministry considers it useful to illustrate how these emission factors have been derived. Appendix 1 discusses and provides an example of how the emission factors have been calculated.

2.1 Timing of emission factors and annual reporting

Organisations can choose to report on a calendar or financial year basis.

Calendar year: If you are reporting on a calendar year basis, then the latest published emissions factors should be used and the inventory may have to be recalculated when the most appropriate emissions factors are published at a later date. Many emission factors will rely on a review of historical data, such as the proportion of renewable generation feeding into the electricity grid. The previous calendar year's emission factors will therefore be provided in this guide each year, following the release of the *Energy Greenhouse Gas Emissions, New Zealand Energy Data File* and *New Zealand's Greenhouse Gas Inventory* publications.

Financial year: If you are reporting on a financial year basis then you could either:

- choose to pro rata the emission factors according to the specific financial year used by your organisation, or
- use the emissions factors for the 2008/2009 inventory with an explanation that these are the latest available published emissions factors.

2.2 The concept of "scope"

The GHG Protocol categorises emission sources into Scope 1, Scope 2 and Scope 3 activities as follows:

- Scope 1: Direct GHG emissions occurring from sources that are owned or controlled by the company (ie, sources within the organisational boundary). For example, emissions from combustion of fuel in owned or controlled vehicles. *The GHG Protocol* and *ISO 14064-1* require Scope 1 emissions to be reported.
- Scope 2: Indirect GHG emissions occurring from the generation of purchased electricity consumed by the company. *The GHG Protocol* and *ISO 14064-1* require Scope 2 emissions to be reported.
- Scope 3: Other indirect GHG emissions occurring as a consequence of the activities of the company, but generated from sources not owned or controlled by the company (eg, emissions from air travel). Under the reporting framework of The GHG Protocol and ISO 14064-1, Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. The GHG Protocol states that Scope 3 emissions should be reported if they are 1) significant in the context of the whole inventory, 2) material to stakeholders, and 3) easy to reduce.

Section 3 of this guide presents emission factors according to each category of activity.

3 Emission factors and methods 2008

3.1 Scope 1: Direct emissions

3.1.1 Stationary combustion of fuels

Scope 1 emissions occur from the combustion of fuels from sources owned or controlled by the reporting organisation. Table 1 contains emission factors for common fuels used for stationary combustion.

In line with the reporting requirements of *ISO 14064-1* and *The GHG Protocol,* emission factors are provided to allow calculation of CO_2, CH_4 and N_2O separately.

Table 1: Fuel combustion emission factors (fuels used for stationary combustion) – 2008

Emission Source	User	Unit	Emission factor Total CO_2-e (kg CO_2-e/unit)	Emission factor CO_2 (kg CO_2/unit)	Emission factor CH_4 (kg CO_2-e/unit)	Emission factor N_2O (kg CO_2-e/unit)
Stationary Combustion						
Distributed Natural Gas	Commercial	KWh	0.194	0.192	0.0000816	0.00231
		GJ	54.0	53.3	0.0227	0.642
Coal – Bituminous	Commercial	Kg	2.59	2.57	0.00589	0.0122
Coal – Sub-bituminous	Commercial	Kg	1.98	1.97	0.00439	0.00906
Coal – Lignite	Commercial	Kg	1.41	1.40	0.00299	0.00618
Coal – Default*	Commercial	Kg	1.98	1.97	0.00439	0.00906
Diesel	Commercial	Litre	2.64	2.64	0.000540	0.00452
LPG**	Commercial	Kg	2.97	2.96	0.00109	0.00875
Heavy Fuel Oil	Commercial	Litre	3.01	3.01	0.00115	0.0037
Light Fuel Oil	Commercial	Litre	2.94	2.93	0.00114	0.0037
Distributed Natural Gas	Industry	KWh	0.192	0.192	0.0000953	0.000100
		GJ	53.4	53.3	0.0265	0.0279
Coal – Bituminous	Industry	Kg	2.58	2.57	0.000415	0.0139
Coal – Sub-bituminous	Industry	Kg	1.98	1.97	0.000309	0.0104
Coal – Lignite	Industry	Kg	1.41	1.40	0.000211	0.00706
Coal – Default*	Industry	Kg	1.98	1.97	0.000309	0.0104
Diesel	Industry	Litre	2.64	2.64	0.000153	0.00452
LPG**	Industry	Kg	2.97	2.96	0.00109	0.00875
Heavy Fuel Oil	Industry	Litre	3.02	3.01	0.00246	0.0037
Light Fuel Oil	Industry	Litre	2.94	2.93	0.00016	0.0048
Wood	Industry***	Kg	0.0178	1.26	0.00361	0.0142
Wood	Fireplaces****	Kg	0.0865	1.26	0.0723	0.0142

* The default coal emission factor should be used if it is not possible to identify the specific type of coal.

** LPG-use data in litres can be converted to kilograms by multiplying by the specific gravity of 0.536 kg/l.

*** It is not expected that many commercial or industrial users will burn wood in fireplaces but this emission factor has been provided for completeness. It is the default residential emission factor.

**** The Total CO_2-e emission factor (for wood) only includes CH_4 and N_2O emissions. This is based on *ISO 14064-1* and *The GHG Protocol* reporting requirements for combustion of biomass as Scope 1 emissions. CO_2 emissions, from the combustion of biologically sequestered carbon, are reported separately.

> Participants in the New Zealand Emissions Trading Scheme (NZ ETS) are required to use emission factors provided in the emissions trading regulations covering their particular sector, or in some cases may apply for Unique Emissions Factors. Emission factors used in the NZ ETS may differ from the factors provided in this guide. For example, emission factors for coal in this guide are given in terms of kilograms of coal used, because this is the most accessible information for most coal users. In the NZ ETS, coal is measured in terms of its energy content, and participants carry out analysis to ensure that they know the heating value of the coal they use.

Assumptions

The kg CO_2-e per activity unit emission factors supplied in Table 1 are derived using calorific values sourced from the *New Zealand Energy Data File 2009*. The calorific values used can be found in Appendix 1.

All emission factors incorporate relevant oxidation factors which are sourced from *New Zealand's Greenhouse Gas Inventory 1990–2007*. Oxidation factors allow for the small proportion of carbon that remains unoxidised due to incomplete combustion, and remains as soot and ash. The oxidation factors used for each of the fuels can be found in Appendix 1.

The emission factors provided above account for the Scope 1 emissions resulting from fuel combustion. They are not full fuel cycle emission factors and do not incorporate Scope 3 emissions associated with the extraction, production and transport of the fuel.

The default coal emission factor is assumed to be the same as the sub-bituminous coal emission factor on the basis that the majority of coal use is of sub-bituminous coal.[6]

The Automotive Gas Oil-50 ppm Sulphur emission factor (provided in the *Energy Greenhouse Gas Emissions (2009)* publication) has been used as the default emission factor for diesel.

Example calculation

A commercial organisation uses 1400 kg of LPG to heat one of its office buildings in 2008.

CO_2 emissions = 1400 * 2.96 = 4144 kg CO_2

CH_4 emissions = 1400 * 0.00109 = 1.526 kg CO_2-e

N_2O emissions = 1400 * 0.00875 = 12.25 kg CO_2-e

Total CO_2-e emissions = 1400 * 2.97 = 4158 kg CO_2-e

6 Approximately 92 per cent of the coal used by the commercial sector is sub-bituminous coal.

3.1.2 Transport fuels (where fuel use data is available)

Scope 1 emissions from transport occur from vehicles which are owned or controlled by the reporting organisation. The most accurate way to quantify the emissions associated with transport is by using information on the quantity of fuel used.

Emission factors for combustion of transport fuels are reported in Table 2. The emission factors are sourced from the *Energy Greenhouse Gas Emissions (2009)* publication.

Table 2: Fuel combustion emission factors (transport fuels) – 2008

Fuel	Unit	Emission factor Total CO_2-e* (kg CO_2-e/unit)	Emission factor CO_2 (kg CO_2/unit)	Emission factor CH_4 (kg CO_2-e/unit)	Emission factor N_2O (kg CO_2-e/unit)
Regular Petrol	litre	2.33	2.30	0.0136	0.0155
Premium Petrol	litre	2.37	2.34	0.0138	0.0157
Petrol – Default*	litre	2.34	2.31	0.0136	0.0155
Diesel	litre	2.69	2.64	0.00306	0.0441
LPG	litre	1.61	1.59	0.0159	0.00469

* The default petrol emission factor should be used if it is not possible to distinguish between regular and premium petrol use.

Assumptions

The kg CO_2-e per activity unit emission factors supplied in Table 2 are derived using calorific values sourced from the *New Zealand Energy Data File 2009*. All emission factors incorporate relevant oxidation factors which are sourced from *Energy Greenhouse Gas Emissions (2009)*.

The default petrol factor is a weighted average of regular and premium petrol based on 2008 sales volume data from the *New Zealand Energy Data File 2009*. It should be used when petrol use data does not distinguish between regular and premium petrol.

As with the fuels for stationary combustion these emission factors are not full fuel cycle emission factors and do not incorporate the Scope 3 emissions associated with the extraction, production and transport of the fuel.

Example calculation

An organisation has 15 petrol vehicles. They used 40,000 litres of regular petrol in 2008.

CO_2 emissions = 40,000 * 2.30 = 92,000 kg CO_2

CH_4 emissions = 40,000 * 0.0136 = 544 kg CO_2-e

N_2O emissions = 40,000 * 0.0155 = 620 kg CO_2-e

Total CO_2-e emissions = 40,000 * 2.33 = 93,200 kg CO_2-e

3.1.3 Transport where no fuel data is available (based on distance travelled)

If your records only provide information on kilometres travelled, and you do not have information on fuel use, the emission factors in Table 3 can be used to calculate emissions from transport. Note, however, that factors such as individual vehicle fuel efficiency and driving efficiency mean that kilometre-based estimates of CO_2-e emissions are less accurate than calculating emissions based on fuel-use data. The emission factors in Table 3 should therefore only be used if information on fuel use is not available.

Table 3: Transport emission factors (based on distance travelled) – 2008

Vehicle size class*	Unit	'Real world' petrol fuel use estimate (L/100km)	Emission factor Total CO_2-e (kg CO_2-e/unit)	Emission factor CO_2 (kg CO_2/unit)	Emission factor CH_4 (kg CO_2-e/unit)	Emission factor N_2O (kg CO_2-e/unit)
Car – Small (<1600 cc)	Km	7.35	0.172	0.170	0.00100	0.00114
Car – Medium (1600 – <2500 cc)	Km	10.01	0.234	0.231	0.00137	0.00156
Car – Large (>= 2500 cc)	Km	13.24	0.310	0.306	0.00181	0.00206
Car – Default**	Km	10.01	0.234	0.231	0.00137	0.00156

* Example (representative) vehicle models for each of the size classes are: Small = Toyota Echo, Medium = Honda Accord, Large = Holden Commodore.

** The default emission factor should be used if vehicle size class can not be determined.

Assumptions

The above emission factors in Table 3 assume that all representative vehicles are petrol. The emission factors are derived by multiplying the default petrol emission factor from Table 2 by 'real world' fuel consumption rates[7] for the petrol light vehicle fleet, based on information from New Zealand vehicle fleet Statistics for 2008 (Ministry of Transport). 'Real world' fuel consumption rates take into account 'real world' effects such as driver behaviour. Due to lack of data it is not currently possible to derive 'real world' fuel consumption rates for vehicles which use other fuels (eg, diesel, LPG). The above CO_2-e emission factors should therefore be applied to all vehicles (for which only kilometre travelled information is available), regardless of the type of fuel used.

The above emission factors are averages and therefore do not reflect the variability in fuel consumption rates between individual vehicles.

The default emission factor (for vehicles of unknown size) is the same as that for medium vehicles (1600 – <2500 cc).[8]

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7 They have been calculated by multiplying the average Euro emissions dyno test cycle fuel consumption rate, for each vehicle size class, by a 'real world' scale-up factor of 1.207. The figures are based on consumption rates for new vehicles sold in New Zealand since 2005.

8 In 2007, 54.9 per cent of light petrol vehicles sold in New Zealand were in the medium vehicle size class, 25.6 per cent were small and 19.5 per cent were large. (*Source*: Motor Industry Association New Vehicle Sales Database 2007).

Example calculation

An organisation has three vehicles which it owns. They are all large vehicles and travelled a total of 37,800 km in 2008.

CO_2 emissions = 37,800* 0.306 = 11,567 kg CO_2

CH_4 emissions = 37,800* 0.00181= 68 kg CO_2-e

N_2O emissions = 37,800* 0.00206 = 78 kg CO_2-e

Total CO_2-e emissions = 37,800* 0.310 = 11,718 kg CO_2-e

3.1.4 Refrigerants

Greenhouse gas emissions from hydrofluorocarbons (HFCs) are associated with unintentional leaks and spills from refrigeration units, air conditioners and heat pumps. While quantities of HFCs reported in a business emissions inventory may be small, HFCs have very high global warming potentials (commonly 1300 to 3300 times more potent than CO_2) and emissions from this source may therefore be material. In addition, emissions associated with this sector are growing significantly as they replace hydrochlorofluorocarbons (HCFCs).[9]

Scope 1 emissions from refrigeration occur from refrigeration units which are owned or controlled by the reporting organisation. If the unit is leased, associated emissions should be reported under Scope 3 emissions.

Emissions of HFCs are not calculated using emission factors, rather they are determined by estimating leakage from refrigerant equipment. Maintenance engineers can be asked to provide the actual amounts that are used to top up equipment (ie, to replace what has leaked). The Ministry recommends three alternative methods for estimating leakage, depending on the equipment and available information. The 2008 guidance describes these methods in detail. These methods have not changed, and rather than repeat the text here, the user is referred to the 2008 version of the Guidance for Voluntary, Corporate Greenhouse Gas Reporting,[10] and the associated *GHG Protocol HFC tool* (WRI/WBCSD 2005). The 2008 version of the Guidance for Voluntary, Corporate Greenhouse Gas Reporting however, makes an incorrect statement about the global warming potential of R22. For global warming potential of R22 readers are directed to the IPCC National Greenhouse Gas Inventory Guidelines.[11]

If you consider it likely your emissions from refrigerant equipment and leakage is a material proportion of your total emissions (ie, >5 per cent), then you should include them in your emissions inventory. You may need to carry out a preliminary screening test to determine materiality.

9 Whilst HCFCs have no GWP; they are an ozone-depleting substance and being phased out through the Montreal Protocol on Substances That Deplete the Ozone Layer.

10 At http://www.mfe.govt.nz/publications/climate/guidance-greenhouse-gas-reporting-2008-09/guidance-voluntary-greenhouse-gas-reporting.pdf

11 IPCC Revised Guidelines for National Greenhouse Gas Inventories, at http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm).

3.2 Scope 2: Electricity indirect emissions

3.2.1 Purchased electricity

An emission factor for the consumption of purchased electricity (by end users) is calculated on a calendar year basis, and accounts for the emissions from fuel combustion at thermal power stations. It also includes a relatively small proportion of fugitive emissions from geothermal generation.

The emission factor for the consumption of purchased electricity and the emission factor for transmission and distribution line losses have been aligned with the definitions used in the *GHG Protocol*.

The electricity emission factor covers purchased electricity which has been bought from an electricity supplier who sources its electricity from the national grid.[12]

Table 4: Emission factor for the consumption of purchased electricity – 2008

Emission Source	Unit	Emission factor Total CO_2-e (kg CO_2-e/unit)
Purchased electricity	kWh	0.195

Assumptions

As with the fuels for stationary combustion emission factors, this emission factor does not incorporate emissions associated with the extraction, production and transport of the fuels burnt to produce electricity.

This emission factor does not account for the emissions associated with the electricity lost in transmission and distribution on the way to the end user. Under the reporting framework of *The GHG Protocol* the emissions associated with transmission and distribution line losses are Scope 3 emissions. Table 5 contains an emission factor for transmission and distribution line losses.

The emission factor in Table 4 is derived from the net electricity generation data (as opposed to consumption data) in the *New Zealand Energy Data File 2009.* This is explained in more detail in the section below covering transmission and distribution line losses.

Notes on the use of electricity emission factors

The emission factor provided in Table 4 is an average over the calendar year to which the emission factor relates and is used for reporting the annual emissions associated with the consumption of purchased electricity.

A grid-average emission factor best reflects the CO_2-e emissions associated with the generation of a unit of electricity, purchased from the national grid, in New Zealand in 2008.

Retailer-specific electricity factors for grid electricity may be considered in the future. At this stage, however, there is insufficient information to prepare such factors and no clear consensus on the advantages of this approach. It is suggested users contact the Ministry for advice on carbon neutrality claims by electricity retailers.

[12] It does not cover on-site, self-generation of electricity.

The grid-average emission factor cannot be used for calculating abatement by intervention or reducing the use of thermal generation (eg, for an offset project). A marginal emission factor is more appropriate in these circumstances, because it is designed to take into account the change in electricity generation at the margin. Users wanting more information on marginal electricity emission factors are advised to contact the Electricity Commission. A report on *Carbon Abatement Effects of Electricity Demand Reductions* is also now available on the Ministry for Economic Development's website.[13]

Example calculation

An organisation uses 800,000 kWh of electricity in 2008. Their Scope 2 emissions from electricity are:

Total CO_2-e emissions = 800,000 * 0.195 = 156,000 kg CO_2-e

3.3 Scope 3: Other indirect emissions

3.3.1 Transmission and distribution line losses for purchased electricity

The transmission and distribution line losses emission factor accounts for emissions from the generation of the electricity lost in the transmission and distribution network due to inefficiencies in the grid. Under *The GHG Protocol* reporting framework, emissions from the generation of electricity that is consumed in a transmission and distribution system should be reported as a Scope 3 emission by end users.

The emission factor for transmission and distribution line losses is the difference between the generation and consumption emission factors reported by the Ministry of Economic Development on their website.[14]

Table 5: Transmission and distribution line losses for purchased electricity – 2008

Emission Source	Unit	Emission factor Total CO_2-e (kg CO_2-e/unit)
Transmission and distribution line losses for purchased electricity	kWh	0.020

Assumptions

This emission factor covers grid purchased electricity, bought by an end user. It is an average figure and therefore makes no allowance for distance from off-take point, or other factors that may vary between individual consumers.[15]

This emission factor does not incorporate the emissions associated with the extraction, production and transport of the fuels burnt to produce the electricity.

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13 *Carbon Abatement Effects of Electricity Demand Reductions.* http://www.med.govt.nz/templates/MultipageDocumentTOC____33805.aspx

14 *http://www.med.govt.nz/templates/MultipageDocumentTOC____41212.aspx*

15 Major electricity users need to be aware that a losses allowance may already be included in their electricity invoices.

Example calculation

An organisation uses 800,000 kWh of electricity in 2008. Their Scope 3 emissions from transmission and distribution line losses for purchased electricity are:

Total CO_2-e emissions = 800,000 * 0.020 = 16,000 kg CO_2-e

3.3.2 Transmission and distribution losses for distributed[16] natural gas

The transmission and distribution losses emission factor for distributed natural gas accounts for fugitive emissions, from the transmission and distribution system, which occur during the delivery of the gas to the end user.

This emission factor is derived based on information from the *Energy Greenhouse Gas Emissions (2009)* and *New Zealand Energy Data File 2009* publications.

Table 6: Transmission and distribution losses for distributed natural gas – 2008

Emission Source	Unit	Emission factor Total CO_2-e (kg CO_2-e/unit)
Transmission and distribution losses for distributed natural gas	kWh	0.032
	GJ	5.342

Assumptions

This figure represents an estimate of the average amount of CO_2-e emitted from losses associated with the delivery (transmission and distribution) of a unit of gas per unit of gas consumed through local distribution networks for 2008. It is an average figure and therefore makes no allowance for distance from off-take point, or other factors that may vary between individual consumers.

This figure assumes that all losses are attributable to gas consumed via local distribution networks. A small amount (<1 per cent) of emissions is attributable to losses occurring from delivery of gas to consumers who are directly connected to a high-pressure transmission pipeline.

This emission factor is therefore appropriate for use by customers who receive their gas through a local distribution network, and is not intended for customers who receive gas directly from the transmission system, or directly from a gas producer via high-pressure transmission lines.

This emission factor does not cover the emissions associated with the extraction and production of the gas.

16 "Distributed" refers to natural gas distributed via low pressure, local distribution networks.

Example calculation

An organisation uses 1000 gigajoules of distributed natural gas in 2008. Their Scope 3 emissions from transmission and distribution losses are:

Total CO_2-e emissions = 1000* 5.342 = 5.342 kg CO_2-e

3.3.3 Taxis and rental cars

Business travel in taxis and rental cars are likely to be a common source of Scope 3 emissions for most businesses. As with Scope 1 emissions from transport, the most accurate way to calculate emissions is based on fuel consumption data. However, this information may not be easily available, particularly for business travel in taxis. **Table 7** provides emission factors for rental car and taxi travel, based on kilometres travelled, as well as an emission factor for taxi travel based on dollars spent.

Table 7: Emission factors for travel in taxis and rental cars (based on distance travelled) – 2008

Emission Source	Unit	Emission factor Total CO_2-e (kg CO_2-e/unit)
Rental car – Small (<1600cc)	Km	0.172
Rental car – Medium (1600 – <2500cc)	Km	0.234
Rental car – Large (>= 2500)	Km	0.310
Rental car – Default*	Km	0.234
Taxi travel – Distance travelled	Km	0.310
Taxi travel – Dollars spent (GST inclusive)	$	0.124

* The default emission factor should be used if the vehicle size class of rental cars can not be determined.

Assumptions

The emission factors for taxis and rental cars are the same as those found in Table 3 and the underlying assumptions are the same.

The default emission factor for rental cars is the same as that for medium vehicles (1600 – <2500 cc). Data from the Motor Industry Association New Vehicle Sales database showed that for the period January 2002–July 2008, 60 per cent of rental vehicles purchased were in the medium vehicle size class.

The default emission factor for taxis is the same as that for large vehicles (>= 2500 cc) from Table 3. Data from the Motor Industry Association New Vehicle Sales database showed that for the period January 2002–July 2008, 84.2 per cent of taxis purchased were in the large vehicle size class.

The dollars spent emission factor is based on a national average figure of $2.50 per kilometre travelled. This figure is sourced from Taxicharge New Zealand and includes GST.

Example calculation

An organisation uses rental cars to travel 12,000 km in 2008. It also spends $18,000 on taxi travel.

Total CO_2-e emissions from rental cars = 12,000* 0.234 = 2808 kg CO_2-e

Total CO_2-e emissions from taxi travel = $18,000*0.124 = 2232 kg CO_2-e

3.3.4 Air travel

The emission factors provided in Table 8 are intended for use by organisations wishing to report their air travel emissions, based on the distance travelled per passenger. The emission factors provided follow those published by the UK Department for Environment Food and Rural Affairs (DEFRA) in their *2009 Guidelines to DEFRA / DECC's GHG Conversion Factors for Company Reporting*. These are deemed to be the most suitable emission factors currently available. The DEFRA publication discusses the emission factor methodology in more detail, including changes in methodology over time.

Table 8: Emission factors for air travel (based on distance travelled) – 2008

Emission Source	Unit	Emission factor Total CO_2-e (kg CO_2-e/unit)
Domestic	pkm	0.1728
Short Haul International (<3700 km)	pkm	0.0946
Long Haul International (>3700 km)	pkm	0.0827

Assumptions

The emission factors contained in Table 8 are based on representative flight distances of: domestic 463 km, short haul 1108 km, and long haul 6482 km. The domestic emission factor should be applied to all domestic flights; the short haul emission factor to flights less than 3700 km; and the long haul emission factor should be applied to any flights greater in length than 3700 km.

DEFRA endorses a nine per cent great circle distance uplift factor to take into account non-direct (ie, not along the straight line between destinations) routes and delays/circling. This figure comes from the IPCC's *Aviation and the Global Atmosphere, Section* 8.2.2.3, and is based on studies on penalties to air traffic associated with the European ATS Route Network. This figure is likely to be overstated in New Zealand (initial estimates from Airways New Zealand is that this figure is likely to be less than five per cent); however in the absence of a New Zealand-specific figure it is recommended that those wishing to take a conservative approach apply the nine per cent uplift factor by multiplying the factors in Table 10 by 1.09.

The emission factors provided above do not include radiative forcing (ie, non-CO_2 climate change impacts). The total climate impacts of aviation due to radiative forcing have been estimated by the IPCC to be up to two to four times those of CO_2 alone. However, the science in this area is currently uncertain and a multiplier is not used for New Zealand's national greenhouse gas inventory reporting. As the emission factors contained in this guide are intended to be consistent with New Zealand's national greenhouse gas inventory reporting, it is not currently deemed appropriate to apply a multiplier to account for radiative forcing.

Example calculation

An organisation makes a number of flights from Auckland to Sydney (2171 km each way). The total distance travelled was 217,100 km.

Total CO_2-e emissions from air travel = 217,100* 0.0946 = 20,538 kg CO_2-e

3.3.5 Waste to landfill

The emission factors and methodologies provided below will help organisations in estimating their emissions from waste disposed of at a landfill. Emission factors are based on figures from *New Zealand's Greenhouse Gas Inventory 1990–2007* and methodologies are derived from IPCC good practice guidance. The base equation methodology provided on page 19 is termed "tier 1" under the IPCC 1996 guidelines and assumes all the potential emissions in a tonne of waste are released in the year of disposal.

Methodologies to determine emissions from wastewater treatment and solid waste incineration are not covered by this guide, as emissions are assumed to be negligible at the individual organisation level (with some exceptions for large industrial wastewater producers).

The anaerobic decomposition of organic waste in landfills generates methane (CH_4). Inventories should be adjusted to account for the landfill gas that is collected and destroyed.[17] The methodologies outlined below provide for such adjustment depending on whether an organisation's waste is sent to a landfill with (or without) a landfill gas collection system.

Methodologies

Two methodologies for determining a solid waste emission factor are provided. Choice of methodology depends on organisational knowledge of waste composition. It is preferable to know the composition of waste as it allows emissions to be more accurately quantified.[18]

Base equation

The base equation used in deriving the waste emission factors, as taken from the 1996 *IPCC Good Practice Guidelines*, is as follows:

$$CO_2\text{-e emissions (kg)} =$$

$$((MSWT \times DOC \times DOCF \times F \times 16/12) \times (1-R) \times (1-OX)) \times 21$$

Where: MSWT = total Municipal Solid Waste (MSW) generated (kg); DOC = degradable organic carbon; DOCF = fraction of DOC dissimilated; F = fraction of CH_4 in landfill gas; R = fraction recovered CH_4; OX = oxidation factor; 21 = GWP of methane (CH_4).

[17] Where CH_4 is recovered and flared or combusted for energy, the CO_2 emitted from the combustion process is regarded as part of the natural carbon cycle.

[18] It also allows you to take into account reductions in emission from altering the composition of your waste (as opposed to just reducing your waste). For example, reducing the amount of paper going to landfill will result in a significantly lower emission factor for waste.

Interpretation

Table 9 provides methodologies for four scenarios where composition of an organisation's waste is / is not known, and is sent to a landfill that has / does not have a landfill gas collection system.

If the organisation has data on individual waste streams, but doesn't know if the waste is going to a landfill with a gas collection system, then the default should be the factors for "without landfill gas recovery" (ie, overestimate rather than potentially underestimate).

If the organisation does not know the composition of its waste but knows it is going to a landfill with a gas recovery system, then it should use the default "mixed waste" emission factor found in Table 9 unless it is an office-based organisation. Note that this will be an inaccurate emission factor at the organisation level, as it assumes the organisation's waste matches the national average mixed municipal waste composition. If an organisation has an advanced diversion system (to recycling and composting) then this methodology will overestimate emissions. If an organisation has no diversion system, then it could underestimate emissions.

Default emission factors for "office waste" are provided in Table 9. These should be used by office-based organisations that do not have information on the composition of their waste. The higher emission factors reflect the higher proportion of organic matter (eg, paper and food) found in office waste. The default office waste emission factors assume no diversion has occurred so if an organisation has an advanced diversion system then this methodology will overestimate emissions.

Table 9: Emission factors for waste to landfill – 2008

Emission source	Data input unit	Kgs CO_2e/unit	Equation
Landfilled waste of known composition (without landfill gas recovery)			
Paper and textiles	kg	2.520	(0.4 * 0.5 * 0.5 * 16/12) * (1-0.1) * 21
Garden and food	kg	0.945	(0.15 * 0.5 * 0.5 * 16/12) * (1-0.1) * 21
Wood	kg	1.890	(0.3 * 0.5 * 0.5 * 16/12) * (1-0.1) * 21
Landfilled waste of known composition (with landfill gas recovery)			
Paper and textiles	kg	1.45	(0.4 * 0.5 * 0.5 * 16/12) * (1-0.423[19]) * (1-0.1) * 21
Garden and food	kg	0.545	(0.15 * 0.5 * 0.5 * 16/12) * (1-0.423) * (1-0.1) * 21
Wood	kg	1.09	(0.3 * 0.5 * 0.5 * 16/12) * (1-0.423) * 0.9 * 21
Landfilled waste – default values (without landfill gas recovery)			
Mixed waste (national average)	kg	1.06	0.0563[20] * (1-0.1) * 21
Office waste	kg	1.55	((0.536[21] * 0.4) + (0.208[20] * 0.15) + (0[20] * 0.3)) * 0.5 * 0.5 * 16/12) * (1-0.1) * 21

[19] This figure can be found by dividing the recovered methane per year by gross emissions as found in the *New Zealand's Greenhouse Gas Inventory 1990–2007.*

[20] This figure is published within the national greenhouse gas inventory supplementary table 6.1A as the methane generation potential of a Gg of solid waste.

[21] These figures represent an assumed default composition (paper (53.6 per cent), garden and food (20.8 per cent) and wood (0 per cent)) for office waste, based on waste data from government buildings.

Emission source	Data input unit	Kgs CO_2e/unit	Equation
Landfilled waste – default values (with landfill gas recovery)			
Mixed waste (national average)	kg	0.614	0.0563 * (1-0.423) * (1-0.1) * 21
Office waste	kg	0.893	$((0.536^{20} * 0.4) + (0.208^{20} * 0.15) + (0^{20} * 0.3)) * 0.5 * 0.5 * 16/12) * (1-0.423) * (1-0.1) * 21$

Assumptions

The emission factors provided in Table 9 are based on 2007 data, however we recommend that they are used for the 2008 reporting period, as this is the most current data available.

Example calculation

An organisation disposes of 30 tonnes of garden waste to a landfill with a gas recovery system in 2008.

Total CO_2-e emissions from waste to landfill = 30,000* 0.545 = 16,350 kg CO_2-e = 16.35 tonnes CO_2-e

4 References

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Appendix: Derivation of fuel emission factors

A1. Importance of calorific value

Because the energy content of fuels may vary within and between fuel types, emission factors are commonly expressed in terms of energy units (eg, tonnes CO_2/TJ). This generally provides more accurate emissions estimates than if emission factors are expressed in terms of mass or volume. Converting to emission factors expressed in terms of mass or volume (eg, kg CO_2-e/litre) requires an assumption around which default calorific value should be used.

It is therefore useful to show how the per activity unit (eg, kg CO_2-e/litre) emission factors have been derived, and which calorific values have been used. It is important to note that if you are able to obtain fuel use information in energy units, or know the specific calorific value of the fuel which you are using, then you can calculate your emissions more accurately. All calorific values are sourced from the *New Zealand Energy Data File 2009*.

Note that gross calorific values have been used.

A2. CH_4 and N_2O emission factors used in this guide

As stated above, although CO_2 emissions remain constant regardless of the way in which a fuel is combusted, CH_4 and N_2O emissions depend on the precise nature of the activity in which the fuel is being combusted. The emission factors for CH_4 and N_2O therefore vary depending on the combustion process. Table 10 shows the default CH_4 and N_2O emission factors (expressed in terms of energy units) which have been used in this guide. The calculations below show how these have been converted to per activity unit (eg, kg CO_2-e/kg) emission factors. All emission factors contained in Table 10 are sourced from the *Energy Greenhouse Gas Emissions (2009)* publication. This publication contains further CH_4 and N_2O emission factors for a range of other users (eg, residential).

Note that gross emission factors have been used.

A3. Oxidation factors used in this guide

All oxidation factors contained in Table 10 are sourced from *New Zealand's National Greenhouse Gas Inventory 1990–2007*. Oxidation factors have been applied only to the CO_2emission factors (and therefore by default to the CO_2-e emission factors) and have not been applied to the CH_4 and N_2O emission factors. This approach is consistent to that adopted by the National Greenhouse Gas Inventory.

A4. Reference data

Table 10: Underlying data used to derive the per activity unit emission factors – 2008

Emission Source	User	Unit	Calorific Value	T CO2/TJ (After Oxidation)	T CH4/TJ	T N2O/TJ
Stationary Combustion						
Distributed Natural Gas	Commercial	KWh	NA	53.3	0.00108	0.00207
		GJ	NA	53.3	0.00108	0.00207
Coal – Bituminous	Commercial	Kg	29.51	87.0	0.00950	0.00133
Coal – Sub-bituminous	Commercial	Kg	21.98	89.4	0.00950	0.00133
Coal – Lignite	Commercial	Kg	14.99	93.3	0.00950	0.00133
Coal – Default	Commercial	Kg	21.98	89.4	0.00950	0.00133
Diesel	Commercial	Litre	38.37	68.8	0.000670	0.000380
LPG	Commercial	Kg	49.51	59.8	0.00105	0.000570
Heavy Fuel Oil	Commercial	Litre	41.12	73.2	0.00133	0.00029
Light Fuel Oil	Commercial	Litre	40.65	72.1	0.00133	0.00029
Distributed Natural Gas	Industry	KWh	NA	53.3	0.00126	0.0000900
		GJ	NA	53.3	0.00126	0.0000900
Coal – Bituminous	Industry	Kg	29.51	87.0	0.000670	0.00152
Coal – Sub-bituminous	Industry	Kg	21.98	89.4	0.000670	0.00152
Coal – Lignite	Industry	Kg	14.99	93.3	0.000670	0.00152
Coal – Default	Industry	Kg	21.98	89.4	0.000670	0.00152
Diesel	Industry	Litre	38.37	68.8	0.000190	0.000380
LPG	Industry	Kg	49.51	59.8	0.00105	0.000570
Heavy Fuel Oil	Industry	Litre	41.12	73.2	0.00285	0.00029
Light Fuel Oil	Industry	Litre	40.65	72.1	0.00019	0.00038
Wood	Industry	Kg	12.08	104.2	0.0143	0.00380
Wood	Fireplaces*	Kg	12.08	104.2	0.285	0.00380
Transport Fuels						
Regular Petrol	Mobile use	Litre	34.98	65.80	0.0185	0.00143
Premium Petrol	Mobile use	Litre	35.35	66.20	0.0185	0.00143
Petrol – Default	Mobile use	Litre	35.05	65.88	0.0185	0.00143
Diesel	Mobile use	Litre	38.37	68.80	0.0038	0.00371
LPG	Mobile use	Litre	26.54	59.80	0.0285	0.00057

Table 11 contains the GWPs for CO_2, CH_4 and N_2O that have been used in converting to CO_2-equivalent emission factors.

Table 11: Global Warming Potentials for CO_2, CH_4 and N_2O

	CO_2	CH_4	N_2O
Global Warming Potential	1	21	310

A5. Example derivation of emission factors

The sub-bituminous coal emission factors for commercial use are derived as follows:

CO_2 emission factor (kg CO_2/kg) = [(Calorific value*TCO_2 per TJ emission factor)*

= (21.98*89.4)/1000

= 1.965 kg CO_2/kg

CH_4 emission factor (kg CO_2-e/kg) = [(Calorific value*TCH_4 per TJ emission factor)*GWP of CH_4]/1000

= [(21.98*0.0095)*21]/1000

= 0.00439 kg CO_2-e/kg

N_2O emission factor (kg CO_2-e/kg) = [(Calorific value*TN_2O per TJ emission factor)*GWP of N_2O]/1000

= [(21.98*0.00133)*310]/1000

= 0.00906 kg CO_2-e/kg

Total CO_2-e emission factor (kg CO_2-e/kg) = Sum of CO_2, CH_4 and N_2O emission factors

= 1.98 CO_2-e/kg

Note that if you knew that the calorific value of your coal was different to the default calorific value used in the above calculation, you could substitute your specific calorific value and obtain a more accurate (specific) emission factor.