# Carbon Credits (Carbon Farming Initiative) (Destruction of Methane Generated from Manure in Piggeries—1.1) Methodology Determination 2013[1]

*Carbon Credits (Carbon Farming Initiative) Act 2011*

I, Yvette D'Ath, Parliamentary Secretary for Climate Change, Industry and Innovation, make this Methodology Determination under subsection 106(1) of the *Carbon Credits (Carbon Farming Initiative) Act 2011*.

Dated 28 May 2013

YVETTE D'ATH

Parliamentary Secretary for Climate Change, Industry and Innovation

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# Part 1 Preliminary

## 1.1 Name of Determination

This Determination is the *Carbon Credits (Carbon Farming Initiative) (Destruction of Methane Generated from Manure in Piggeries—1.1) Methodology Determination 2013*.

## 1.2 Commencement

This Determination is taken to have come into force on 1 July 2010.

## 1.3 Definitions

In this Determination:

***Act*** means the *Carbon Credits (Carbon Farming Initiative) Act 2011*.

***anaerobic decomposition*** means the active and naturally occurring biological process where organic matter is degraded by bacteria under anoxic conditions to yield biogas, consisting primarily of methane and carbon dioxide, and a nutrient rich effluent.

***biogas*** means a mixture of gases, primarily methane and carbon dioxide, that is generated from anaerobic decomposition.

***$CO_2$-e*** means carbon dioxide equivalent.

***combustion device*** means a flare, whether enclosed or open, or an internal combustion engine or a gas boiler.

***continuous monitoring system*** means the equipment used to continuously acquire data, process the data and deliver the required information.

***enclosed flare*** means a device where residual gas is burned in a cylindrical or rectilinear enclosure that includes a burning system and a damper where air for the combustion reaction is admitted.

***flaring system*** means a system which is used to combust biogas and which involves an open flare or an enclosed flare.

***gas boiler*** means a combustion device for gaseous fuels, including biogas, for heating water or raising steam.

***$GWP_{CH4}$*** means the global warming potential of methane, as prescribed in the NGER Regulations.

***internal combustion engine*** means an engine in which the combustion of a fuel occurs with an oxidizer in a combustion chamber.

***lagoon*** means a dam into which liquid waste slurry produced during cleaning of sheds in conventional piggeries is deposited, stored and treated.

***monitoring instrument*** means an instrument for measuring a quantity.

***NATA*** means the National Association of Testing Authorities, Australia (ACN 004 379 748).

***NGER Measurement Determination*** means the applicable determination made under subsection 10(3) of the *National Greenhouse and Energy Reporting Act 2007*.

***NGER Regulations*** means the regulations made under the *National Greenhouse and Energy Reporting Act 2007*.

***open flare*** means a device where residual gas is burned in open air with or without any auxiliary fuel assistance.

***PigBal model*** means PigBal Version 2.14 produced by the Queensland Department of Agriculture, Fisheries and Forestry; the publication is used to calculate nutrient and salt content in the waste effluent from a piggery and comprises:

- the PigBal Manual; and
- the PigBal workbook;

and is available at www.climatechange.gov.au.

***standard conditions*** has the same meaning provided in the NGER Measurement Determination.

***US EPA Method*** means a test method so named and approved by the United States Environmental Protection Agency, as amended from time to time.

***Note*** A link to these methods is available at www.climatechange.gov.au.

***Note*** Other words and expressions used in this Determination have the meaning given by the Act. These terms include:

***baseline***

***eligible offsets project***

***emission***

***greenhouse gas***

***offsets project***

***offsets report***

***project***

***project area***

***project proponent***

***reporting period***

## 1.4 Kind of project to which this Determination applies

***Note*** See paragraph 106(1)(a) of the Act.

This Determination applies to a project to capture biogas generated by the decomposition of piggery manure waste in anaerobic lagoons and to combust the methane component of the captured biogas.

# Part 2 Requirements for declaration as eligible project

***Note*** See paragraphs 27(4)(c), 35(2)(a) and 106(1)(b) of the Act.

## 2.1 Eligible projects

To be declared an eligible offsets project, a project to which this Determination applies must meet the requirements in this Part.

## 2.2 Requirement 1—Location

The project must be located within Australia.

## 2.3 Requirement 2—Project mechanism

The project must be carried out at a piggery that, on or after 1 July 2007, has equipment installed:

(a) to cover lagoons to prevent release of biogas containing methane;

(b) to collect the gas from the covered lagoon; and

(c) to combust the methane component in the gas to convert it to carbon dioxide.

## 2.4 Requirement 3—Project equipment

(1) Subject to subsection (2), equipment referred to in section 2.3 may be installed for new lagoons or for existing uncovered lagoons.

(2) Equipment referred to in section 2.3 does not include the reinstallation, or replacement of, upgrades to or modifications of an existing covered lagoon, where such covered lagoons were installed prior to 1 July 2007.

## 2.5 Requirement 4—Lagoons

(1) A lagoon that is used for the anaerobic treatment of effluent must:

(a) have a minimum depth of 2 metres; and

(b) comply with the best practice principles for the design of effluent treatment ponds as set out in the *National Environmental Guidelines for Piggeries 2010*.

***Note*** The *National Environmental Guidelines for Piggeries 2010* are available at www.climatechange.gov.au.

(2) The input to a lagoon must consist only of effluent from the operation of the piggery to which the project relates.

## 2.6 Requirement 5—Flaring systems

Any flaring system used in the project must:

(a) use a type of flare that is designed to maintain continuous destruction of methane; and

(b) include a system that detects and records when operation of the flare fails for periods exceeding 20 minutes.

***Note*** A flare that is designed to maintain continuous destruction of methane includes continuously sparking flares with a system to detect operation, or an enclosed flare with a system that detects if the temperature in the exhaust gas of the flare falls below the level required to achieve a destruction efficiency of 0.98.

# Part 3 Requirements for operation of eligible projects

***Note*** See paragraphs 27(4)(c), 35(2)(a) and 106(1)(b) of the Act and regulation 3.26 of the *Carbon Credits (Carbon Farming Initiative) Regulations 2011*.

## Division 3.1 Operation of eligible projects

### 3.1 Operation of eligible projects

An eligible offsets project must be operated in accordance with this Part.

### 3.2 Flare operation

(1) This section sets out the requirements for determining whether a flaring system used in the project is operational, for the purposes of determining the destruction efficiency of the flaring system in accordance with Subdivision 4.2.5.

(2) Subject to subsection (3), if for any particular hour:

(a) there is no record of the flare being operational; or

(b) the flare is not operational for a period exceeding 20 minutes;

then it must be assumed that during that hour the flare destruction efficiency is zero.

(3) A flare is operational if the continuous presence of a flame at the pilot light is detected using:

(a) an ultra-violet beam sensor; or

(b) a thermocouple; or

(c) a temperature sensor; or

(d) an equivalent device that automatically detects the presence or absence of the flame.

## Division 3.2 Greenhouse gas assessment boundary

### 3.3 Greenhouse gases that must be accounted for

Only the greenhouse gases set out in column 3 of the following table may be taken into account when making calculations under Part 4 in respect of the sources specified in column 2 of the table.

***Note*** No other gases, carbon pools or emissions may be taken into account in respect of a source.

*Table of gases accounted for in the abatement calculations*

| | Source | Greenhouse gas/carbon pools |
|---|---|---|
| **Baseline** | Anaerobically treated waste in project lagoons | Methane ($CH_4$) |
| **Project Activity** | Electricity from the grid and fuel used for gas capture and combustion | Carbon dioxide ($CO_2$) |
| | | Methane ($CH_4$) |
| | | Nitrous oxide ($N_2O$) |
| | Gas capture and combustion via internal combustion engine | Methane ($CH_4$) |
| | | Nitrous oxide ($N_2O$) |
| | Gas capture and combustion via gas boiler used to heat water or generate steam | Methane ($CH_4$) |
| | | Nitrous oxide ($N_2O$) |
| | Gas capture and combustion via flaring | Methane ($CH_4$) |
| | | Nitrous oxide ($N_2O$) |

# Part 4 The net abatement amount

## Division 4.1 The net abatement amount

### 4.1 The net abatement amount

***Note*** See paragraph 106(1)(c) of the Act.

For a project to which this Determination applies, the carbon dioxide equivalent net abatement amount for the project in relation to a reporting period for the project is taken to be the quantity of methane emissions avoided as a consequence of the project, minus emissions from electricity and fuel used to operate the gas capture and combustion equipment, as calculated in accordance with Subdivision 4.2.3.

## Division 4.2 Calculations

## Subdivision 4.2.1 Preliminary

### 4.2 How calculations are to be made

In this Part:

(a) all calculations:

(i) are in respect of activities undertaken, or outcomes achieved, during the reporting period for the eligible offsets project;

(ii) must be performed at least once every 12 months;

(b) for all relevant equations:

(i) n = number of combustion devices;

(ii) h denotes a combustion device;

(c) unless otherwise specified, a reference to a project is a reference to an eligible offsets project that meets the requirements of Part 2; and

(d) if a calculation in this Division refers to a factor or parameter prescribed in the NGER Measurement Determination or the NGER Regulations, the person carrying out the calculations must apply, to the entire offsets reporting period, the NGER Measurement Determination or NGER Regulations in force at the time that the offsets report was submitted or was required to be submitted, whichever occurs first.

### 4.3 Calculating the baseline for the project

(1) For paragraph 106(4)(f) of the Act, the baseline for a project is the methane that would have been generated and released from each lagoon included in the project, for each year of the project, in the absence of the abatement activity.

(2) The project baseline must be calculated based on the amount of volatile solids (VS) in the effluent stream deposited into each lagoon included in the project.

(3) The amount of VS in the effluent stream must be calculated using the PigBal model.

(4) Project proponents must input all required data into the PigBal model to calculate VS in accordance with the procedures and requirements set out in the PigBal Manual.

## Subdivision 4.2.2 Baseline emissions ($E_b$)

### 4.4 Calculating the baseline methane emissions

Baseline methane emissions must be calculated using the following formula:

| $E_b = \gamma Q_b$ | **Equation 1.1** |
|---|---|

Where:

$\mathbf{E_b}$ = methane emissions from the operation of uncovered anaerobic treatment lagoons within the project site in the absence of the project, in tonnes of $CO_2$-e.

$\boldsymbol{\gamma}$ = the factor 6.784 x $10^{-4}$ x $GWP_{CH_4}$, which converts cubic metres of methane to tonnes of $CO_2$-e at standard conditions.

$\mathbf{Q_b}$ = volume of methane that would be released from the operation of uncovered anaerobic treatment lagoons within the project site in the absence of the project, in cubic metres of methane ($m^3$ $CH_4$) at standard conditions, calculated using Equation 1.2.

### 4.5 Calculating the volume of methane

The volume of methane that would be emitted from the operation of uncovered anaerobic treatment lagoons within the project site in the absence of the project must be calculated using the following formula:

| $Q_b = VS \times Bo \times MCF$ | **Equation 1.2** |
|---|---|

Where:

**$Q_b$** = volume of methane that would be released from the operation of uncovered anaerobic treatment lagoons within the project site, in the absence of the project, in cubic metres of methane ($m^3$ $CH_4$) at standard conditions.

**VS** = quantity of Volatile Solids entering the project lagoons, in kilograms, calculated using the PigBal model in accordance with the PigBal Manual.

**Bo** = 0.45, which is the maximum methane-producing capacity from VS for pigs, in units of cubic metres of methane per kilogram of VS ($m^3$ $CH_4$/kg VS).

**MCF** = methane conversion factor which reflects that portion of Bo that is achieved under temperature and treatment specifications. For anaerobic lagoons across Australia this is 0.9.

## Subdivision 4.2.3 Calculating the carbon dioxide equivalent net abatement amount

### 4.6 Calculating net greenhouse gas abatement (A)

The carbon dioxide equivalent net abatement amount must be calculated using the following formula:

| $A = (A_p - Y_p)$ | **Equation 2.1** |
|---|---|

Where:

**A** = net greenhouse gas abatement due to the project, in tonnes of $CO_2$-e.

**$A_p$** = quantity of emissions avoided as a consequence of the project in tonnes of $CO_2$-e, as calculated in Equation 2.2 or Equation 3.1 as applicable.

**$Y_p$**= emissions from fuel and/or grid derived electricity used to operate gas capture and combustion equipment for the purpose of the project, measured in tonnes of $CO_2$-e as calculated in accordance with Equation 4.1.

## Subdivision 4.2.4 Calculating $A_p$

### 4.7 Calculating avoided greenhouse gas emissions ($A_p$)

(1) Subject to subsection (2), avoided greenhouse gas emissions must be calculated using the following formula:

| | |
|---|---|
| $\mathbf{A_p = \gamma \sum_{h=1}^{n} Q_{com,h} - E_{N_2O}}$ | **Equation 2.2** |

Where:

$\mathbf{A_p}$ = quantity of emissions avoided as a consequence of the project, in tonnes of $CO_2$-e.

$\boldsymbol{\gamma}$ = the factor 6.784 x $10^{-4}$ x $GWP_{CH_4}$, which converts cubic metres of methane to tonnes of $CO_2$-e at standard conditions.

$\mathbf{Q_{com,h}}$ = volume of methane destroyed by combustion device h, in cubic metres ($m^3$) and capped according to section 4.11.

$\mathbf{E_{N_2O}}$ = quantity of nitrous oxide emissions released as a result of methane destruction from all combustion devices, in tonnes of $CO_2$-e.

(2) If the requirements set out in subsection 4.13(1) are met, a project proponent may calculate $A_p$ by substituting Equation 3.1 for Equation 2.2.

## Subdivision 4.2.5 Calculating $Q_{com,h}$

### 4.8 Calculating volume of methane destroyed by combustion device ($Q_{com,h}$)

The volume of methane destroyed by a combustion device is to be calculated using the following formula:

| | |
|---|---|
| $\mathbf{Q_{com,h} = Q_{CH_4,h} \times DE_h}$ | **Equation 2.3** |

Where:

$\mathbf{Q_{com,h}}$ = capped volume of methane destroyed by combustion device h, in cubic metres ($m^3$) and capped according to section 4.11.

$\mathbf{Q_{CH_4,h}}$ = volume of methane sent to combustion device h, in cubic metres ($m^3$) as calculated in Equation 2.4.

$\mathbf{DE_h}$ = methane destruction efficiency for device h, as a fraction, as determined in accordance with sections 3.2 and 4.9.

### 4.9 Determining the destruction efficiency of combustion device ($DE_h$)

(1) For an open flare, a default value of 0.98 must be used for the destruction efficiency of the device.

(2) Subject to subsection (4), the destruction efficiency of enclosed flares or internal combustion engines may be either:

(a) a default value of 0.98; or

(b) measured in accordance with Division 4.3.

(3) Subject to subsection (4), the destruction efficiency of a gas boiler system has a default value of 0.98.

(4) A default destruction efficiency of 0.98 may be used only if the combustion device is installed and operated in accordance with the requirements set out by the manufacturer.

## Subdivision 4.2.6 Calculating $Q_{CH_4,h}$

### 4.10 Calculating the volume of methane

(1) The volume of methane is to be calculated using the following formula:

| $Q_{CH_4,h} = Q_{biogas,h} \times W_{CH_4}$ | **Equation 2.4** |
|---|---|

Where:

$Q_{CH_4,h}$ = volume of methane sent to combustion device h, in cubic metres ($m^3$).

$Q_{biogas,h}$ = volume of biogas sent to combustion device h, adjusted to conditions, in cubic metres ($m^3$).

$W_{CH_4}$ = the proportion of the volume of biogas that is methane.

(2) To calculate $W_{CH_4}$ either:

(a) a default value of 0.70 may be used (70% of the biogas released from uncovered lagoons as defined in the NGER Measurement Determination); or

(b) the proportion of the volume of biogas that is methane may be measured in accordance with Division 4.3.

(3) Where volumetric measurements have not been adjusted to standard conditions based on actual temperature and pressure readings of the biogas, $Q_{biogas,h}$ must be multiplied by 0.97 before multiplying by $W_{CH_4}$.

(4) If:

(a) more than one combustion device is installed; and

(b) the devices have the same destruction efficiency as determined in accordance with section 4.9;

then for the purposes of calculating $Q_{CH_4,h}$ the devices may be considered as one device.

***Note*** A single flow meter may be used to measure $Q_{biogas,h}$ for all combustion devices that have the same destruction efficiency.

(5) Subject to subsection (6), in the event of a failure of one or more of the combustion devices referred to in paragraph (4)(a), a project proponent must:

(a) document the type of device and the date and duration of the failure;

(b) adjust the value of $Q_{CH_4,h}$ to account for methane not combusted; and

(c) demonstrate how the adjustment referred to in paragraph (b) was made.

***Note*** An example of how the adjustment referred to in paragraph (5)(b) may be demonstrated is by using deductions based on estimations of methane combusted from electricity generated.

(6) If the requirements of subsection (5) cannot be met for one or more devices, then the destruction efficiency of that device or those devices will be zero for the duration of the failure referred to in subsection (5).

### 4.11 Capping the volume of methane

(1) $Q_b$ (calculated using Equation 1.2) and $\sum_{h=1}^{n} Q_{com,h}$ (calculated using Equation 2.4) must be estimated over the same time period and at least once every 12 months.

(2) If the value of the volume of methane destroyed by all combustion devices ($\sum_{h=1}^{n} Q_{com,h}$) is greater than the value for baseline methane emissions ($Q_b$), the value for $Q_b$ must be used instead of the value for $\sum_{h=1}^{n} Q_{com,h}$ in Equation 2.2.

## Subdivision 4.2.7 Calculating $E_{N_2O}$

### 4.12 Calculating nitrous oxide emissions

(1) Subject to subsection (2), nitrous oxide emissions released as a result of methane destruction must be calculated using the following formula:

| | |
|---|---|
| $\mathbf{E_{N_2O}} = \sum_{\mathbf{h=1}}^{\mathbf{n}} \left( \mathbf{Q_{com,h}} \times \mathbf{EC\ biogas} \times \frac{\mathbf{EF_{N_2O}}}{\mathbf{1000}} \right)$ | **Equation 2.5** |

Where:

$\mathbf{E_{N_2O}}$ = quantity of nitrous oxide emissions released as a result of methane destruction from all combustion devices, in tonnes of $CO_2$-e.

$\mathbf{Q_{com,h}}$ = capped volume of methane destroyed by combustion device h, in cubic metres ($m^3$) as calculated in Equation 2.3.

**EC biogas** = energy content of biogas, in gigajoules per cubic metre ($GJ/m^3$), in accordance with the relevant energy content factors in Schedule 1 of the NGER Measurement Determination.

**$EF_{N_2O}$** = emissions factor for nitrous oxide emitted during the combustion of biogas in kilograms of $CO_2$-e per gigajoule of energy (kg $CO_2$-e/GJ) as prescribed in Schedule 1 of the NGER Measurement Determination.

(2) If section 4.13 applies, then $E_{N_2O}$ must be calculated using the following formula:

| | |
|---|---|
| $$E_{N_2O} = \frac{QE}{DE_h} \times \frac{EF_{N_2O}}{1000}$$ | **Equation 2.5(a)** |

Where:

**$E_{N_2O}$** = quantity of nitrous oxide emissions released as a result of methane destruction from all combustion devices, in tonnes of $CO_2$-e.

**QE** = energy content of the methane sent to the internal combustion engine, in gigajoules (GJ), calculated using Equation 3.3.

**$DE_h$**= destruction efficiency for the internal combustion engine generator, expressed as a fraction. For an internal combustion engine h, the default value is 0.98, or the methane destruction efficiency of the device can be determined in accordance with section 4.17.

**$EF_{N_2O}$** = emissions factor for nitrous oxide emitted during the combustion of biogas in kilograms of $CO_2$-e per gigajoule of energy (kg $CO_2$-e /GJ) in accordance with Schedule 1 of the NGER Measurement Determination.

## Subdivision 4.2.8 Calculating emissions combusted in an internal combustion engine

### 4.13 Quantity of emissions combusted in an internal combustion engine—optional calculations

(1) This section applies if:

(a) an offsets project to which this methodology determination applies uses one or more internal combustion engines as a combustion device; and

(b) the project proponent elects to calculate the quantity of methane destroyed by internal combustion engines ($A_{com,ice}$) from the amount of electricity produced by an internal combustion engine generator ($Ep_h$) measured in megawatt hours); and

(c) the quantity of methane destroyed by internal combustion engines is not included in the total volume of methane destroyed from all the remaining combustion devices for which Equation 2.2 is used ($\sum_{h=1}^{n} Q_{com,h}$).

*Alternative Calculation for $A_p$*

(2) If the conditions specified in subsection (1) apply and $A_{com,ice}$ is to be calculated in accordance with subsection (3), then $A_p$ is to be calculated using the following formula:

| | |
|---|---|
| $$\mathbf{A_p} = \left[\left(\boldsymbol{\gamma} \sum_{\mathbf{h=1}}^{\mathbf{n}} \mathbf{Q_{com,h}}\right) + \mathbf{A_{com,ice}}\right] - \mathbf{E_{N_2O}}$$ | **Equation 3.1** |

Where:

$\mathbf{A_p}$ = quantity of methane emissions avoided as a consequence of the project, minus nitrous oxide emissions generated from the destruction of methane, in tonnes of $CO_2$-e.

$\boldsymbol{\gamma}$ = the factor 6.784 x $10^{-4}$ x $GWP_{CH_4}$, which converts cubic metres of methane at standard conditions to tonnes of $CO_2$-e.

$\mathbf{Q_{com,h}}$ = capped volume of methane destroyed by combustion device h, other than internal combustion engines, in cubic metres ($m^3$) as calculated in Equation 2.3.

$\mathbf{A_{com,ice}}$ = amount of methane destroyed as a consequence of one or more internal combustion engines, in tonnes of $CO_2$-e.

$\mathbf{E_{N_2O}}$ = quantity of nitrous oxide emissions released as a result of methane destruction from all combustion devices, in tonnes of $CO_2$-e.

(3) $A_{com,ice}$ is to be calculated using the following formula:

| | |
|---|---|
| $$\mathbf{A_{com,ice}} = \left(\sum_{\mathbf{h=1}}^{\mathbf{n}} \mathbf{QE_h} \times \mathbf{DE_h}\right) \times \mathbf{CH_4\ conversion\ factor} \times \mathbf{GWP_{CH_4}}$$ | **Equation 3.2** |

Where:

$\mathbf{A_{com,ice}}$ = amount of methane destroyed as a consequence of one or more internal combustion engines, in tonnes of $CO_2$-e.

$\mathbf{QE_h}$ = energy content of the methane sent to the internal combustion engine, h, in gigajoules (GJ) calculated in accordance with Equation 3.3.

$\mathbf{DE_h}$ = methane destruction efficiency for the internal combustion engine generator, expressed as a fraction. For

an internal combustion engine h, the default value is 0.98, or the destruction efficiency of the device can be determined in accordance with section 4.17.

**$CH_4$ conversion factor** = methane conversion factor of 0.018, to convert gigajoules to tonnes of methane.

**$GWP_{CH_4}$** = means the global warming potential of methane, as prescribed in the NGER Regulations.

(4) QE is to be calculated using the following formula:

| | |
|---|---|
| $$QE = \frac{Ep_h \times E_{GJ}}{Eff}$$ | **Equation 3.3** |

Where:

**QE** = energy content of the methane sent to the internal combustion engine, in gigajoules (GJ).

**$Ep_h$** = amount of electricity (supplied to the grid or used on-site) produced by the internal combustion engine, as a result of combustion of methane, in megawatt hours (MWh).

**$E_{GJ}$** = energy in GJ per megawatt hours (MWh) = 3.6.

**Eff** = electrical efficiency factor (as a fraction) for the internal combustion engine for conversion of energy to electricity as per the manufacturer's specifications for the equipment. If there is no value specified by the manufacturer, a default value of 36% (0.36 as a fraction) must be used for inclusion in Equation 3.3 as outlined in the NGER Measurement Determination.

## Subdivision 4.2.9 Calculating emissions from fuel and grid-derived electricity used to operate the gas extraction system in the project ($Y_p$)

### 4.14 Calculating emissions from electricity and fuel use

(1) To calculate the total emissions from the use of fuel and electricity for the operation of gas capture and combustion equipment (Yp) the following formula must be applied:

| | |
|---|---|
| $$Yp = (E_f + E_{elec})$$ | **Equation 4.1** |

Where:

**Yp** = direct and indirect emissions from fuel and/or electricity used to operate gas capture and combustion equipment, measured in tonnes of $CO_2$-e.

**$E_f$** = total emissions from fuel use, measured in tonnes of $CO_2$-e.

**$E_{elec}$** = total emissions from consumption of purchased electricity, measured in tonnes of $CO_2$-e.

(2) Emissions from fuel and electricity use must be estimated using the energy content and emission factors prescribed in Schedule 1 of the NGER Measurement Determination.

***Note*** These factors are also included, with worked examples, in the National Greenhouse Accounts Factors and are available at www.climatechange.gov.au

## 4.15 Calculating total emissions from fuel use ($E_f$)

(1) Emissions from fuel use ($E_{ij}$) must be calculated for each fuel type (i) and each greenhouse gas (j) ($CO_2$, $N_2O$, $CH_4$) using the following formula:

| | |
|---|---|
| $$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1000}$$ | **Equation 4.2** |

Where:

**$E_{ij}$** = emissions from fuel type (i) of greenhouse gas (j) in tonnes of $CO_2$-e.

**$Q_i$** = quantity of fuel type (i), measured in cubic metres, kilolitres or gigajoules.

**$EC_i$** = energy content factor of fuel type (i) (gigajoules per kilolitre or gigajoules per cubic metres), as prescribed in Schedule 1 of the NGER Measurement Determination.

**$EF_{ijoxec}$** = emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (in kilograms of $CO_2$-e per gigajoule), calculated using the relevant emission factor set out in Schedule 1 of the NGER Measurement Determination.

***Note*** If $Q_i$ is measured in gigajoules, then $EC_i$ is not required.

(2) Total emissions from fuel used (including supplemental natural gas) to operate the gas capture and combustion system ($E_f$) is to be calculated using the following formula:

| | |
|---|---|
| $\mathbf{E_f} = \sum_{i=1}^{n} \sum_{j=1}^{N} \mathbf{E_{i,j}}$ | **Equation 4.3** |

Where:

$\mathbf{E_f}$ = total emissions from fuel use, in tonnes of $CO_2$-e.

**j** = greenhouse gas type ($CO_2$, $N_2O$, $CH_4$).

**i** = fuel type.

## 4.16 Emissions from the consumption of purchased electricity ($E_{elec}$)

(1) Total emissions from the consumption of purchased electricity used to operate the gas capture and combustion system ($E_{elec}$) is to be calculated as follows:

(a) for the consumption of grid derived electricity that occurred before 1 July 2012—in accordance with Equation 4.4; and

(b) where the project uses grid derived electricity after 1 July 2012—$E_{elec}$ is taken to be zero.

(2) For paragraph (1)(a), $E_{elec}$ must be calculated as follows:

| | |
|---|---|
| $\mathbf{E_{elec}} = \mathbf{Q_{elec}} \times \frac{\mathbf{EF}}{\mathbf{1000}}$ | **Equation 4.4** |

Where:

$\mathbf{E_{elec}}$= total emissions from consumption of purchased electricity used to operate the landfill gas extraction system, in tonnes of $CO_2$-e.

$\mathbf{Q_{elec}}$ = quantity of electricity purchased from the electricity grid (kilowatt hours). If $Q_{elec}$ is measured in gigajoules, the quantity of kilowatt hours must be calculated by dividing the amount of gigajoules by the conversion factor of 0.0036.

**EF** = the scope 2 emissions factor for the State, Territory or electricity grid in which consumption occurs as prescribed in Part 6 of Schedule 1 of the NGER Measurement Determination, in kg $CO_2$-e per kilowatt hour.

## Division 4.3 Data collection

### 4.17 Data collection procedures and measurement frequency

A project proponent must measure the matters specified in the following table, in the manner and frequency specified, for the purposes of calculating baseline emissions and removals and project emissions.

*Table of parameters to be measured*

| Parameter | Description | Unit | Measurement Procedure | Measurement Frequency |
|---|---|---|---|---|
| **PigBal inputs to determine VS** | | | | |
| Pig numbers | The number of pigs in each class housed in the shed. | Number per class<br>(class as defined within the worksheet entitled "Herd Input Data" in the PigBal workbook). | From shed records. | Monthly; or following destocking, herd expansion or herd mix changes, weekly until numbers stabilise. |
| Feed used | For each type of feed mix used, the weight delivered to the facility minus the stockpile remaining each year. | Kg feed type as defined within the worksheet entitled "Feed Details" in the PigBal workbook. | From delivery records. | Monthly. |
| Pre-treatment screening | Presence or absence of screens. | As defined within the worksheet entitled "Assumptions" in the PigBal workbook. | From shed maintenance records. | Addition or removal. |

| Parameter | Description | Unit | Measurement Procedure | Measurement Frequency |
|---|---|---|---|---|
| **Data collection for abatement calculations** | | | | |
| $Q_{biogas,h}$ | Quantity of biogas sent to combustion device h. | Cubic metres ($m^3$). | The standards and protocol for measurement are outlined at section 4.18. | Continuous monitoring—an average value in a time interval not greater than 1 hour. |
| Flare operating conditions | Flare operation detection, and for enclosed flares, the flame temperature. | All flares—on or off;<br>and<br>enclosed flares—degrees Celsius. | All flares—automated flame detection using an ultraviolet beam sensor, thermocouple, temperature sensor, or equivalent device. | Continuous monitoring with at least one record every 20 minutes. |
| $DE_h$ | Methane destruction efficiency for device h. | % | Open flares:<br>- Default: 98% (factor of 0.98).<br>Enclosed flares:<br>- Measured efficiency. Duplicate compliance testing, measured every 6 months, by a NATA accredited emission stack testing company, using a method based on US EPA Method 18 or US EPA Method 3C.<br>- Default: 98% (factor of 0.98).<br>Internal combustion engine:<br>- Measured efficiency. Duplicate compliance | Every 6 months if using measured efficiency by a testing company, or not applicable if using the default value. |

| Parameter | Description | Unit | Measurement Procedure | Measurement Frequency |
|---|---|---|---|---|
| | | | testing, measured every 6 months, by a NATA accredited emission stack testing company, using a method based on US EPA Method 18 or US EPA Method 3C;<br>or<br>- Not measured if amount of methane combusted is calculated from amount of electricity (MWh) produced in accordance with section 4.13.<br>- Default: 98% (factor of 0.98).<br>Gas boiler:<br>- Default: 98% (factor of 0.98). | |
| $W_{CH_4}$ | The proportion of the volume of biogas that is methane, as a percentage. | The fraction of cubic metres of methane in the cubic metres of biogas ($m^3CH_4/m^3$). | A default methane proportion of the gas may be used. This default proportion is 70%.<br>Otherwise the methane fraction must be measured, as described below:<br>- using an inline gas analyser; or<br>- samples of the biogas are collected and sent to a laboratory for analysis.<br>See section 4.19 for further details. | Continuous, if using inline gas analyser;<br>or<br>monthly, if sampling (laboratory analysis). |

| Parameter | Description | Unit | Measurement Procedure | Measurement Frequency |
|---|---|---|---|---|
| Electricity used<br>$Q_{elec}$ | Quantity of electricity used for the operation of gas capture and combustion equipment. | Kilowatt hours (kWh). | Meter measuring the electricity used by equipment installed, the electricity usage is the value from that meter.<br><br>Electricity used to operate the biogas capture and combustion equipment can be estimated as a proportion of the total electricity used on the property. Project proponents must provide a justification for the estimates. | If submetering is used, then monthly.<br><br>If estimated from invoices, then estimate from total electricity used for the reporting period. |
| Fuel used<br>$Q_i$ | Quantity of fuel type (i). | For liquid fuels, measured in kilolitres (kL), or for gaseous fuels, measured in $m^3$ unless otherwise specified in the NGER Measurement Determination. | For each fuel used (for example, diesel or LPG) the amount must be estimated as a proportion of totals for the project activities.<br>The estimation can be made from a reading from a meter or from invoices.<br>Manufacturer's specifications will assist with these estimates for the gas capture and combustion component. | At least once during the reporting period. |
| $Ep_h$ | Quantity of electricity produced by methane combustion in the internal combustion engine generator. | MWh | Meter data, recording electricity sent to the grid; meter data recording electricity produced by internal combustion engine generator (for electricity used on site). The accuracy of the meter used must be equivalent | Total amount of electricity produced during the reporting period. |

| Parameter | Description | Unit | Measurement Procedure | Measurement Frequency |
|---|---|---|---|---|
| | | | of a revenue meter; or meter data recording electricity sent to the grid. | |
| Electrical Efficiency Factor (Eff) | The electrical efficiency factor of the internal combustion engine generator. | % | As specified by the manufacturer of the generator in the technical manual for the equipment or the default value of 36% (as outlined in the *Greenhouse Gas Benchmark Rule (Generation) No. 2 of 2003* (NSW) as amended). | Set value as per manufacturer's specification or default. |

***Note*** The *Greenhouse Gas Benchmark Rule (Generation) No. 2 of 2003* is available at www.greenhousegas.nsw.gov.au/documents/syn62.asp.

### 4.18 Volumetric measurement—quantity of biogas sent to combustion device h ($Q_{biogas, h}$)

(1) When measuring $Q_{biogas, h}$ the requirements set out in this section apply.

(2) Gas flow must be measured:

(a) at the delivery location of the gaseous fuel;

(b) using a gas volumetric flow meter that uses a continuous monitoring system; and

(c) in cubic metres per hour ($m^3$ per hour).

(3) Subject to subsection (2), gas flow must be measured using equipment that:

(a) is rated for use with a process gas/biogas/dirty stream;

(b) is rated for use at the expected flow rate and pressure;

(c) is designed for use in the anticipated operating temperature range; and

(d) has a meter that is accurate to +/-5% for flow measurement.

(4) Gas flow must be continuously recorded and integrated using an integration device that is isolated from the flow computer in such a way that if the computer fails, the integration device will retain the last reading, or the previously stored information, that was on the computer immediately before the failure.

## 4.19 Measurement of $W_{CH_4}$ methane percentage in biogas

(1) To measure the percentage of methane in biogas ($W_{CH_4}$) a project proponent must either:

(a) use the default value of 70% as specified in the NGER Measurement Determination; or

(b) measure the composition of biogas at the project site using an inline gas analyser or by analysis in a laboratory.

(2) Where a project proponent elects to measure the composition of biogas in accordance with paragraph (1)(b) the following requirements apply:

(a) where an inline gas analyser is used to measure gas composition:

(i) paired values of the methane fraction of the gas and gas flow that are averaged for the same time interval must be used in the calculation of emission reductions; and

(ii) measurement of the methane fraction must occur at the same time as flow measurement;

(b) where the composition of biogas is measured using biogas samples analysed in a laboratory:

(i) gas composition samples must be taken at the delivery location of the gaseous fuel;

(ii) gas composition samples must be taken on a regular basis, occurring no less than once per month;

(iii) the sampling vessel must be set up to provide a time period for the instrument to stabilise and carry out initial checks in accordance with the instrument provided by the manufacturer;

(iv) there must be no leaks in the sampling train or between the sampling train and the instrument; and

(v) gas samples must be analysed:

(A) using US EPA Method 18 or US EPA Method 3C using gas chromatography, or an equivalent Australian or international standard; and

(B) in a NATA accredited laboratory;

based on triplicate samples collected in accordance with subparagraph (ii); and

(c) all measurements must be taken in accordance with the instrument manufacturer's instructions and the Australian and New Zealand standards.

# Part 5 Monitoring, record-keeping and reporting requirements

***Note*** See subsection 106(3) of the Act.

## Division 5.1 General

### 5.1 Application

For the purposes of subsection 106(3) of the Act, a project proponent of an offsets project to which this Determination applies must comply with the monitoring, record-keeping and reporting requirements of this Part.

## Division 5.2 Monitoring requirements

### 5.2 Monitoring requirements

*Frequency of recording of PigBal inputs*

(1) Subject to subsection (2), a project proponent must monitor and record the following data, as set out in the PigBal Manual, no less than once per month:

(a) herd data;

(b) herd performance data where this data is necessary in accordance with the conditions set out in the PigBal Manual;

(c) piggery feed usage data; and

(d) diet analysis.

(2) Where destocking, herd expansion, or herd mix changes have occurred, the herd data specified in paragraphs (1)(a) and (1)(b) must be monitored and recorded weekly until numbers stabilise.

*Gas measurement error margins*

(3) The measurement of gas pressures must be carried out using equipment that complies with the following accuracy requirements:

(a) pressure $<\pm 0.5\%$; and

(b) differential pressure $<\pm 0.5\%$.

### 5.3 Quality assurance and quality control

(1) All monitoring instruments must be:

(a) cleaned and inspected on a regular basis to ensure the equipment operates within an accuracy threshold of +/-5%, with the activities performed and the "as found/as left" condition of the equipment documented;

(b) field checked for calibration accuracy, with the per cent drift documented, within 2 months before the end of the reporting period by a third-party technician:

(i) using an appropriate instrument or apparatus; or

(ii) as per the manufacturer's guidance;

(c) calibrated by the manufacturer or an accredited third-party calibration service as per the manufacturer's guidance, or every 5 years, whichever occurs with greater frequency.

(2) Field checks of monitoring instruments must determine whether the instrument reads measurement within the accuracy threshold of +/-5%.

(3) If a field check of a monitoring instrument determines that its accuracy is outside of the accuracy threshold of +/-5% then the instrument must be calibrated by the manufacturer or an accredited third-party calibration service. The calibration must ensure that the instrument reads measurement within the accuracy threshold of +/-5%.

(4) All combustion devices must be installed, operated and maintained in accordance with the manufacturer's guidance.

## Division 5.3 Record-keeping requirements

### 5.4 Records that must be kept

The project proponent must make and keep records of the information specified in this Division.

### 5.5 General information

The following information must be recorded and kept for general purposes:

(a) all maintenance records for monitoring instruments and combustion devices;

(b) logs of operations of the combustion device including notation of all shut-downs, start-ups, process adjustments;

(c) evidence of corrective measures taken if monitoring instruments do not meet the accuracy threshold specified in section 5.2; and

(d) if default values are not used for methane destruction efficiency—certificates from the stack testing laboratory showing measured methane destruction efficiency.

## 5.6 Project information

The following information must be recorded and kept for calculating and verifying emissions:

(a) pig number and classes;

(b) type and quantity of feed;

(c) pre-screening of waste;

(d) number of project lagoons;

(e) lagoon dimensions;

(f) climate data (within the meaning provided in the PigBal model); and

(g) calculations of VS.

## 5.7 Combustion devices

The following information must be recorded and kept in relation to combustion devices:

(a) combustion device information including the model, serial number, and calibration procedures for the device;

(b) combustion device monitoring data for each device;

(c) for combustion device failures:

(i) the number of failures;

(ii) the date and duration of the failures; and

(iii) adjustments and calculations made to account for methane not combusted; and

(d) combustion device calibration data for each device.

## 5.8 Monitoring equipment

The following information must be kept in relation to monitoring instruments:

(a) gas flow meter information including the model, serial number and calibration procedures for the instrument; and

(b) gas flow meter calibration data for each flow meter.

## 5.9 Gas composition

The following information must be kept in relation to site determination of gas composition:

(a) gas analyser information if used, including the model, serial number and calibration procedures for the instrument;

(b) gas analyser calibration data for each gas analyser; and

(c) gas quality data (including particulate content and humidity).

## 5.10 Direct and indirect measurement

The following information must be kept in an auditable form in relation to direct and indirect measurement:

(a) records of any raw data and site observations relating to the gas capture and combustion system and parameters entered into PigBal;

(b) all values and calculations used in baseline calculations;

(c) all values and calculations used to calculate net greenhouse gas abatement;

(d) monthly and annual $CO_2$-e tonnage calculations; and

(e) electronic recording of values of logged primary parameters for each measurement interval, for each meter, including:

(i) gas flow data for each flow meter;

(ii) temperature data from the temperature measurement device for each device, if the device uses a temperature system to detect performance and failure;

(iii) operation and non-operation data for flares, as required under section 3.2;

(iv) methane content of gas (% by volume) for each measurement (if default value not used) including date, time and location of measurement, notes of non-compliance to performance specifications, remedial actions taken to correct instrument;

(v) auditable evidence of fuel use;

(vi) auditable evidence of the grid-delivered electricity use; and

(vii) auditable evidence of amount of electricity produced by the internal combustion engine generator if section 4.13 applies.

## Division 5.4 Offsets report requirements

### 5.11 Report requirements

Project proponents must submit:

(a) a report for the first reporting period; and

(b) further reports for subsequent reporting periods.

### 5.12 First reporting period

(1) The first report must be submitted at the end of the first reporting period.

(2) The following information is required to be provided in the first report:

(a) net greenhouse gas abatement number;

(b) independent audit report;

(c) quantity of methane generated under baseline conditions in tonnes of $CO_2$-e;

(d) total volume of methane sent to combustion devices, in cubic metres (sum of $Q_{CH_4,h}$);

(e) destruction efficiencies of combustion devices (if default values not used);

(f) the number of combustion device failures that exceeded 20 minutes duration and any periods where there were no records of operation;

(g) total amount of fuel and/or electricity used by the project, in kilolitres (kL), cubic metres ($m^3$), or kilowatt hours (kWh); and

(h) electrical efficiency (Eff) of the internal combustion engine generator.

### 5.13 Subsequent reporting periods

(1) Ongoing reports must be submitted at the end of each subsequent reporting period.

(2) The following information is required to be provided in subsequent reports:

(a) net greenhouse gas abatement number;

(b) independent audit report;

(c) quantity of methane generated under baseline conditions, in tonnes of $CO_2$-e;

(d) total volume of methane sent to combustion devices, in cubic metres (sum of $Q_{CH_4,h}$);

(e) destruction efficiencies of combustion devices (if default values not used);

(f) the number of combustion device failures that exceeded 20 minutes duration and any periods where there were no records of operation;

(g) total amount of fuel and/or electricity used by the project, in kilolitres (kL), cubic metres ($m^3$) or kilowatt hours (kWh); and

(h) electrical efficiency (Eff) of the internal combustion engine generator.

**Note**

1. All legislative instruments and compilations are registered on the Federal Register of Legislative Instruments kept under the *Legislative Instruments Act 2003*. See http://www.frli.gov.au.