Ministry for the Environment
Manatū Mō Te Taiao

Guidance for Voluntary, Corporate Greenhouse Gas Reporting

Data and methods for the 2006 calendar year

New Zealand Government

This is the first version of an annual production. Each year the Ministry for the Environment will update this publication with emission factors for the previous calendar year.

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Contents

Tables

1 Guidance on Reporting

1.1 Introduction

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

It is intended to encourage best practise 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 publication 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 publication intended for?

This publication is intended to assist those that wish to voluntarily[1] monitor and report greenhouse gas emissions on an organisational (sometimes called "corporate" or "entity" level) basis for their New Zealand operations.

The emission factors and methods contained within this publication are provided for emission sources deemed common for commercial[2] organisations; however this publication is also applicable to industrial organisations who wish to report on the same emission sources.

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

The Ministry for the Environment (the Ministry) recommends that 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 organisation 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 from http://www.ghgprotocol.org/standards.

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

2 The commercial sector includes non-manufacturing business establishments such as hotels, motels, restaurants, wholesale businesses, retail stores and health, social and educational facilities.

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 GHG monitoring and reporting.

Both publications are widely recognised and used. They provide comprehensive guidance on monitoring and reporting GHG emissions, and the Ministry believes there is no need to duplicate their content. Those wishing to monitor and report their emissions on a voluntary basis should use these publications for New Zealand operations.

1.4 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.

1.5 What are the differences between these standards?

The approaches laid out in *ISO 14064-1* and *The GHG Protocol* are compatible as the ISO standard is closely based on *The GHG Protocol*.

ISO 14064-1 is a shorter, more direct document than *The GHG Protocol* which is more descriptive and (for example) discusses 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.

> It is worth noting that the infrastructure is being developed to enable users of *ISO 14064-1* to have their greenhouse gas inventories certified by an accredited verification body. Verification of inventories is discussed below.

1.6 What other information do I need?

This publication aims to provide information to assist organisations using the above standards in a voluntary context. 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 (tonnes of CO_2-equivalent). These methods involve using what are sometimes called “emission factors”. An emission factor is a factor which 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 GHG Protocol* 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 publication aims to meet this need by drawing on technical information provided by New Zealand government agencies, and presenting 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 publication provides emission factors and methods for common emission sources, for the most recent calendar year. The Ministry will update this information on emission factors every year.
>
> This publication also details how these emission factors were derived and any assumptions surrounding their use.

1.7 Is this information for use in an emissions trading scheme?

No. The information in this publication 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.

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

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 emissions inventory to confirm that, not only are calculations free from error, but the approach in the *ISO 14064-1* standard or *The GHG Protocol* has been correctly applied.

1.8.2 Who should verify my inventory?

A framework for accrediting verifiers is being developed by the International Standards Organisation. This will involve accrediting 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*. The necessary infrastructure to apply ISO 14065 is still being developed.

The Ministry recommends that organisations use verifiers who:

- are independent
- are members of a suitable professional organisation
- can demonstrate that 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) will have experience in verifying greenhouse gas emission reductions on a project basis under the Kyoto Protocol.[3] While verification of greenhouse gas emission reductions from projects is a different task than verification of organisation level greenhouse gas emission inventories, there are many similarities, and providers who have achieved DOE or AIE status will have many of the competencies required to verify emission inventories.

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

[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 publication 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 emissions 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 emission factors for voluntary corporate reporting
- present emission factors in an 'easy to use' form which will facilitate reporting by corporate organisations
- provide emission factors for some emission sources which were not previously publicly available (eg, waste to landfill, taxis)
- provide guidance on a consistent approach to choosing emission factors for financial year and calendar-year reporting.

As discussed previously, these emission factors are largely derived from technical information published by New Zealand government agencies.[4] The key source of the emission factors contained in this publication is the Ministry of Economic Development's *Energy Greenhouse Gas Emissions 1990–2006* publication (Ministry of Economic Development, 2007). Information is also taken from the Ministry of Economic Development's *New Zealand Energy Data File* publication (Ministry of Economic Development, 2007) and the Ministry for the Environment's *New Zealand's Greenhouse Gas Inventory* (Ministry for the Environment, 2007). The relevant sources for each emission factor and how the emission factors are derived are discussed in more detail below.

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*.[5] This is also consistent with the reporting requirements for *New Zealand's Greenhouse Gas Inventory*.

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 publication 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). They have been converted to CO_2-e using GWPs sourced from the *Energy Greenhouse Gas Emissions* publication.[6]

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4 For instance the energy emission factors are largely sourced from the *Energy Greenhouse Gas Emissions* publication. References for specific emission factors are included below.

5 HFCs, PFCs and SF_6 are gases commonly used as refrigerants and are therefore not associated with the combustion of fuels.

6 Appendix 1 contains a table of the GWPs used in these conversions.

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 below).

In line with the reporting requirements of ISO 14064-1, the emission factors provided allow calculation of CO_2, CH_4 and N_2O separately (as well as the total CO_2-equivalent) for Scope 1 (the concept of "scope" is discussed below in Section 2.2) emission sources. Emission factors for CH_4 and N_2O are expressed in kg CO_2-e.

CO_2 emissions factors are derived based on the carbon content and energy content (ie, calorific value or heating value) of a fuel. CO_2 emissions (for a specific fuel) 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.[7] Separate CO_2-e emission factors for commercial and industrial users are presented in Table 1. The *Energy Greenhouse Gas Emissions* publication discusses the source of the relevant emission factors in more detail. Any assumptions which are made in the underlying reports are also made for these emission factors.

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 shows an example) of how the emission factors have been calculated.

2.1 Timing of emission factors and annual reporting

Organisations should report on a calendar-year basis where possible.

Calendar year: If you are reporting on a calendar-year basis then you should wait until the emission factors for the reporting period become available in the following year (for example the 2007 emission factors will be published in 2008). Many 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 publication 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 should pro rata the emission factors according to the specific financial year used by your organisation. For example, if you wished to report on your 2006/2007 emissions then you would need to wait until the Ministry issued this publication in 2008, in order that the 2007 emission factors (as well as the 2006 emission factors) were available.

[7] 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.

Organisations could choose to adopt the policy of using the emission factors contained in the most recent report. This is likely to be less accurate than using data determined specifically for the reporting year, and is not the preferred approach.[8]

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 occur 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: Electricity indirect GHG emissions occur from the generation of purchased electricity[9] consumed by the company. *The GHG Protocol* and *ISO 14064-1* require Scope 2 emissions to be reported.

Scope 3: Other indirect GHG emissions occur as a consequence of the activities of the company, but occur from sources not owned or controlled by the company, for example 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.

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

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8 This will be particularly so in the case of emissions from purchased electricity, which vary significantly from year to year, depending on the proportion of generation from renewable sources.

9 The term electricity is used by *The GHG Protocol* as shorthand for electricity, heat, or steam. Purchased heat and steam are also Scope 2 emissions.

3 Emission Factors and Methods 2006

3.1 Scope 1: Direct emissions

3.1.1 Stationary combustion of fuels

Table 1 contains emission factors for common fuels used for stationary combustion.

These emission factors are sourced from the *Energy Greenhouse Gas Emissions 1990–2006* publication. The *Energy Greenhouse Gas Emissions* publication provides CO_2, CH_4 and N_2O emission factors for a range of fuels used by the energy sector.

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) – 2006

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)
Distributed natural gas	**Commercial**	**kWh** **GJ**	**0.190** **52.7**	**0.187** **52.07**	**0.0000816** **0.0227**	**0.00231** **0.642**
Coal – bituminous	Commercial	kg	2.58	2.56	0.00588	0.0121
Coal – sub-bituminous	Commercial	kg	2.016	2.0020	0.00447	0.00924
Coal – lignite	Commercial	kg	1.50	1.49	0.00318	0.00658
Coal – default**	Commercial	kg	2.016	2.0020	0.00447	0.00924
Diesel	Commercial	litre	2.61	2.61	0.000529	0.00446
LPG***	Commercial	kg	2.97	2.96	0.00109	0.00875
Heavy fuel oil	Commercial	litre	2.97	2.96	0.00114	0.00360
Light fuel oil	Commercial	litre	2.72	2.72	0.00106	0.00337
Distributed natural gas	**Industry**	**kWh** **GJ**	**0.188** **52.1**	**0.187** **52.07**	**0.0000953** **0.0265**	**0.000100** **0.0279**
Coal – bituminous	Industry	kg	2.58	2.56	0.000411	0.0139
Coal – sub-bituminous	Industry	kg	2.013	2.0020	0.000313	0.0106
Coal – lignite	Industry	kg	1.50	1.49	0.000223	0.00752
Coal – default**	Industry	kg	2.013	2.0020	0.000313	0.0106
Diesel	Industry	litre	2.61	2.61	0.000151	0.00446
LPG***	Industry	kg	2.97	2.96	0.00109	0.00875
Heavy fuel oil	Industry	litre	2.97	2.96	0.00244	0.00360
Light fuel oil	Industry	litre	2.72	2.72	0.000152	0.00449
Wood	**Industry** **Fireplaces********	**kg** **kg**	**0.0178******* **0.0865*******	**1.26** **1.26**	**0.00361** **0.0723**	**0.0142** **0.0142**

* Use the total CO_2-e emission factor for calculating total CO_2-e emissions, rather than summing the totals for CO_2, CH_4 and N_2O.

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

*** Fuel 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) does not include the CO_2 emission factor. Under *ISO 14064-1* and *The GHG Protocol* reporting requirements, only CH_4 and N_2O emissions from the combustion of biomass are included as Scope 1 emissions. CO_2 emissions, from the combustion of biologically sequestered carbon, are reported separately from the scopes.

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 2007*. 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 1990–2005*. 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 distributed natural gas emission factor is a weighted average of Maui- and Kapuni-treated natural gas. The *Energy Greenhouse Gas Emissions* publication contains additional CO_2 emission factors for a number of other gas streams.

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.[10]

The Automotive Gas Oil-50 ppm Sulphur emission factor (provided in the *Energy Greenhouse Gas Emissions 1990–2006* publication) has been used as the default emission factor for diesel.

Example calculation

A commercial organisation uses 1,400 kg of LPG to heat one of its office buildings in 2006.

CO_2 emissions = 1,400 * 2.96 = 4,144 kg CO_2/1000 = 4.14 tonnes CO_2

CH_4 emissions = 1,400 * 0.00109 = 1.526 kg CO_2-e/1000 = 0.00153 tonnes CO_2-e

N_2O emissions = 1,400 * 0.00875 = 12.25 kg CO_2-e/1000 = 0.0123 tonnes CO_2-e

Total CO_2-e emissions = 1,400 * 2.97 = 4,158 kg CO_2-e/1000 = 4.158 tonnes CO_2-e

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 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 1990–2006* publication.

Table 2: Fuel combustion emission factors (transport fuels) – 2006

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	2.32	2.29	0.0136	0.0154
Premium petrol	litre	2.37	2.34	0.0137	0.0156
Petrol – default**	litre	2.33	2.30	0.0136	0.0155
Diesel	litre	2.65	2.61	0.00302	0.0435
LPG	litre	1.61	1.59	0.0159	0.00469

* Use the total CO_2-e emission factor for calculating total CO_2-e emissions, rather than summing the totals for CO_2, CH_4 and N_2O.

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

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

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 2007*. All emission factors incorporate relevant oxidation factors which are sourced from *Energy Greenhouse Gas Emissions 1990–2006*.

The default petrol factor is a weighted average of regular and premium petrol based on 2006 sales volume data from the *New Zealand Energy Data File 2007*. 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 2006.

CO_2 emissions = 40,000 * 2.29 = 91,600 kg CO_2 = 91.6 tonnes CO_2

CH_4 emissions = 40,000 * 0.0136 = 544 kg CO_2-e = 0.544 tonnes CO_2-e

N_2O emissions = 40,000 * 0.0154 = 616 kg CO_2-e = 0.616 tonnes CO_2-e

Total CO_2-e emissions = 40,000 * 2.32 = 92,800 kg CO_2-e = 92.8 tonnes 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 the following table can be used. 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 the below table should therefore only be used if information on fuel use is not available.

Table 3: Transport emission factors (based on distance travelled) – 2006

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	7.67	0.179	0.176	0.00104	0.00119
Car – medium (1600–<2500 cc)	km	10.4	0.241	0.238	0.00141	0.00160
Car – large (≥2500 cc)	km	14.2	0.330	0.326	0.00193	0.00219
Car – default***	km	10.4	0.241	0.238	0.00141	0.00160

* Use the total CO_2-e emission factor for calculating total CO_2-e emissions, rather than summing the totals for CO_2, CH_4 and N_2O.

** 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 cannot be determined.

Assumptions

The above emission factors assume that all vehicles are petrol. The emission factors are derived by multiplying the default petrol emission factor from Table 2 by 'real world' fuel consumption rates[11] for the petrol light vehicle fleet, based on information from *The New Zealand Light Vehicle Fleet: Light Fleet Statistics 2006* (Ministry of Transport, 2007). '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).[12] 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).[13]

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11 They have been calculated by multiplying the average Euro emissions dyno test cycle fuel consumption rate, for each vehicle size class (from the Ministry of Transport's Vehicle Fleet Emissions Model), by a 'real world' scale-up factor of 1.20. The figures are based on new vehicles sold in New Zealand in 2006.

12 For the purpose of comparison in 2006 approximately 15 per cent of the light vehicle fleet was made up of diesel vehicles.

13 In 2006, 50.8 per cent of light petrol vehicles sold in New Zealand were in the medium vehicle size class, 14.9 per cent were small and 34.4 per cent were large.

Example calculation

An organisation has three vehicles which it owns. They are all large vehicles and travelled a total of 37,800 km in 2006.

CO_2 emissions = 37,800* 0.326 = 12,322.8 kg CO_2 = 12.3 tonnes CO_2

CH_4 emissions = 37,800* 0.00193= 72.954 kg CO_2-e = 0.0730 tonnes CO_2-e

N_2O emissions = 37,800* 0.00219 = 82.782 kg CO_2-e = 0.0828 tonnes CO_2-e

Total CO_2-e emissions = 37,800* 0.330 = 12,474 kg CO_2-e = 12.5 tonnes CO_2-e

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 provided in Table 4. The emission factor is calculated on a calendar year basis and accounts for the emissions, from fuel combustion at thermal power stations, which are associated with the consumption of purchased electricity from the grid. It also includes a relatively small proportion of fugitive emissions from geothermal generation.

The emission factor for the consumption of purchased electricity, as well as the emission factor for transmission and distribution line losses (included below, in Table 5), have been aligned with the definitions used in the *GHG Protocol*.

This emission factor is sourced from the *Energy Greenhouse Gas Emissions 1990–2006* publication which provides a historic record of (electricity) emission factors up to the previous calendar year.

The electricity emission factor covers purchased electricity which has been bought from an electricity supplier who sources their electricity from the national grid.[14]

Table 4: Emission factor for the consumption of purchased electricity – 2006

Emission source	Unit	Emission factor total CO_2-e (kg CO_2-e/unit)
Purchased electricity	kWh	0.209

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.

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[14] It does not cover on-site self-generation of 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 tCO_2-e/MWh generation emission factor (as opposed to the consumption emission factor) in the *Energy Greenhouse Gas Emissions 1990–2006* publication. This is explained in more detail in the section below covering the transmission and distribution line losses emission factor.

Notes on the use of electricity emission factors

The emission factor provided in Table 4 is an average over the calendar year for 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.

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. In the meantime, use of a grid average factor does not ignore or refute claims of carbon neutrality or similar by some electricity retailers. Rather, these claims should be accounted for separately. It is suggested users contact the Ministry for further advice on this issue.

This factor cannot be used for calculating abatement by intervention or reducing the use of thermal generation, for an offset project for example. 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. As such, it is often a higher figure than the historical average factor as listed in Table 4. Users wanting more information on marginal electricity emission factors are advised to contact the Electricity Commission.

It is also possible that a different emission factor may be used for determining allocation under the New Zealand Emissions Trading Scheme. An allocation factor has yet to be determined at this stage, but it may need to take into account a number of different issues that could produce a different value to that listed in Table 4.

Example calculation

An organisation uses 800,000 kWh of electricity in 2006. Their Scope 2 emissions from electricity are:

Total CO_2-e emissions = 800,000 * 0.209 = 167,200 kg CO_2-e = 167.2 tonnes 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 in Table 4.8 of the *Energy Greenhouse Gas Emissions 1990–2006*.[15]

Table 5: Transmission and distribution line losses for purchased electricity – 2006

Emission source	Unit	Emission factor total CO_2-e (kg CO_2-e/unit)
Transmission and distribution line losses for purchased electricity	kWh	0.0197

Assumptions

This emission factor covers grid-purchased electricity, purchased by an end user. It is an average figure and therefore makes no allowance for distance from offtake-point, or other factors that may vary between individual consumers.[16]

This emission factor accounts for emissions from the generation of the electricity lost in the transmission and distribution network, during delivery to end users. It does not incorporate the emissions associated with the extraction, production and transport of the fuels burnt to produce the electricity.

Example calculation

An organisation uses 800,000 kWh of electricity in 2006. Their Scope 3 emissions from transmission and distribution line losses for purchased electricity are:

Total CO_2-e emissions = 800,000 * 0.0197 = 15,760 kg CO_2-e = 15.8 tonnes CO_2-e

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[15] The electricity figures reported in the *Energy Greenhouse Gas Emissions 1990-2006* are rounded figures. Calculations to derive the figure reported in Table 5 are sourced from unrounded figures retrieved from http://www.med.govt.nz/upload/49905/EGHG-tables.xls.

[16] Major electricity users need to be aware that a losses allowance may already be included on their electricity invoices. This may warrant the use of an alternative transmission and distribution losses emission factor.

3.3.2 Transmission and distribution losses for distributed[17] 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 1990–2006* and *New Zealand Energy Data File 2007* publications.

Table 6: Transmission and distribution losses for distributed natural gas – 2006

Emission source	Unit	Emission factor total CO_2-e (kg CO_2-e/unit)
Transmission and distribution losses for distributed natural gas	kWh GJ	0.0248 6.89

Assumptions

As with the distributed natural gas emission factor, the transmission and distribution losses emission factor is based on a weighted average of Maui- and Kapuni-treated natural gas.

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 2006. It is an average figure and therefore makes no allowance for distance from offtake-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.[18]

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 covers the fugitive emissions which occur during the delivery of the gas to end users. It does not cover the emissions associated with the extraction and production of the gas.

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

18 See p.16 of the *Energy Greenhouse Gas Emissions 1990–2006* publication for more details.

Example calculation

An organisation uses a 1,000 gigajoules of distributed natural gas in 2006. Their Scope 3 emissions from transmission and distribution losses are:

Total CO_2-e emissions = 1,000* 6.89 = 6,890 kg CO_2-e = 6.89 tonnes CO_2-e

3.3.3 Taxis and rental cars

Business travel in taxis and rental cars is 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) – 2006

Emission source	Unit	Emission factor total CO_2-e (kg CO_2-e/unit)
Rental car – small (<1600cc)	km	0.179
Rental car – medium (1600–<2500cc)	km	0.241
Rental car – large (≥2500cc)	km	0.330
Rental car – default*	km	0.241
Taxi travel – distance travelled	km	0.330
Taxi travel – dollars spent	$	0.143

* 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 so the underlying assumptions are the same.

The default emission factor for rental cars is the same as that for medium vehicles (1600–<2500 cc) from Table 3. Data from the Motor Industry Association New Vehicle Sales database showed that for the period January 2002–June 2007, 58.6 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 (1600–<2500 cc) from Table 3. Data from the Motor Industry Association New Vehicle Sales database showed that for the period January 2002–June 2007, 81.3 per cent of taxis purchased were in the large vehicle size class.

The dollars spent emissions factor is based on a national average figure of $2.30 per kilometre travelled. This figure is sourced from Taxicharge New Zealand.

Example calculation

An organisation uses rental cars to travel 12,000 km in 2006. They also spend $18,000 on taxi travel.

> Total CO_2-e emissions from rental cars = 12,000* 0.241 = 2,892 kg CO_2-e = 2.89 tonnes CO_2-e
>
> Total CO_2-e emissions from taxi travel = $18,000* 0.143 = 2,574 kg CO_2-e = 2.57 tonnes 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 below are based on emission factors published by the UK Department for Environment Food and Rural Affairs (Defra) in their *Guidelines to Defra's GHG conversion factors for company reporting* publication (Defra, 2007). These are deemed to be the most suitable emission factors currently available.[19] The Defra publication discusses the emission factor methodology in more detail.

Table 8: Emission factors for air travel (based on distance travelled) – 2006

Emission source	Unit	Emission factor total CO_2-e (kg CO_2-e/unit)
Domestic	km	0.159
Short haul international (<3700 km)	km	0.132
Long haul international (>3700 km)	km	0.107

Assumptions

The underlying assumptions stated in the Defra publication are made here. Further discussion on the methodology used to derive the air travel emission factors can be found at http://www.defra.gov.uk/environment/business/envrp/pdf/passenger-transport.pdf.

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.

[19] The Greenhouse Gas Protocol Initiative provides air travel emission factors which are in the process of being updated. The suitability of the air travel emission factors contained in this publication will be reviewed once these become available.

DEFRA endorse a 9 per cent 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 Aviation and the global Atmosphere 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 5 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 9 per cent uplift factor.

The DEFRA emission factors only take into account CO_2 emissions. In line with *ISO 14064-1* and *The GHG Protocol* reporting requirements, the emission factors provided in Table 8 are CO_2-e emission factors. They have been scaled up based on the default CH_4 and N_2O emission factors (for aviation fuels) sourced from the *Energy Greenhouse Gas Emissions 1990–2006* publication. The percentage mark-up (used to convert to CO_2-e) is 0.923 per cent. The mark up assumes that all fuel burnt is jet fuel.

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 2–4 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 publication 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. The total distance travelled was 200,000 km.

> Total CO_2-e emissions from air travel = 200,000* 0.144 = 28,600 kg CO_2-e = 28.6 tonnes CO_2-e

3.3.5 Waste to landfill

The emission factors and methodologies provided below will assist organisations in estimating their emissions from waste disposed of at landfill. Emission factors are based on figures from *New Zealand's Greenhouse Gas Inventory 1990–2005* and methodologies are derived from IPCC good practice guidance. The (base equation) methodology provided below is termed "tier 1" under IPCC guidelines and assumes that 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 publication, 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.[20] 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.[21]

Base equation

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

$$CO_2\text{-e emissions (kg)} = ((MSW_T \times DOC \times DOC_F \times F \times 16/12) \times (1-R) \times (1-OX)) \times 21$$

Where:

MSW_T	=	total Municipal Solid Waste (MSW) generated (kg)
DOC	=	degradable organic carbon
DOC_F	=	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)

Interpretation

Table 9 provides methodologies for four scenarios; where composition of an organisation's waste is known and is or isn't sent to a landfill with a landfill gas system, and where composition is unknown and is or isn't sent to a landfill with a landfill gas 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 potential to underestimate.

[20] 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 and is not counted as an emission.

[21] It also allows you to take into account reductions in emissions 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.

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. 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 will 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 (ie, 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 – 2006

Emission source	Data input unit	Kg CO_2e/unit	Equation
Landfilled waste of known composition (without landfill gas recovery)			
Paper and textiles	kg	2.52	(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	1.89	(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	1.53	(0.4 * 0.5 * 0.5 * 16/12) * (1-0.39.4)[22] * (1-0.1) * 21
Garden and food	kg	0.572	(0.15 * 0.5 * 0.5 * 16/12) * (1-0.39.4) * (1-0.1) * 21
Wood	kg	1.14	(0.3 * 0.5 * 0.5 * 16/12) * (1-0.39.4) * 0.9 * 21
Landfilled waste – default values (without landfill gas recovery)			
Mixed waste (national average)	kg	0.874	0.0462[23] * (1-0.1) * 21
Office waste	kg	1.5	((0.536[24] * 0.4) + (0.208[24] * 0.15) + (0[24] * 0.3)) * 0.5 * 0.5 * 16/12) * (1-0.1) * 21
Landfilled waste – default values (with landfill gas recovery)			
Mixed waste (national average)	kg	0.529	0.0462 * (1-0.394) * (1-0.1) * 21
Office waste	kg	0.9	((0.536[24] * 0.4) + (0.208[24] * 0.15) + (0[24] * 0.3)) * 0.5 * 0.5 * 16/12) * (1-0.39.4) * (1-0.1) * 21

22 This figure can be found by dividing the recovered methane per year by gross emissions as found in the Supplementary Table 6.1A in the *New Zealand’s Greenhouse Gas Inventory 1990–2005*. These supplementary tables are anticipated to be within the next national inventory report.

23 This figure is published within the national greenhouse gas inventory supplementary table 6.1A as the Methane Generation Potential of a kg of waste.

24 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.

Assumptions

The emission factors provided in Table 9 are based on 2005 data, however we recommend that they are used for the 2006 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 2006.

Total CO_2-e emissions from waste to landfill = 30,000* 0.573 = 17,190 kg CO_2-e = 17.19 tonnes CO_2-e

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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*.

Note that gross emission factors have been used.

A2 CH_4 and N_2O emission factors used in this guidance

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 publication. The below calculations show how these have been converted to per activity unit (eg, kg CO_2-e/litre) emission factors. All emission factors contained in Table 10 are sourced from the *Energy Greenhouse Gas Emissions* publication. This publication contains further CH_4 and N_2O emission factors for a range of other users (eg, residential).

Note that gross calorific values have been used.

A3 Oxidation factors used in this publication

All oxidation factors contained in Table 10 are sourced from *New Zealand's National Greenhouse Gas Inventory 1990–2005*. Oxidation factors have been applied only to the CO_2 emission 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.

A4 Reference data

Table 10: Underlying data used to derive the per activity unit emission factors – 2006

Emission source	User	Unit	Calorific value	Oxidation factor	T CO_2/TJ	T CH_4/TJ	T N_2O/TJ
Stationary combustion							
Distributed natural gas	Commercial	kWh	NA	0.995	52.3365	0.00108	0.00207
		GJ	NA	0.995	52.3365	0.00108	0.00207
Coal – bituminous	Commercial	kg	29.46	0.98	88.8	0.0095	0.00133
Coal – sub-bituminous	Commercial	kg	22.40	0.98	91.2	0.0095	0.00133
Coal – lignite	Commercial	kg	15.96	0.98	95.2	0.0095	0.00133
Coal – default	Commercial	kg	22.40	0.98	91.2	0.0095	0.00133
Diesel	Commercial	litre	37.86	0.99	69.5	0.000665	0.00038
LPG	Commercial	kg	49.51	0.99	60.4	0.001045	0.00057
Heavy fuel oil	Commercial	litre	40.72	0.99	73.5	0.00133	0.000285
Light fuel oil	Commercial	litre	38.12	0.99	72	0.00133	0.000285
Distributed natural gas	Industry	kWh	NA	0.995	52.336	0.00126	0.00009
		GJ	NA	0.995	52.336	0.00126	0.00009
Coal – bituminous	Industry	kg	29.46	0.98	88.8	0.000665	0.00152
Coal – sub-bituminous	Industry	kg	22.40	0.98	91.2	0.000665	0.00152
Coal – lignite	Industry	kg	15.96	0.98	95.2	0.000665	0.00152
Coal – default	Industry	kg	22.40	0.98	91.2	0.000665	0.00152
Diesel	Industry	litre	37.86	0.99	69.5	0.00019	0.00038
LPG	Industry	kg	49.51	0.99	60.4	0.001045	0.00057
Heavy fuel oil	Industry	litre	40.72	0.99	73.5	0.00285	0.000285
Light fuel oil	Industry	litre	38.12	0.99	72	0.00019	0.00038
Wood	Industry	kg	12.08	1	104.15	0.01425	0.0038
Wood	Fireplaces	kg	12.08	1	104.15	0.285	0.0038
Transport fuels							
Regular petrol	Mobile use	litre	34.8910303	0.99	66.2	0.018525	0.001425
Premium petrol	Mobile use	litre	35.24191249	0.99	67	0.018525	0.001425
Petrol – default	Mobile use	litre	34.96643432	0.99	66.37	0.018525	0.0014250
Diesel	Mobile use	litre	37.8627	0.99	69.5	0.0038	0.003705
LPG	Mobile use	litre	26.54	0.99	60.4	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/litre)	=	[(Calorific value*tCO_2 per TJ emission factor)*Oxidation factor]/1000
	=	[(22.40*91.2)*0.98]/1000
	=	2.00 kg CO_2/litre
CH_4 emission factor (kg CO_2-e/litre)	=	[(Calorific value*tCH_4 per TJ emission factor)*GWP of CH_4]/1000
	=	[(22.40*0.0095)*21]/1000
	=	0.00447 kg CO_2-e/litre
N_2O emission factor (kg CO_2-e/litre)	=	[(Calorific value*tN_2O per TJ emission factor)*GWP of N_2O]/1000
	=	[(22.40*0.00133)*310]/1000
	=	0.00924 kg CO_2-e/litre
Total CO_2-e emission factor (kg CO_2-e/litre)	=	Sum of CO_2, CH_4 and N_2O emission factors

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.