

Carbon Farming (Destruction of Methane Generated from Manure in Piggeries) Methodology Determination 2012

*Carbon Credits (Carbon Farming Initiative) Act 2011*

I, MARK DREYFUS, Parliamentary Secretary for Climate Change and Energy Efficiency, make this methodology determination under subsection 106 (1) of the *Carbon Credits (Carbon Farming Initiative) Act 2011*.

Dated 27 June 2012

MARK DREYFUS

Parliamentary Secretary for Climate Change and Energy Efficiency

**Part 1 Preliminary**

* 1. **Name of Determination**

This methodology determination is the *Carbon Farming (Destruction of Methane Generated from Manure in Piggeries) Methodology Determination 2012.*

* 1. **Commencement**

This methodology determination commences on 1 July 2010.

* 1. **Application**

This methodology 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.

* 1. **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 when bacteria degrade biological material in the absence of oxygen, in a process known as anaerobic decomposition.

***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 the system used to combust biogas produced by anaerobic decomposition, 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.

***internal combustion engine*** means an [engine](http://en.wikipedia.org/wiki/Engine) in which the [combustion](http://en.wikipedia.org/wiki/Combustion) of a [fuel](http://en.wikipedia.org/wiki/Fuel) occurs with an oxidizer in a [combustion chamber](http://en.wikipedia.org/wiki/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 determination of that name made under subsection 10 (3) of the *National Greenhouse and Energy Reporting Act 2007* as in force from time to time.

***NGER Regulations***means the regulations made under the *National Greenhouse and Energy Reporting Act 2007* as in force from time to time.

***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 Queensland Department of Primary Industries, which is used to calculate nutrient and salt content in the waste effluent from a piggery and is comprised of:

* the PigBal Manual; and
* the PigBal workbook,

and is available at: http://www.climatechange.gov.au

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

***US EPA Method*** means the test method approved by the United States Environmental Protection Agency by the same name as amended from time to time.

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

*Note: Several other words and expressions used in this methodology determination have the meaning given by section 5 of the Act, for example:*

* baseline;
* carbon dioxide equivalence;
* eligible offsets project;
* emission;
* methodology determination;
* National Inventory Report;
* offsets project;
* offsets report;
* project;
* project area;
* project proponent; and
* reporting period.

**Part 2 Requirements that must be met for an offsets project to be an eligible offsets project**

* 1. **Requirements that must be met for an offsets project to be an eligible offsets project**
1. For paragraph 106 (1) (b) of the Act, this section sets out the requirements that must be met for an offsets project to which this methodology determination applies to be an eligible offsets project.
2. The project must consist of the following activities:
	1. using covered lagoons to prevent release of biogas containing methane;
	2. collecting the gas from the covered lagoon; and
	3. combusting the methane component in the gas to convert it to carbon dioxide.
3. The abatement activity must be performed at piggeries where anaerobic treatment of effluent is performed through the use of lagoons that:
	1. have a minimum depth of 2 metres; and
	2. 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: A link to the National Environmental Guidelines for Piggeries 2010 is*

*available at:* http://www.climatechange.gov.au

1. The input to the lagoon must only consist of effluent from the operation of piggery sheds in the project.
2. Any flaring system used in the project must:
3. use a frequently sparking flare (every 2 seconds) to ensure continuous destruction of methane; or
4. include a control system that prevents gas flow through the flare when the flare is not operational.
5. In circumstances where the flaring system includes a control system in accordance with paragraph 2.1 (5) (b) the following requirements apply:
	1. the flaring system must include a temperature monitoring system that ensures the flare is operating at the temperature required for complete combustion of methane; and
	2. when the flare temperature drops below the temperature required for complete combustion of methane, the control system must shut down biogas flow through the flare.

**Part 3 Calculating the carbon dioxide equivalent net abatement amount for a project in relation to a reporting period**

**Division 3.1 Preliminary**

* 1. **General**
1. For paragraph 106 (1) (c) of the Act, this Part sets out requirements that must be met to ascertain the carbon dioxide equivalent net abatement amount for an offsets project to which this methodology determination applies.
2. In this Part:
3. all calculations are in respect of activities undertaken, or outcomes achieved, during the reporting period for the offsets project;
4. for all relevant equations:
	1. n = number of combustion devices;
	2. h denotes a combustion device; and
5. if a calculation in Division 3.2 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.
6. The data used in the calculations set out in Division 3.2 must comply with the data collection requirements set out in Division 3.3.
	1. **Greenhouse gas assessment boundary**
7. The following greenhouse gases from the following sources within the project must be taken into account when making calculations under this Part. No other gases may be taken into account.

 *Table of gases accounted for in the abatement calculations*

|  |  *Source*  | *Greenhouse gas/carbon pools* |
| --- | --- | --- |
| *Baseline* | Greenhouse gas emissions from anaerobically treated waste in project lagoons | Methane (CH4) |
| *Project Activity* | Electricity from the grid and fuel used for gas capture and combustion | Carbon dioxide (CO2) |
| Methane (CH4) |
| Nitrous oxide (N2O) |
| Gas capture and combustion via internal combustion engine | Methane (CH4) |
| Nitrous oxide (N2O) |
| Gas capture and combustion via gas boiler use to heat water or generate steam | Methane (CH4) |
| Nitrous oxide (N2O) |
| Gas capture and combustion via flaring | Methane (CH4) |
| Nitrous oxide (N2O) |

* 1. **Calculating the baseline for the offsets 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. 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.

**Division 3.2 Calculations**

* 1. **General**

All calculations undertaken with this Division must be performed at least once every 12 months.

**Subdivision 3.2.1 Calculating baseline emissions (Eb)**

* 1. **Calculating the baseline methane emissions**

Baseline methane emissions must be calculated using the following formula:

|  |  |
| --- | --- |
| $$E\_{b}=γQ\_{b}$$ | **Equation 1.1** |

where:

**Eb** = methane emissions from the operation of uncovered anaerobic treatment lagoons within the project site in the absence of the project, in tonnes of CO2-e.

$γ$= the factor 6.784 x 10-4 x 21 converting cubic metres of methane to tonnes of CO2-e at standard conditions.

**Qb** = 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 (m3 CH4) at standard conditions, calculated using Equation 1.2.

* 1. **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 at least once every 12 months using the following formula:

|  |  |
| --- | --- |
| $$Q\_{b}=VS ×Bo×MCF$$ | **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 (m3 CH4) 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** = the maximum methane-producing capacity from VS, in units of cubic metres of methane per kilogram of VS (m3 CH4/kg VS). This is standard for each animal species. The Bo factor for pigs is 0.45.

**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 3.2.2 Calculating the carbon dioxide equivalent net abatement amount

* 1. **Calculating net greenhouse gas abatement (A)**
1. For paragraph 106 (1) (c) of the Act, the carbon dioxide equivalent net abatement amount must be calculated as 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, using the following formula:

|  |  |
| --- | --- |
| $$A = \left(A\_{p}- Y\_{p}\right)$$ | **Equation 2.1** |

where:

**A**= net greenhouse gas abatement due to the project, in tonnes of CO2‑e.

$A\_{p}$= quantity of emissions avoided as a consequence of the project in tonnes of CO2‑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 CO2‑e as calculated in Equation 4.1.

**Subdivision 3.2.3 Calculating Ap**

* 1. **Calculating avoided greenhouse gas emissions (Ap)**

Avoided greenhouse gas emissions must be calculated using the following formula:

|  |  |
| --- | --- |
| $$A\_{p}=γ\sum\_{h=1}^{n}Q\_{com,h}- E\_{N\_{2}O}$$ | **Equation 2.2** |

where:

$A\_{p}$= quantity of emissions avoided as a consequence of the project, in tonnes of CO2‑e.

$γ$= the factor 6.784 x 10-4 x 21 converting cubic metres of methane to tonnes of CO2-e at standard conditions.

$Q\_{com,h}$= volume of methane destroyed by combustion device h, in cubic metres (m3) and capped according to section 3.11.

$E\_{N\_{2}O}$= quantity of nitrous oxide emissions released as a result of methane destruction from all combustion devices, in tonnes of CO2‑e.

**Subdivision 3.2.4 Calculating Qcom,h**

* 1. **Calculating volume of methane destroyed by combustion device (Qcom,h)**

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

following formula:

|  |  |
| --- | --- |
| **Qcom, h** $= Q\_{CH\_{4},h} × DE\_{h}$ | **Equation 2.3** |

where:

**Qcom, h** = capped volume of methane destroyed by combustion device h, in cubic metres (m3) and capped according to section 3.11.

$Q\_{CH\_{4},h}$ = volume of methane sent to combustion device h, in cubic metres (m3) as calculated in Equation 2.4.

$DE\_{h}$= methane destruction efficiency for device h, as a fraction.

**Determining the destruction efficiency of combustion device (DEh)**

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 3.9 (4), the destruction efficiency of enclosed flares or internal combustion engines, may be either:
	1. a default value of 0.98; or
	2. measured in accordance with Division 3.3.
3. Subject to subsection 3.9 (4), the destruction efficiency of a gas boiler system is a default of 0.98.
4. A default destruction efficiency of 0.98 may only be used if the combustion device is installed and operated in accordance with the requirements set out by the manufacturer.
5. For open or enclosed flares, if:
6. there is no record of the temperature of the exhaust gas of the flare; or
7. the recorded temperature is less than 500° C for any period exceeding 20 minutes in any particular hour,

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

**Subdivision 3.2.5 Calculating** $Q\_{CH\_{4},h}$

* 1. **Calculating the volume of methane**

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

|  |  |
| --- | --- |
| $$Q\_{CH\_{4},h} = Q\_{biogas,h} × W\_{CH\_{4}}$$ | **Equation 2.4** |

where:

$Q\_{CH\_{4},h}$= volume of methane sent to combustion device h, in cubic metres (m3).

$Q\_{biogas,h} $= volume of biogas sent to combustion device h, adjusted to standard

$ $conditions, in cubic metres (m3).

$W\_{CH\_{4}}$ = the proportion of the volume of biogas that is methane.

1. To calculate $W\_{CH\_{4}}$ either:
2. a default value of 0.70 may be used (70% of the biogas released from uncovered lagoons as defined in the NGER Determination); or
3. the proportion of the volume of biogas that is methane may be measured in accordance with Division 3.3.
4. 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 $W\_{CH\_{4}}$.
	1. **Capping the volume of methane**
5. Qb (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.
6. 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 (Qb), the value for Qb must be used instead of the value for$ \sum\_{h=1}^{n}Q\_{com,h}$ in Equation 2.2.

**Subdivision 3.2.6 Calculating** $E\_{N\_{2}O}$

* 1. **Calculating nitrous oxide emissions**
1. Subject to subsection 3.12 (2), nitrous oxide emissions released as a result of methane destruction must be calculated using the following formula:

|  |  |
| --- | --- |
| $$E\_{N\_{2}O} = \sum\_{h=1}^{n}\left(Q\_{com,h}× EC biogas× \frac{EF\_{N\_{2}0}}{1000}\right) $$ | **Equation 2.5** |

where:

**EN2O** = quantity of nitrous oxide emissions released as a result of methane destruction from all combustion devices, in tonnes of CO2‑e.

**Qcom,h** = capped volume of methane destroyed by combustion device h, in cubic metres (m3) as calculated in equation 2.3.

**ECbiogas**=energy content of biogas, in gigajoules per cubic metre (GJ/ m3), in accordance with the relevant energy content factors in Schedule 1 of the NGER Measurement Determination.

**EFN2O** = emissions factor for nitrous oxide emitted during the combustion of biogas in kilograms of CO2‑e per gigajoule of energy (kg CO2‑e /GJ) as prescribed in Schedule 1 of the NGER Measurement Determination.

1. If section 3.13 applies, then $E\_{N\_{2}O}$ must be calculated using the following formula:

|  |  |
| --- | --- |
| $$E\_{N\_{2}O} = \frac{QE}{DE\_{h}}× \frac{EF\_{N\_{2}0}}{1000}$$ | **Equation 2.5(a)** |

where:

**EN2O** = quantity of nitrous oxide emissions released as a result of methane destruction from all combustion devices, in tonnes of CO2‑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 3.17.

**EFN2O** = emissions factor for nitrous oxide emitted during the combustion of biogas in kilograms of CO2‑e per gigajoule of energy (kg CO2‑e /GJ) in accordance with Schedule 1 of the NGER Measurement Determination.

**Subdivision 3.2.7 Calculating Emissions combusted in an internal combustion engine**

* 1. **Quantity of emissions combusted in an internal combustion engine – optional calculations**
1. This section applies if:
	1. an offsets project to which this methodology determination applies uses one internal combustion engine as the combustion device;
	2. the project proponent elects to calculate the quantity of methane destroyed by the internal combustion engine ($A\_{com,ice}$), from the amount of electricity produced by an internal combustion engine generator ($Ep\_{h}$) measured in megawatt hours); and
	3. no other combustion devices are employed to combust the methane generated by the project activity.
2. For the avoidance of doubt, if another combustion device is used in conjunction with the internal combustion engine in the offsets project, the calculation in subsection 3.13 (4) cannot be utilised. In this circumstance the calculation in section 3.8 must be used.
3. For the avoidance of doubt, if the conditions specified in subsection 3.13 (1) apply then thequantity of methane destroyed in an internal combustion engine $A\_{com,ice} $must be determined using the formula set out in subsection 3.13 (4).

*Alternative* *Calculation for Ap*

1. If the conditions specified in section 3.13 (1) apply and $A\_{com,ice}$ is to be calculated in accordance with subsection 3.13 (5),$ then $Ap is to be calculated using the following formula:

|  |  |
| --- | --- |
| $$A\_{p}=\left[\left(γ \sum\_{h=1}^{n}Q\_{com,h}\right)+ A\_{com,ice}\right]-E\_{N\_{2}O}$$ | **Equation 3.1** |

where:

$A\_{p}$ = quantity of methane emissions avoided as a consequence of the project, minus nitrous oxide emissions generated from the destruction of methane, in tonnes of CO2‑e.

$γ$= the factor 6.784 x 10‑4 x 21 converting cubic metres of methane at standard conditions to tonnes of CO2‑e.

$Q\_{com,h}$ = capped volume of methane destroyed by combustion device h, in cubic metres (m3) as calculated in Equation 2.3.

$A\_{com,ice}$= amount of methane destroyed as a consequence of an internal combustion engine, in tonnes CO2‑e.

$E\_{N\_{2}O}$ = quantity of nitrous oxide emissions released as a result of methane destruction from all combustion devices, in tonnes of CO2‑e.

 *Note: If an internal combustion engine is the only type of combustion device used, then the value for Qcom,h will be zero.*

1. $A\_{com,ice}$ is to be calculated using the following formula:

|  |  |
| --- | --- |
| $$A\_{com,ice} = QE ×DE\_{h}×CH\_{4} conversion factor×GWP\_{CH\_{4}}$$ | **Equation 3.2** |

where:

$A\_{com,ice}$ = amount of methane destroyed as a consequence of an internal combustion engine, in tonnes CO2‑e.

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

$DE\_{h}$= 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 3.17.

**CH4** conversion factor = methane conversion factor of 0.018, to convert gigajoules to tonnes of methane.

$GWP\_{CH\_{4}}$=global warming potential of methane as specified in the *NGER Regulations,* Regulation 2.02

1. QE is to be calculated using the following formula:

|  |  |
| --- | --- |
| $$QE= \frac{ Ep\_{h} ×E\_{GJ} }{ Eff}$$ | **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 outlined in the NGER Determination.

**Subdivision 3.2.8 Calculating emissions from fuel and grid-derived electricity used to operate the gas extraction system in the project (Yp)**

* 1. **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:

|  |  |
| --- | --- |
| $$Yp = \left(E\_{f}+ E\_{elec}\right)$$ | **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 CO2‑e.

**Ef** = total emissions from fuel use, measured in tonnes of CO2‑e.

 **Eelec**= total emissions from consumption of purchased electricity, measured in

tonnes of CO2‑e.

1. 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 are also included, with worked examples, in the National Greenhouse Accounts Factors and are at* <http://www.climatechange.gov.au>

* 1. **Calculating total emissions from fuel use (Ef)**
1. Emissions from fuel use (Eij) must be calculated for each fuel type (i) and each greenhouse gas (j) (CO2,N2O, CH4) using the following formula:

|  |  |
| --- | --- |
| $$E\_{ij}= \frac{Q\_{i } ×EC\_{i }×EF\_{ijoxec }}{1000}$$ | **Equation 4.2** |

where:

$E\_{ij}$=emissions from fuel type (i) of greenhouse gas (j) in tonnes of CO2-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 CO2-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*

1. 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:

|  |  |
| --- | --- |
| $$E\_{f}= \sum\_{i=1}^{n}\sum\_{j=1}^{N}E\_{i,j}$$ | **Equation 4.3** |

where:

**Ef** = total emissions from fuel use, in tonnes of CO2‑e.

**j** = greenhouse gas type (CO2, N2O, CH4).

**i** = fuel type.

* 1. **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 using the following formula:

|  |  |
| --- | --- |
| $$E\_{elec}=Q\_{elec} × \frac{EF}{1000}$$ | **Equation 4.4** |

where:

$E\_{elec}$= total emissions from consumption of purchased electricity used to operate the landfill gas extraction system, in tonnes of CO2-e.

$Q\_{elec}$ = 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 CO2-e per kilowatt hour.

Division 3.3 Data Collection

* 1. **Data collection procedures and measurement frequency**
1. 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.

| Parameter | Description | Unit | Measurement Procedure | Measurement Frequency |
| --- | --- | --- | --- | --- |
| PigBal inputs to determine VS  |
| Pig numbers | This is the number of pigs in each class housed in the shed. | Number per class(class as defined within the worksheet entitled “Herd Input Data” in the PigBal workbook). | From shed records  | Daily |
| 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 | Daily |
| 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 |
| Data collection for abatement calculations |
| Qbiogas,h | Quantity of biogas sent to combustion device h. | m3 | The standards and protocol for measurement are outlined at 3.18. | Continuous monitoring – an average value in a time interval not greater than 1 hour. |
| DEh | Methane destruction efficiency for device h. | % | Open flares: * Default: 98% (factor of 0.98)

Enclosed flares:‑ 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 3 C‑ Default: 98% (factor of 0.98).Internal combustion engine:‑ 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. or‑ Not measured if amount of methane combusted is calculated from amount of electricity (MWh) produced in accordance with section 3.13.- Default: 98% (factor of 0.98).Gas boiler:- Default: 98% (factor of 0.98). | Every 6 months if using measured efficiency by a testing company, or not applicable if using the default value. |
| $W\_{CH\_{4}}$ | The proportion of the volume of biogas that is methane, as a percentage.  | m3CH4/ m3 | A default methane proportion of the gas may be used. This default proportion is 70%.Otherwise the methane fraction must be measured, as described below:1) using an inline gas analyser; or2) samples of the biogas are collected and sent to a laboratory for analysis. See section 3.19 for further details. | Continuous, if using inline gas analyser; or Monthly, if sampling (laboratory analysis). |
| Electricity usedQelec | 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.- 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.If estimated from invoices, then estimate from total electricity used for the reporting period.  |
| Fuel used Qi  | Quantity of fuel type (i). | For liquid fuels, measured in kilolitres (kL), or for gaseous fuels, measured in m3 unless otherwise specified in the NGER Determination. | - For each fuel used (diesel, LPG, etc) the amount must be estimated as a proportion of totals for the project activities. The estimation can be made from a reading from a meter or from invoices.- 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 of a revenue meter; or meter data recording electricity sent to the grid. | Total amount of electricity produced during the reporting period. |
| 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 *NSW Greenhouse Gas Benchmark Rule (Generation) No.2 of 2003* as amended). | Set value as per manufacturer’s specification or default. |

* 1. **Volumetric Measurement - Quantity of biogas sent to combustion device h *(Qbiogas, h)***

When measuring Qbiogas,hthe following requirements apply:

1. Gas flow must be measured:
2. at the delivery location of the gaseous fuel;
3. using a gas volumetric flow meter that uses a continuous monitoring system; and
4. in cubic metres per hour (m3 per hour).
5. Subject to subsection 3.18 (1), gas flow must be measured using equipment that:
6. is rated for use with a process gas/biogas/dirty stream;
7. is rated for use at the expected flow rate and pressure;
8. is designed for use in the anticipated operating temperature range; and
9. the meter is to be accurate to +/‑ 5% for flow measurement.
10. 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.
	1. **Measurement of** $W\_{CH\_{4}}$ **methane percentage in biogas**
11. To measure the percentage of methane in biogas ($W\_{CH\_{4}}$) a project proponent must either:
12. use the default value of 70% as specified in the NGER Measurement Determination; or
13. measure the composition of biogas at the project site using an inline gas analyser or by analysis in a laboratory.
14. Where a project proponent elects to measure the composition of biogas in accordance with paragraph 3.19 (1) (b) the following requirements apply:
15. where an inline gas analyser is used to measure gas composition:
	* 1. 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
		2. measurement of the methane fraction must occur at the same time as flow measurement.
16. where the composition of biogas is measured using biogas samples analysed in a laboratory the following provisions apply:
	* 1. gas composition samples must be taken at the delivery location of the gaseous fuel;
		2. gas composition samples must be taken on a regular basis, occurring no less than once per month;
		3. 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; and
		4. there must be no leaks in the sampling train or between the sampling train and the instrument;
		5. gas samples must be analysed:
			1. using US EPA Method 3 gas chromatography or mass spectrometry;
			2. in a NATA accredited laboratory;

based on triplicate samples collected in accordance with subparagraph 3.19 (2) (b) (ii).

1. all measurements must be taken in accordance with the instrument manufacturer’s instructions and the Australian and New Zealand standards.

**Part 4 Monitoring and Reporting**

**Division 4.1 Project monitoring**

* 1. **Application**

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

**4.2 Monitoring requirements**

Frequency of recording of PigBal inputs

1. A project proponent must monitor and record the following data, as set out in the PigBal Manual, no less than once per week:
	1. Herd Data;
	2. Herd Performance Data where this data is necessary in accordance with the conditions set out in the PigBal Manual;
	3. Piggery Feed Usage Data; and
	4. Diet Analysis.

*Gas measurement error margins*

* + - 1. The measurement of gas pressures must be carried out using equipment that complies with the following accuracy requirements:
				1. Pressure <±0.5%; and
				2. Differential Pressure <±0.5%.
	1. **Quality assurance and quality control**
		+ 1. All monitoring instruments must be:
1. 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;
2. field checked for calibration accuracy, with the percent drift documented, within two months before the end of the reporting period by a third-party technician:

using an appropriate instrument or apparatus; or

as per the manufacturer’s guidance;

* + - * 1. 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.
			1. Field checks of monitoring instruments must determine whether the instrument reads measurement within the accuracy threshold of +/-5%.
			2. 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%.
			3. All combustion devices must be installed, operated and maintained in accordance with the manufacturer’s guidance.

**Division 4.2 Record-keeping requirements**

* 1. **Records that must be kept**
1. The project proponent must make and keep records of the information specified in this section.

*General information*

1. The following information must be recorded and kept for general purposes:
2. all maintenance records for monitoring instruments and combustion devices;
3. logs of operations of the combustion device including notation of all shut‑downs, start‑ups, process adjustments;
4. evidence of corrective measures taken if monitoring instruments do not meet the accuracy threshold specified in section 4.2; and
5. if default values are not used for methane destruction efficiency - certificates from the stack testing laboratory showing measured methane destruction efficiency.

Project information

1. The following information must be recorded and kept for calculating and verifying emissions:
2. pig number and classes;
3. type and quantity of feed;
4. pre‑screening of waste;
5. number of project lagoons;
6. lagoon dimensions;
7. climate data (within the meaning provided in the PigBal model);
8. calculations of VS; and
9. non-effluent waste entering the project lagoons in the year prior to project commencement (by type and weight).

*Combustion devices*

1. The following information must be recorded and kept in relation to combustion devices:
2. combustion device information including the model, serial number, and calibration procedures for the device;
3. combustion device monitoring data for each device; and
4. combustion device calibration data for each device.

*Monitoring equipment*

1. The following information must be kept in relation to monitoring instruments:
2. gas flow meter information including the model, serial number and calibration procedures for the instrument;
3. gas flow meter calibration data for each flow meter.

*Gas Composition*

1. The following information must be kept in relation to site determination of gas composition:
	1. gas analyser information if used, including the model, serial number and

 calibration procedures for the instrument;

* 1. gas analyser calibration data for each gas analyser; and
	2. gas quality data (including particulate content and humidity).

*Direct and indirect measurement*

1. The following information must be kept in relation to direct and indirect measurement:
2. records of any raw data and site observations relating to the gas capture and combustion system and parameters entered into PigBal;
3. all values and calculations used in baseline calculations;
4. all values and calculations used to calculate net greenhouse gas abatement;
5. monthly and annual CO2‑e tonnage calculations; and
6. electronic recording of values of logged primary parameters for each measurement interval, for each meter. This includes:

gas flow data for each flow meter;

temperature data from temperature measurement device for each device; and

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;

evidence of fuel use including invoices and receipts;

evidence of grid‑delivered electricity use including invoices, receipts and meter data; and

evidence of amount of electricity produced by the internal combustion engine generator if section 3.13 applies.

**Division 4.3 Project report requirements**

* 1. **Report requirements**
1. Project proponents must submit:
2. a report for the first reporting period; and
3. further reports for subsequent reporting periods.

 **First reporting period**

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

1. The following information is required to be provided in the first report:
	1. net greenhouse gas abatement number;
	2. independent audit report;
	3. quantity of methane generated under baseline conditions in tonnes of CO2‑e;
	4. total volume of methane sent to combustion devices, in cubic metres (sum of $Q\_{CH\_{4}, h}$);
	5. destruction efficiencies of combustion devices (if default values not used);
	6. total amount of fuel and/or electricity used by the project, in kilolitres (kL), cubic metres (m3), or kilowatt hours (kWh); and
	7. electrical efficiency of (Eff) of the internal combustion engine generator.
	8. **Subsequent reporting periods**
2. Ongoing reports must be submitted at the end of each subsequent reporting period.
3. The following information is required to be provided in subsequent reports:
	1. net greenhouse gas abatement number;
	2. independent audit report;
	3. quantity of methane generated under baseline conditions, in tonnes of CO2‑e;
	4. total volume of methane sent to combustion devices, in cubic metres (sum of $Q\_{CH\_{4}, h}$);
	5. destruction efficiencies of combustion devices (if default values not used);
	6. total amount of fuel and/or electricity used by the project, in kilolitres (kL), cubic metres (m3) or kilowatt hours (kWh); and
	7. electrical efficiency of (Eff) of the internal combustion engine generator.