Emissions trading bulletin

Climate Change (Stationary Energy and Industrial Processes) Regulations 2009

No 13 October 2009

Introduction

The Climate Change Response Act 2002 (the Act) creates obligations for people carrying out certain activities listed in the schedules to the Act to monitor and report on greenhouse gas emissions associated with those activities as part of the New Zealand Emissions Trading Scheme (NZ ETS).

This bulletin explains, and should be read alongside, the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 (SEIP Regulations).

The SEIP Regulations set out data collection requirements and methods to calculate the emissions associated with stationary energy and industrial process activities. The relevant activities are listed in Schedules 3 and 4 of the Act and relate to:

- importing, mining and purchasing coal
- importing, mining and purchasing natural gas
- using geothermal fluid to generate electricity or industrial heat
- combusting used or waste oil, used tyres or waste to generate electricity or industrial heat
- refining petroleum
- producing iron and steel, cement clinker and burnt lime, aluminium, glass or gold.

Framework

These regulations establish practical and accurate methods by which SEIP participants can meet their reporting obligations from 1 January 2010.

The SEIP Regulations are intended to:

- provide for an accurate, verifiable statement of emissions
- minimise transaction costs
- neither advantage nor disadvantage the Crown fiscally ie, result in a true reflection of New Zealand's emissions liability
- enable a clear price signal, without creating perverse incentives.

Calculation methods

The process for calculating the emissions associated with an activity reflects the following basic formula:

Emissions = Activity data x Emissions factor

One or more measures of activity, such as tonnes of coal sold or gifted, are multiplied by an emissions factor. Factors such as exports may be explicitly excluded from the total emissions.

Following consultation, additional methods have been provided to allow the direct estimation of emissions from the combustion of waste.

Emissions factors

Alignment with Inventory

The emissions calculation methods and default emissions factors (DEFs) have been aligned with New Zealand's Greenhouse Gas Inventory (the Inventory) reporting requirements. This is intended to achieve approximate fiscal neutrality ie, participants are required to surrender a similar number of emission units for an activity to the number the Crown is required to surrender. It is also intended to send a clear price signal and provide appropriate incentives to minimise the overall economic cost of meeting obligations under the Kyoto Protocol and any successor international agreements.

The revised 1996 IPCC guidelines[1] will apply to New Zealand's National Inventory until at least 2012. Subsequent draft IPCC (2006) guidelines[2] have been developed, but international agreement to their use in national Inventory reporting has yet to occur.

Default emissions factors

Default emissions factors are listed in Schedule 2 of the regulations. They are based on the best quality data available that is consistent with the approach taken in the Inventory. More detailed background information on these DEFs can be found in the Appendix to this bulletin.

It is intended that the DEFs will be reviewed and amended periodically on the basis of better data, where consistent with the Inventory, including that gathered from UEF applications, or changes to the approach taken in the Inventory. Further information on the time period for review can be found at the end of this bulletin.

Using DEFs minimises the transaction costs for participants to calculate and report on emissions.

Unique emissions factors

In some cases, participants have the opportunity to apply for approval to use a unique emissions factor (UEF) in place of a default emissions factor when completing an emissions return. Further information on the regulations relating to UEF applications can be found in Emissions Trading Bulletin No 13.

Fixed emissions factors

For all industrial processes, emissions factors are based on a ratio reflecting the amount of carbon dioxide generated from the amount of pure chemical substance, such as carbon, used in the particular industrial process.

A fixed emissions factor for carbon is also included in the calculation methods for mining and purchasing natural gas, and the optional methods for waste combustion.

These emissions factors have generally been rounded to four significant figures, reflecting their greater inherent precision and avoiding systematic errors.

Stationary energy

Coal

The regulations for the coal sector remain largely unchanged from the draft released for consultation in June 2009. Participants must collect data on the tonnes and calorific value of coal imported, mined or purchased. An optional stockpile adjustment is provided for coal importers or purchasers. For coal mining, there is no need for a stockpile adjustment because the point of measurement is the point of sale, so stockpiled coal does not have to be reported. Coal sold and gifted must be reported. Coal miners must also report on emissions of fugitive coal seam methane (FCSM). A reduction of up to 85 per cent is allowed for any FCSM that is flared or oxidised.

Feedback received during consultation focused on three key areas: the joint DEF/UEF model, the treatment of fugitive coal seam methane, and the stockpile adjustment.

The DEF/UEF model

The DEFs are based on an adjusted average of the expected properties for each class of New Zealand coal. The underlying coal property information for the DEFs was provided by coal industry specialists CRL Energy,[3] along with information on associated uncertainties.

Allowing for UEFs in the coal sector potentially creates a divergence between the NZ ETS and the Inventory. To minimise the fiscal risk to the Crown from this divergence, DEFs were adjusted from the relevant expected distribution mean along with a corresponding threshold applied to UEF applications. Further explanation of these calculations can be found in the Appendix to this bulletin.

Some submissions indicated support for the proposed DEF and others for a DEF set at the expected mean. Some submitters expressed a view that no UEF threshold should apply, effectively implying that the Crown should bear the potential cost of allowing UEFs. Others suggested that high thresholds should be set both above and below the mean and participants be required to apply for a UEF if their coal properties fall outside either threshold.

The DEF/UEF model delivers the fairest overall outcome for different groups of participants and the Crown (see the Appendix to this bulletin for further explanation). It also avoids the need to create potentially complicated and costly sampling and testing requirements to ensure the UEF is materially different from the DEF.

Fugitive coal seam methane

A number of submissions were received about the treatment of fugitive coal seam methane (FCSM) associated with coal mining. FCSM is sometimes referred to as ‘fugitive emissions of methane’. These

submissions ranged from a request to exempt FCSM from the NZ ETS, to a request for a low or zero DEF, along with an option to apply for a UEF for FCSM.

Two key principles of the NZ ETS are that it is an all-gases, all-sectors emissions trading scheme, and that the approach to emissions reporting taken in New Zealand's Greenhouse Gas Inventory guides reporting and surrender requirements under the NZ ETS. These principles help to ensure fairness across sectors, maintain the integrity of the NZ ETS, and provide for a clear price signal. DEFs for FCSM remain unchanged from the consultation draft.

New Zealand's topographical and geological conditions mean there may be considerable variation in FCSM between and across coalfields. The option to apply for a UEF has now been provided for FCSM associated with underground mining. Further details can be found in Emissions trading bulletin No 15.

Stockpile adjustment

The regulations provide a stockpile adjustment mechanism, whereby coal importers and purchasers may defer surrender obligations for stockpiled coal until the year it is used.

Modified reporting provisions for stockpile adjustments were previously included in the June 2009 draft regulations. These were designed to enable reporting for a single stockpile containing different classes of coal (eg, a mix of purchased and imported coal). This approach reflects the typical use of a stockpile and was supported by stakeholders.

Refinements have been made to the June 2009 draft regulations to manage transitional accounting for a pre-existing stockpile containing coal for which NZ ETS obligations do not apply.

Natural gas

Mined natural gas

Reporting of emissions by gas miners is focused on the readily available, continuous, high-quality gas measurement at the sales metering point immediately downstream of gas processing before gas enters the high-pressure transmission network. This approach requires direct measurement of the carbon content and other properties of all natural gas sold. This removes the need for UEFs. The gas miner must also estimate emissions from venting, flaring and their own use of gas during production and processing using the hydrocarbon accounting system (HAS) needed for process control.

Some adjustments have been made to the June 2009 draft regulations to clarify and simplify reporting requirements, including revised definitions of the point of measurement and classes of gas.

Where direct measurement of the volume and properties of mined natural gas is not continuous, as in the case of smaller or intermittent producers, testing can be done periodically.

The equation has been simplified so that participants are no longer required to report a share of national emissions associated with unaccounted-for gas or downstream losses. This simplification has been balanced by the removal of the oxidation factor for natural gas injected into a high-pressure transmission pipeline. While not an exact correlation, this change is approximately fiscally neutral and reduces administrative cost and complexity.

Purchasing natural gas

The Act allows a purchaser of natural gas to opt in to the NZ ETS ie, voluntarily take over the responsibility for emissions associated with their purchased gas, should they purchase more than two petajoules directly from a gas miner in any year.

Opt-in participants have the option to use the same direct measurement method as the gas miner to report on emissions. A number of submitters commented on possible difficulties for opt-in participants to access the data required by this method. Consequently, opt-in participants may use a field-specific DEF instead. The field-specific emissions factors listed in the regulations will be periodically updated based on information provided to the administering agency by gas miners.

Gas storage adjustment

The process for including a gas storage adjustment in an emissions return has been simplified. A national average emissions factor, which will be regularly updated, is applied both for gas injected into and removed from a storage reservoir.

Importing and purchasing natural gas: LPG

As most LPG is expected to be a 60:40 blend of propane and butane, a DEF for this mix has been provided to minimise transaction costs for participants. To allow for other LPG blends, an additional equation

has been included to enable participants to calculate the appropriate emissions factor.

Other issues

A number of other matters were raised in submissions which would have required changes to the Act and therefore were out of scope for these regulations. They included:

- reducing the 2 PJ per annum gas opt-in threshold
- altering the 'one step down from a miner' requirement for opt-in
- requiring gas miners to provide information to opt-in participants
- altering reporting and liability provisions for people who carry out activities jointly.

Geothermal fluid

The SEIP Regulations provide two methods for geothermal participants to report on emissions, the choice of which is determined by whether they use separated geothermal steam or two-phase geothermal fluid to generate electricity or industrial heat. The point of obligation in the NZ ETS for this activity, and the person who must report on emissions, is the user of geothermal fluid. In most instances, this will be the operator of an industrial geothermal plant.

DEFs have been provided for known geothermal fluid users based on information received from the plant operators themselves. Any other participants must use the revised 'any other' DEF or apply for a UEF.

Some submitters sought an emissions threshold for participation in the NZ ETS for the use of geothermal fluid in generating industrial heat. There are many factors that need to be considered in deciding on a threshold, as detailed in section 60 of the Act. Further information on any possible emissions threshold will be provided in due course.

Waste

Following consultation, emissions factors have been refined and additional methods have been provided for participants to monitor and report on emissions from the combustion of waste.

One or more of these methods can be used to report emissions for one or more classes of waste. Adjustments are allowed to avoid double counting emissions associated with any obligation fuel that is combusted, or to avoid counting any carbon dioxide emissions from combusting biomass materials.

Standard method

As well as the standard method for calculating emissions based on tonnes of fuel inputs, the regulations also allow reporting on the basis of energy outputs. Participants who use this second option must collect data on emissions from particular combustion equipment only, as the efficiency of that equipment is a key determining factor in total emissions.

Periodic source testing

The second method allowed is to estimate emissions directly through periodic sampling of exhaust gas from the stacks. This approach does not require the use of emission factors or activity data. Instead, there is a requirement that the sampling and testing of stack gases be sufficient to ensure the results are representative of the full range of operating conditions for the equipment for the year.

Continuous emissions monitoring

The third method requires continuous monitoring of emissions by taking samples of exhaust gas from the stacks at least every 30 minutes. Total annual emissions are determined through adding up estimates of emissions per hour when the plant is operating.

Other issues raised in submissions

Many submitters expressed the view that biofuels, such as wood, should not be covered by these regulations as such fuels should not be considered 'waste'. At this point, no DEFs have been included for biofuels; further clarification on the treatment of emissions from combusting biofuels will be provided in due course.

Refining petroleum

The regulations for refining petroleum have been changed to correct the emissions factors and align them more closely to the Inventory. This includes incorporating direct measurement of the CO_2 emissions from hydrogen manufacturing, which is a more accurate approach than basing the emissions entirely on fuel and feedstock inputs. Because there is only one participant, the emissions factors are site specific.

Industrial processes

The methods for reporting on emissions from industrial processes are based on monitoring the amount of pure chemical compounds in inputs or outputs. This allows

participants to use appropriate internal processes to calculate the amount of pure substance used or produced by their particular industrial process. It is the participant's responsibility to carry out and document the necessary sampling, analysis and calculations to determine these quantities.

Emissions are calculated according to fixed chemical ratios provided in the regulations.

Producing iron or steel

Carbon-containing materials added to iron and steel during processing, for the reduction of iron sand and for other purposes such as temperature control, generate emissions of carbon dioxide.

A boundary definition has been included in the regulations to simplify the data collection requirements. This excludes the small quantities of carbon-containing inputs added to the steel product during or after tapping hot metal, which are unlikely to generate significant emissions. All limestone, dolomite and any other carbon-containing materials must be reported on if they are added before this point in the process.

Any obligation coal which will be reported on by a coal participant in the NZ ETS is explicitly excluded.

Producing aluminium

Process emissions from the aluminium smelting industry come from the production and use of carbon-containing anodes in smelting, and from anode effects which result in intermittent emission of perfluorocarbons (CF_4 and C_2F_6). The regulations provide for the estimation of emissions using the International Aluminium Institute's Aluminium Sector Greenhouse Gas Protocol (2006). This standard incorporates the relevant IPCC-based emission factors.

Producing clinker or burnt lime

In consultation with participants, minor wording changes have been made to clarify which emissions source inputs for which data must be collected. As with the other industrial processes, the regulations require the participant to report tonnes of pure substances – these are calcium oxide (CaO) and magnesium oxide (MgO) produced by calcination of limestone or other carbonate materials.

Magnesium, in various mineral forms, is likely to be present as an impurity in the limestone used for clinker and lime production. The regulations allow for up to 5 per cent of MgO to be calculated as CaO. If more than 5 per cent of MgO is present due to impurities, or if magnesium is added in the form of dolomite or other inputs, it must be reported on.

Submitters requested a variability factor or UEF option for cement kiln dust. It is expected that in most processes some calcined material will leave the kiln in the form of dust. If this dust is recycled into the kiln, it becomes part of the product; any calcined material in dust that is not recycled represents an additional source of emissions. The regulations now allow for participants to report only on the calcined proportion of un-recycled cement or lime kiln dust. It is not necessary to carry out detailed analysis of kiln dust, beyond that needed to establish the proportion of calcinated material in it. Use of the World Business Council for Sustainable Development's CO_2 Accounting and Reporting Standard for the Cement Industry (2005) would be a useful way to document the information collected under these regulations, but is not mandatory.

Producing glass using soda ash

Minor adjustments have been made to the regulations for glass production to allow for the use of naturally occurring soda ash in glass production. As with other industrial processes, reporting is based on data collected about the quantities of pure substance used in producing glass.

Producing gold

Emissions from gold production are calculated from the quantities of limestone or dolomite used, expressed as tonnes of pure calcium carbonate or calcium magnesium carbonate.

Submitters requested a variability factor for limestone used in managing the acidity of mined waste rock, where not all of the carbonate reacts and give rise to emissions. The regulations now take account of this possibility and it is the participant's responsibility to estimate and document the proportion that is reacted to complete the emissions return.

[1] IPCC 1996. Houghton J.T., Meira Filho L.G., Lim B., Treanton K., Mamaty I., Bonduki Y., Griggs D.J., Callender B.A. (eds). IPCC/OECD/IEA. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. UK Meteorological Office: Bracknell.

[2] IPCC 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T., and Tanabe K. (eds). Published: IGES, Japan.

[3] This report and other sector-specific reports by independent consultants can be found at www.climatechange.govt.nz.

Review

The Government may review the operation of the regulations at any time. There will be a formal opportunity to review the regulations and their methods during scheduled reviews of the operation and effectiveness of the NZ ETS. The first review is to be completed during 2011.

Getting ready

Participants have seven main tasks under the Act.

1. Notify the administering agency of the NZ ETS that they are participants in respect of the activity in Part 3 or Part 4 of Schedule 3 of the Act.
2. Open a holding account in the emission unit registry.
3. Collect data about their company's emissions and retain it for seven years.
4. Calculate emissions according to the methods prescribed by regulations.
5. File an annual emissions return by 31 March.
6. Surrender emission units to match the assessment of liability contained in the emissions return.
7. Be ready to respond to enquiries from the Crown about audit or verification of an emissions return.

Step 1 must be done within 20 working days of carrying out the activity. In most cases, this will be within 20 working days of 1 January 2010.

Enforcement

As the regulations will operate under the NZ ETS, enforcement will be activated under the relevant provisions in the Climate Change Response Act 2002.

The compliance system for the NZ ETS is based on a 'self-assessment' model like that used in the New Zealand tax system. Rights are given to the chief executive of the administering agency to check the validity of information provided and to issue penalties where breaches are identified. There are also criminal penalties for various offences under the Act.

Further information

To read the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009, Climate Change (Unique Emissions Factors) Regulations 2009, background documents and for further information on the NZ ETS, visit www.climatechange.govt.nz.

Material incorporated by reference in the SEIP Regulations, such as sampling or measurement standards, is available for inspection free of charge at the offices of the Ministry of Economic Development in Auckland, Christchurch and Wellington. Enquiries about purchasing any standards should be directed to enquiries@standards.co.nz.

The administering agency of the NZ ETS is the Ministry of Economic Development. For more information on registering as a participant in the NZ ETS and filing an emissions return, visit www.eur.govt.nz.

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ETS Bulletin No 13 APPENDIX: Emissions factors

Overview

The default emissions factors (DEFs) in the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 (SEIP Regulations) are based on the best quality data available that is consistent with the approach taken in New Zealand's Greenhouse Gas Inventory (the Inventory). This involves using the Revised 1996 IPCC Guidelines for inventory reporting for at least the period up to December 2012, to match New Zealand's commitments under the Kyoto Protocol. At such time as the draft 2006 IPCC Guidelines are agreed internationally for use in national reporting, this approach will be taken in New Zealand's Inventory.

The combustion of coal, natural gas and waste generates methane and nitrous oxide emissions as well as carbon dioxide. The methane and nitrous oxide emissions factors are IPCC Tier 2 – Industrial boilers throughout, except where specified otherwise.

Fugitive emissions of methane also arise from mining coal, the transmission and distribution of gas, and are emitted when using geothermal fluid for electricity production and industrial heat. In most cases, industrial process emissions (emissions from non-energy sources) are carbon dioxide only.

Global warming potentials (GWPs) are used to express the climate impacts of different greenhouse gases in a common form, carbon dioxide equivalents (CO_2-e). The GWPs used are those agreed internationally and used in the Kyoto Protocol until the end of 2012. The emissions factors included in the SEIP Regulations are expressed in CO_2-e terms; the respective GWPs are listed below:

Gas	**Chemical formula**	**Global warming potential (tCO_2-e)**
Carbon dioxide	CO_2	1
Methane	CH_4	21
Nitrous oxide	N_2O	310
Tetrafluoromethane	CF_4	6,500
Hexafluoroethane	C_2F_6	9,200

The DEFs are generally expressed to four significant figures to help avoid introducing systematic error into emissions returns. In the case of fugitive coal seam methane where measurement uncertainty is higher only three significant figures have been used.

Table 1: Importing coal

Class	**Emissions factors (tCO_2-e/TJ)**					**DEF**
	Oxidation factor	**Net CO_2**	**CH_4**	**N_2O**	**Total**	
Lignite	0.980	93.930	0.01397	0.4712	94.415	**94.79**
Sub-bituminous	0.980	90.006	0.01397	0.4712	90.491	**90.64**
Bituminous	0.980	87.208	0.01397	0.4712	87.693	**88.15**

The DEF for imported coal is aligned with the DEF for domestic coal.

Table 2: Mining and purchasing coal

Class	Emissions factors tCO_2-e/TJ					DEF
	Oxidation factor	Net CO_2	CH_4	N_2O	Total	
Lignite – all other fields	0.980	93.930	0.01397	0.4712	94.415	**94.79**
Lignite – Waimumu and Roxburgh	0.980	91.102	0.01397	0.4712	91.587	**91.95**
Sub-bituminous	0.980	90.006	0.01397	0.4712	90.491	**90.64**
Bituminous	0.980	87.208	0.01397	0.4712	87.693	**88.15**

The coal emissions factors are based on a survey of the average CO_2-only emissions factors for local coals provided by CRL Energy. This average was then multiplied by a standard IPCC oxidation factor of 0.98 to reflect the expected oxidation efficiency of coal in typical power stations or industrial boilers, yielding the 'net CO_2' emission factor. Emissions factors (in CO_2-e terms) for expected methane and nitrous oxide from the combustion of coal are added to the net CO_2 emission factors to yield the 'total' emission factor.

The DEF is the 'total' emission factor from Table 1 plus 0.4 standard deviations to allow for UEF applications. This adjustment, along with a UEF threshold of one standard deviation below the DEF, gives a DEF that is fiscally neutral in comparison with the expected properties of New Zealand coals and enables feasible, low-cost methods for UEF applications. Further information on the DEF/UEF model is provided in the Appendix to Emissions Trading Bulletin 15.

Table 3: Mining coal – fugitive coal seam gas

Part A

Class	Emissions factors (tCO_2-e/t coal)		DEF
	Mining CH_4	Post-mining CH_4	
Surface mining	0.01618	0.00141	**0.018**
Underground bituminous mining	0.3518	0.0336	**0.385**
Underground sub-bituminous mining	0.2541	0.0336	**0.288**

Part B

Class	Emissions factor (tCO_2-e/t CH_4)	DEF
Flaring, combusting or oxidising	17.892	**17.89**

The fugitive coal seam gas emissions factors are based on the 1996 IPCC Guidelines as follows:

- surface mining = Tier 1-midpoint
- underground bituminous = Tier 1-high
- underground sub-bituminous = Tier 1-midpoint

The flaring, combusting or oxidising DEF enables a participant to estimate avoided emissions from flaring, combusting or oxidising methane in mine ventilation air that would otherwise be vented to the atmosphere. The emissions factor is based on the IPCC assumption of flaring gas having an oxidation factor of 0.98, that is for each tonne of methane flared 980 kg is converted to CO_2 and 20 kg released as CH_4. The CO_2-e emissions of the CO_2 and CH_4 emitted are calculated and then subtracted from 21 tonnes, the CO_2-e emissions from venting 1 tonne of methane, to produce the DEF.

Table 4: Importing and purchasing natural gas

Class	**Emissions factors tCO_2-e/t gas**				**DEF**
	Oxidation factor	**CO_2**	**CH_4**	**N_2O**	
Commercial propane	0.995	2.9932	0.001	0.009	**2.988**
Commercial butane	0.995	3.0289	0.001	0.009	**3.024**
LPG (P60:B40)	0.995	3.0085	0.001	0.009	**3.003**
Class	**Emissions factors tCO_2-e/TJ**				
Liquefied natural gas	1.0	53.5881	0.02646	0.0279	**53.64**

The emissions factors for LPG are expressed on a per-tonne basis because this is the unit most commonly used by the sector. For LPG mixes other than P60:B40 (60 per cent propane), participants calculate an appropriate emissions factor using the formula in the regulations.

The liquefied natural gas oxidation factor of 1.0 reflects a simplification to the emissions calculation allowing the factor for downstream losses from gas that passes through the high pressure network to be removed from the emissions equation.

Table 5: Purchasing natural gas

Class	**Emissions factors tCO_2-e/TJ**				**DEF**
	Oxidation factor	**CO_2**	**CH_4**	**N_2O**	
National average (specification gas)	1.0	53.5881	0.02646	0.0279	**53.64**
Kaimiro	1.0	55.0880	0.02646	0.0279	**55.14**
Kapuni	1.0	53.0336	0.02646	0.0279	**53.09**
Kapuni LTS	1.0	84.1000	0.02646	0.0279	**84.15**
Mangahewa	1.0	57.4000	0.02646	0.0279	**57.45**
Maui	1.0	52.3699	0.02646	0.0279	**52.42**
McKee	1.0	54.3000	0.02646	0.0279	**54.35**
Ngatoro	1.0	53.0650	0.02646	0.0279	**53.12**
Pohokura	1.0	54.2278	0.02646	0.0279	**54.28**
Rimu/Kauri	1.0	51.8510	0.02646	0.0279	**51.91**
TAWN	1.0	54.8540	0.02646	0.0279	**54.91**
Turangi	1.0	54.6689	0.02646	0.0279	**54.72**

The CO_2 emissions factors are based on the best available information held by the Ministry of Economic Development. This information is also the basis of inventory reporting on the natural gas sector. These will be updated periodically. An oxidation factor of 1.0 reflects a simplification of the emissions calculation allowing the factor for downstream losses from gas that passes through the high pressure network to be removed from the emissions equation.

Table 6: Using geothermal fluid

Part A

Class	DEF	Unit
Kawerau II Power Plant	**0.0275**	tCO_2e/t steam
Kawerau Industrial Use	**0.0275**	tCO_2e/t steam
Kawerau KA24 Power Plant	**0.0275**	tCO_2e/t steam
Mokai I & II Power Plants	**0.0069**	tCO_2e/t steam
Ngawha I & II Power Plants	**0.2120**	tCO_2e/t steam
Ohaaki Power Plant	**0.0575**	tCO_2e/t steam
Poihipi Road Geothermal Plant	**0.0049**	tCO_2e/t steam
Rotokawa I Power Plant	**0.0214**	tCO_2e/t steam
Wairakei A and B	**0.0050**	tCO_2e/t steam
Wairakei G14	**0.0050**	tCO_2e/t steam
Any other plant or process using geothermal steam	**0.0300**	tCO_2e/t steam

Part B

Mokai Greenhouse	**0.000**	tCO_2e/t 2-phase fluid
Tauhara/Tenon	**0.0008**	tCO_2e/t 2-phase fluid
Any other plant or process using geothermal fluid	**0.0008**	tCO_2e/t 2-phase fluid

The CO_2-e emissions factors are based on the most recent data from the geothermal facilities listed in the tables, and are consistent with the approach taken in the Inventory. For geothermal steam, they are the weighted average of non-condensable CO_2 and CH_4 concentrations in both first flashed and second flashed steam volumes.

The emissions factor for any other plant or process using geothermal steam was set slightly above the average emissions factor after considering results from three statistical tests on individual plant emission factors, including a weighted average based on energy generated and a simple mean of values. This is intended to avoid creating adverse selection issues or discouraging small or new participants.

The emissions factor for any other plant or process using geothermal fluid was set as the same as the only known source of emissions in this category.

Table 7: Combusting used oil, waste oil, used tyres and waste

Class	Emissions factors tCO_2-e/TJ				
	Oxidation factor	CO_2	CH_4	N_2O	Total (gross)
Used and waste oil	0.99	77.1579	0.6632	1.3053	**78.35**
Used tyres	0.99	150.5263	0.6632	1.3053	**150.99**
Municipal waste - biomass	0.00	0.00	0.6632	1.3053	**1.969**
Municipal waste - consisting of or containing non-biomass	0.99	96.5263	0.6632	1.3053	**97.53**

These emissions factors are based on the 1996 or 2006 IPCC Guidelines. Where the activities are not currently occurring in New Zealand (for example, municipal waste combustion and used tyre combustion), the 2006 IPCC Guidelines have been followed. This is consistent with the approach taken in the Inventory.

IPCC emissions factors are presented as net energy values. These have been converted into gross energy values in Table 6 by dividing the IPCC emissions factor by 0.95 as the Inventory, and the NZ ETS, reports in gross energy terms. An oxidation factor of 0.99 is applied to the CO_2 emissions factor.

Table 8: Refining petroleum (Marsden Point Refinery)

Class of intermediate crude oil product	Emissions factor	Unit
Refinery fuel gas	2.848	
Refinery fuel oil	3.115	
Refinery asphalt	3.179	tCO_2e/t
Refinery flare gas	2.921	
Other intermediate crude oil products	3.179	

The emissions factors and descriptions of intermediate crude oil products align with those reported in the Inventory. This is the best available information on emissions from the Marsden Point Refinery and is specific to the fuel characteristics for this refinery, New Zealand's only refinery.

Table 9: Chemical ratios

Activity	Term	Class	Emissions factor	Unit
Mining or purchasing natural gas Producing steel Waste combustion	EF_C	Carbon (C)	**3.6641**	tCO_2e/t

This emissions factor is the stoichiometric ratio of a given mass of CO_2 to the mass of pure carbon that was oxidised to produce it. In draft regulations it was given as 3.67, which is a close approximation to the true value. Given the high precision possible for this emissions factor, two further decimal places have been included in the regulations to allow participants to calculate emissions more accurately and avoid systematic error. It is based on the actual atomic weights of carbon (12.011) and oxygen (15.9994).

Table 10: Industrial processes

Activity	Term	Class	Emissions factors	Unit
Producing clinker Producing burnt lime	EF_{CAO}	Calcium oxide (CaO)	**0.7848**	tCO_2e/t
Producing clinker Producing burnt lime	EF_{MGO}	Magnesium oxide (MgO)	**1.0919**	tCO_2e/t
Producing glass	EF_{SOA}	Soda ash (Na_2CO_3)	**0.4152**	tCO_2e/t
Producing iron or steel Producing glass Producing gold	EF_{LST}	Uncalcined limestone ($CaCO_3$)	**0.4397**	tCO_2e/t
Producing iron or steel Producing glass Producing gold	EF_{DOL}	Uncalcined dolomite ($CaMg(CO_3)_2$)	**0.4773**	tCO_2e/t

Each of these factors is the stoichiometric ratio of a given mass of CO_2 to the mass of a pure carbon-containing substance associated with the CO_2 emissions. Use of these factors means that the participant must, before completing an emissions return, carry out and document the appropriate measurement and analysis to determine the amount of pure substance used in the year.