Carbon Credits (Carbon Farming Initiative) (Destruction of Methane Generated from Dairy Manure in Covered Anaerobic Ponds) 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 17 December 2012

MARK DREYFUS

Parliamentary Secretary for Climate Change and Energy Efficiency

Part 1 Preliminary

1.1 Name of Determination

This Methodology Determination is the *Carbon Credits (Carbon Farming Initiative) (Destruction of Methane Generated from Dairy Manure in Covered Anaerobic Ponds) Methodology Determination 2012*.

1.2 Commencement

This Methodology Determination is taken to commence on 1 July 2010.

1.3 Application

For paragraph 106 (1) (a) of the Act, this Methodology Determination applies to an agricultural emissions avoidance project to capture biogas generated by the decomposition of dairy effluent in anaerobic ponds and to combust the methane component of the captured biogas.

1.4 Definitions

In this determination:

Act means the *Carbon Credits (Carbon Farming Initiative) Act 2011* as in force from time to time.

active pond volume means the volume of an anaerobic pond consisting primarily of water, organic matter and live microorganisms and not the sludge storage volume which exists at the lowest level of the pond.

anaerobic decomposition means a biological process in which organic matter is broken down by bacteria in the absence of oxygen.

biogas means a mixture of gases that is generated as a result of anaerobic decomposition.

carbon dioxide equivalence (CO_2-e) means the carbon dioxide emissions equivalence of a substance that produces greenhouse gas emissions.

combustion device means an open flare or a closed flare, an internal combustion engine or a gas boiler.

dairy farm means a farm that, for its primary purpose, engages in dairy cow farming, raw cow milk production or share milking.

DGAS Calculator means the Dairy Greenhouse Gas Abatement Strategies Calculator, Advisor version 1.4, produced by the Tasmanian Institute of Agricultural Research.

DGAS Manual means the Dairy Greenhouse Gas Abatement Strategies User Manual, Advisor version 1.4, produced by the Tasmanian Institute of Agricultural Research.

Note: The DGAS Calculator and the DGAS Manual are available at http://www.climatechange.gov.au

effluent means a mixture of water, excreta, liquid waste and slurry resulting from cleaning impervious surfaces around the dairy shed, feedpad or any cow housing. This includes, but is not limited to, chemicals and residual milk from cleaning equipment, waste feed and bedding, and runoff from such areas.

Effluent and Manure Management Database means the Effluent and Manure Management Database for the Australian Dairy Industry published by Dairy Australia in 2008, which is available at http://www.climatechange.gov.au

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.

Faecal Methane Worksheet means the spreadsheet of that name located within the DGAS Calculator.

flaring system means the system used to combust biogas which includes an open flare or an enclosed flare.

frequently sparking flare means a flare that sparks at least every two seconds.

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

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

herd recording event means the counting and recording of the number of milking cows in the herd.

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

monitoring instrument means an instrument for measuring a quantity.

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

National Measurement Act means the *National Measurement Act 1960* as in force from time to time.

NGER (Measurement) Determination means the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* as in force from time to time.

NGER Regulations means the *National Greenhouse and Energy Reporting Regulations 2008* 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.

pond means a dam into which effluent is deposited, stored or treated.

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

sludge storage volume means the volume of an anaerobic pond located at the bottom consisting primarily of material that cannot readily be anaerobically decomposed.

US EPA Method means, in relation to a test mentioned in this Methodology Determination, 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

volatile solids (VS) means that portion of the total solids driven off as volatile (combustible) gases when heated at 550 degrees Celsius (+/- 50 degrees) for at least one hour.

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;
- National Inventory Report;
- offsets project;
- offsets report;
- project proponent; and
- reporting period.

Part 2 Requirements that must be met for declaration as an eligible offsets project

2.1 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 is an agricultural emissions avoidance project that:

(a) uses covered ponds to prevent the release of biogas;

(b) collects the biogas from the covered pond; and

(c) combusts the methane component in the biogas to convert it to carbon dioxide.

(3) The ponds referred to in paragraph (2) (a) must:

(a) have a minimum loading rate of 50g of volatile solids per cubic metre of active pond volume per day; and

(b) comply with the standards for the construction, operation and maintenance of ponds as prescribed in the Effluent and Manure Management Database.

(4) Only effluent from the management of dairy cows within the project may be deposited in the project ponds.

(5) Any flaring system used in the project must:

(a) use a frequently sparking flare to ensure continuous destruction of methane; or

(b) include a control system that prevents gas flow through the flare when the flare is not operational.

(6) Where paragraph (5) (b) applies:

(a) 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

(b) 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 an eligible offsets project for a reporting period

Division 3.1 Preliminary

3.1 General

(1) For paragraph 106 (1) (c) of the Act, the carbon dioxide equivalent net abatement amount for an eligible offsets project is equal to the amount ascertained using the method set out in this Part.

(2) In this Part:

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

(b) unless otherwise specified:

(i) a reference to a project is a reference to an eligible offsets project that meets the requirements of section 2.1;

(ii) all references to Parts, Divisions, sections, subsections, paragraphs and Equations are references to corresponding parts of this Methodology Determination.

(c) for all equations:

(i) n = number of combustion devices; and

(ii) h denotes a combustion device.

(3) References in Division 3.2 to a factor or parameter prescribed in the NGER (Measurement) Determination or the NGER Regulations, are, for the entire offsets reporting period, references to the NGER (Measurement) Determination or NGER Regulations in force at the time that the offsets report was required to be submitted.

(4) The data used in the calculations set out below in Division 3.2 must comply with the data collection requirements set out in Division 3.3.

3.2 Greenhouse gas assessment boundary

(1) 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 in respect of a source.

Table of gases accounted for in the abatement calculations

	Source	Greenhouse gas
Baseline	Greenhouse gas emissions from effluent in project ponds	Methane (CH_4)
Project Activity	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 use 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)

3.3 Calculating the baseline for the project

(1) For paragraph 106 (4) (f) of the Act, the baseline for a project is the total amount of methane that would have been generated and released from all ponds used in the project, for each year of the project, in the absence of the abatement activity, including that the ponds were uncovered.

(2) The baseline must be calculated based on the amount of volatile solids in the effluent stream deposited into each pond used in the project, which is calculated in accordance with Division 3.2.

Division 3.2 Calculations

Subdivision 3.2.1 Calculating baseline emissions (E_b)

3.4 Calculating the baseline methane emissions

(1) The baseline for the project is calculated as follows:

$E_b = \gamma Q_b$	Equation 1.1

Where:

E_b = total methane emissions that would have occurred from the operation of all of the ponds used in the project, as if the project did not occur, including that the ponds were uncovered, in tonnes of CO_2-e.

γ = the factor $6.784 \times 10^{-4} \times GWP_{CH_4}$ converting cubic metres of methane to tonnes of CO2-e at standard conditions.

Q_b = total volume of methane that would be released to the atmosphere from the operation of the ponds used in the project, as if the project did not occur, including that the ponds were uncovered, in cubic metres of methane (m^3 CH_4) at standard conditions.

(2) Q_b must be calculated as follows:

$Q_b = VS \times Bo \times MCF$	Equation 1.2

Where:

Q_b = total volume of methane that would be released to the atmosphere from the operation of the ponds used in the project, as if the project did not occur, including that the ponds were uncovered, in cubic metres of methane (m^3 CH_4) at standard conditions.

VS = quantity of volatile solids deposited into the project ponds, in kilograms, calculated using subsection 3.4 (3).

Bo = $0.24 m^3$/kg VS.

MCF = 0.9.

(3) VS must be calculated using one of the methods set out in Subdivision 3.2.2.

Note: VS may be calculated in accordance with one of three methods, being tier one, tier two, or tier three.

Subdivision 3.2.2 Calculating volatile solids (VS)

3.5 Calculating VS using the tier one method

(1) The amount of VS entering project ponds each year may be calculated using the following formula:

$\mathrm{VSa} = \left((\mathrm{Mp} \times 0.1) + (\mathrm{Clw} \times 0.025)\right) \times (1 - \mathrm{DMD}) \times \mathrm{Navg} \times 0.83 \times (\mathrm{Ta}/24) \times (1 - S_R) \times 365$	Equation 1.3

Where:

VSa =	annual quantity of volatile solids entering the ponds used in the project in kilograms per year.
Mp =	average cow milk production (L/cow/day).
Clw =	milking cow live weight as prescribed in the National Inventory Report.
DMD =	0.75.
Navg =	average number of cows milked per day, averaged over the year.
Ta =	time milking cows spend in the area that effluent is collected and directed to project pond, expressed as a fraction of a day and determined in accordance with subsection (2).
S_R =	solids removal efficiency of the dairy production system as a fraction and determined in accordance with subsection (3).

(2) Ta is, in accordance with the choice of a project proponent, either:

(a) a standard factor of 2.4 hrs/d; or

(b) the average time in hrs/day that animals spend in areas where effluent is directed to the project pond, measured in accordance with section 3.14.

(3) S_R is, in accordance with the choice of a project proponent, either:

(a) the figure prescribed from the supplier of the separator unit appropriate for dairy shed waste; or

(b) the highest value for the type of separation unit prescribed in Appendix A of the Effluent and Manure Management Database; or

(c) the figure derived from measuring the solid removal efficiency in accordance with subsection (4).

(4) If solid removal efficiency is measured, the samples must:

(a) be taken on enough occasions to produce an unbiased, representative sample; and

(b) be representative of the dairy shed waste stream and the total solids concentrations at the project site; and

(c) only be used for the dairy operation for which it was intended to be representative.

3.6 Calculating VS using the tier two method

(1) The amount of VS entering project ponds each year may be determined using the DGAS Calculator in accordance with the requirements set out in the DGAS Manual and the following formula:

$\mathrm{VSa} = \mathrm{VS}_{\mathrm{DGAS}} \times \mathrm{SF} \times \mathrm{Navg} \times \mathrm{Ta} \times (1 - \mathrm{S_R}) \times 365$	Equation 1.4

Where:

VSa =	annual quantity of volatile solids entering the ponds used in the project in kilograms per year.
$\mathrm{VS}_{\mathrm{DGAS}}$ =	annual quantity of volatile solids generated by the milking cows in kilograms per year and determined in accordance with subsection (2)
SF =	fraction of effluent collected that is directed to the project pond or pre-treatment after removing the average fraction spread daily on land from a sump.
Navg =	average number of cows milked per day, averaged over the year.
Ta =	time milking cows spend in the area that effluent is collected and directed to project pond, expressed as a fraction and determined in accordance with subsection (3).
S_R =	solids removal efficiency of the dairy production system as a fraction and determined in accordance with section 3.5 (3).

(2) The amount of VS generated by the milking cows each year may be determined using:

(a) the DGAS Calculator in accordance with the requirements set out in the DGAS Manual; and

(b) using the Faecal Methane Worksheet of the DGAS Calculator to calculate the total average volatile solids for milking cows in kilograms per head per day;

Note: The DGAS calculator refers to anaerobic ponds as lagoons.

(3) Ta is the average fraction of time that milking cows spend in areas where their effluent is directed to the project pond calculated using the following formula:

$$\text{Ta} = \frac{\text{La}}{365} \times \frac{\text{Td}}{24}$$	Equation 1.5

Where:

Ta = time milking cows spend in the area that effluent is collected and directed to project pond.

La = average lactation length in days per year per milking cow.

Td = average hours per day milking cows spend in the area that effluent is collected and directed to project pond.

3.7 Calculating VS using the tier three method

(1) The amount of VS entering project ponds each year may be calculated by directly measuring:

(a) milking cow numbers;

(b) time cows spend in areas where effluent is collected for transfer to project ponds;

(c) the volume of effluent; and

(d) the VS concentration of the effluent.

Note: All measurements must be performed in accordance with section 3.14.

Subdivision 3.2.3 Calculating the carbon dioxide equivalent net abatement amount

3.8 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 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 CO_2-e.
A_p =	gross quantity of emissions avoided as a consequence of the project in tonnes of CO_2-e, as calculated in Equation 2.2.
Y_p =	emissions from fuel used to operate gas capture and combustion equipment for the purpose of the project, measured in tonnes of CO_2-e as calculated in Equation 4.1.

(2) A_p must be calculated as follows:

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

Where:

A_p =	gross quantity of emissions avoided as a consequence of the project, in tonnes of CO_2-e.
γ =	the factor $6.784 \times 10^{-4} \times GWP_{CH_4}$, converting cubic metres of methane to tonnes of CO_2-e at standard conditions.
$Q_{com,h}$ =	volume of methane destroyed by combustion device h, in cubic metres (m^3) and capped according to section 3.9.
E_{N_2O} =	quantity of N_2O emissions released as a result of methane destruction from all combustion devices, in tonnes of CO_2-e.

(3) $Q_{com,h}$ must be calculated as follows:

$Q_{com,h} = Q_{CH_4,h} \times DE_h$	Equation 2.3

Where:

$Q_{com,h}$ =	volume of methane destroyed by combustion device h, in cubic metres (m^3) and capped according to section 3.9.
$Q_{CH_4,h}$ =	volume of methane sent to combustion device h, in cubic metres (m^3) as calculated in Equation 2.4.
DE_h =	methane destruction efficiency for device h, as a fraction determined in accordance with section 3.10.

(4) $Q_{CH_4,h}$ must be calculated as follows:

$Q_{CH_4,h} = Q_{biogas,h} \times W_{CH_4}$	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 standard conditions, in cubic metres (m^3), measured in accordance with Division 3.3.
W_{CH_4} =	the proportion of the volume of biogas that is methane.

(5) W_{CH_4} is, in accordance with the choice of a project proponent, either:

(a) 0.70; or

(b) measured in accordance with Division 3.3.

(6) 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}.

3.9 Capping the volume of methane

(1) Q_b (calculated using Equation 1.2) and $\sum_{h=1}^{n} Q_{com,h}$ (calculated using Equation 2.3) 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 $\sum_{h=1}^{n} Q_{com,h}$ is deemed to be (Q_b) in Equation 1.2.

3.10 Determining the methane destruction efficiency for a combustion device (DE_h)

(1) Subject to subsection (2):

(a) the methane destruction efficiency for an open flare is 0.98; and

(b) for an internal combustion engine or an enclosed flare or a gas boiler, the methane destruction efficiency, may be either:

(i) 0.98; or

(ii) measured in accordance with Division 3.3.

(2) A methane 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 device manufacturer.

(3) If the internal combustion engine or the gas boiler is shut down, has failed or is not being operated in accordance with the requirements set out by the device manufacturer, then the methane destruction efficiency for that hour is taken to be zero.

(4) For an open or an enclosed flare, if:

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

(b) the recorded temperature is less than 500°C for any period exceeding 20 minutes in any particular hour,

then the methane destruction efficiency for that hour is taken to be zero.

Subdivision 3.2.4 Calculating nitrous oxide emissions

3.11 Calculating nitrous oxide emissions (E_{N_2O})

(1) Nitrous oxide emissions released as a result of methane destruction must be calculated using the following formula:

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

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.

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

EC = energy content of biogas, in gigajoules per cubic metre (GJ/ m^3), as prescribed in 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 the NGER (Measurement) Determination.

Subdivision 3.2.5 Calculating emissions combusted in an internal combustion engine

3.12 Quantity of emissions combusted in an internal combustion engine – optional verification methods

(1) This section applies if a project uses an internal combustion engine for electricity generation which is fed by methane generated by the project activity.

(2) If subsection (1) applies, a project proponent must:

(a) determine the destruction efficiency of the internal combustion engine in accordance with section 3.10;

(b) calculate the volume of methane combusted ($Q_{com,h}$), where h is the internal combustion engine, using Equation 2.3; and

(c) .

(3) In addition to subsection (2), a project proponent may verify $Q_{com,h}$ by using the quantity of methane combusted by the internal combustion engine for electricity generation ($A_{com,ice}$). This may be calculated using Equation 3.1 and Equation 3.2.

Note: To compare $Q_{com,h}$ with $A_{com,ice}$ for the purposes of subsection (3) the figure produced at 3.12 (2) (b) will need to be multiplied by 6.784 x 10^{-4} x GWP_{CH_4} to obtain tonnes CO_2-e.

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

$A_{com,ice} = QE \times CH_4 \text{ conversion factor} \times GWP_{CH_4}$	Equation 3.1

Where:

$A_{com,ice}$ =	amount of methane destroyed as a consequence of an internal combustion engine, in tonnes CO_2-e.
QE =	energy content of the methane sent to the internal combustion engine, in gigajoules (GJ) calculated in accordance with Equation 3.2.
CH_4 conversion factor =	0.018.
GWP_{CH_4} =	global warming potential of methane as specified in the NGER Regulations.

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

$QE = \frac{\text{Electrcity produced} \times EC}{Eff}$	Equation 3.2

Where:

QE =	quantity of energy produced as a result of methane combustion in the internal combustion engine, in gigajoules (GJ).
Electricity produced =	the total amount of electricity produced by the internal combustion engine (supplied to the grid or used on-site) in megawatt hours (MWh).
EC =	3.6.
Eff =	Electrical efficiency factor (as a fraction) for the internal combustion engine for conversion of energy to electricity, determined in accordance with subsection (6).

(6) Eff must be determined:

(a) in accordance with the manufacturer’s specifications for the equipment; or

(b) if there is no value specified by the manufacturer — a default of 0.36 must be used.

Subdivision 3.2.6 Calculating emissions from fuel used to operate the gas extraction system in the project (Y_p)

3.13 Calculating emissions from fuel use (Yp)

(1) This section applies if fuel is used to operate the gas capture and combustion system used in the project.

(2) Yp must be calculated using the following formula:

$Yp = (E_f)$	Equation 4.1

Where:

Yp = emissions from fuel 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 in accordance with Equation 4.3.

(3) E_f 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:

$E_{f=}$ total emissions from fuel use, in tonnes of CO_2-e.

i = fuel type

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

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

EC_i = energy content factor of fuel type (i), as prescribed in the NGER (Measurement) Determination, and used subject to subsection (4).

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), as prescribed in the NGER (Measurement) Determination.

(4) If Q_i is measured in gigajoules, then EC_i is equal to 1.

(5) Total emissions from fuel used to operate the gas capture and combustion system (E_f) must be calculated as the sum of all emissions calculated using Equation 4.2, using the following formula:

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

Where:

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.
n =	number of fuel types (i).
N =	number of gas types (j).
E_{ij} =	emissions from fuel type (i) of greenhouse gas (j) in tonnes of CO_2-e.

Division 3.3 Data Collection

3.14 Data collection procedures and measurement frequency

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

Parameter	Description	Unit	Measurement Procedure	Measurement Frequency
Tier 1 Method for calculating VS				
Milking cow numbers	Number of milking cows in an area where manure is collected and directed to the project pond.	Number	From herd recording data or farm records.	Once every 4-8 weeks as part of a herd recording event.
Milk production	Average amount of milk produced per cow per day.	L/cow/day	- Sales receipts; or - Herd recording data; or - Milk meters.	- Milk collection frequency; or - With each herd recording event; or - Daily.
Time milking cows spend in area (Ta)	For free-stall systems this is 21.6 hrs. For all others this is 2.4 unless weekly records are kept.	Hours	Recorded in log book.	If default value is not used, in accordance with the Effluent and Manure Management Database.

Parameter	Description	Unit	Measurement Procedure	Measurement Frequency
Pre-treatment screening	Solid removal efficiency from effluent using pre-treatment methods	Fraction	In accordance with section 3.5.	For direct measurement, solids removal must be measured for a one week period for each season (four times per year) in accordance with the Effluent and Manure Management Database.
Tier 2 Method for calculating VS - DGAS inputs				
Milking cow numbers	Number of milking cows in an area where manure is collected and directed to the project pond.	Number	From herd recording data or farm records.	Once every 4-8 weeks as part of a herd recording event.
Milk production	The average amount of milk produced per cow per day.	L/cow/day	- Sales receipts; or - Herd recording data; or - Milk meters.	- Milk collection frequency; or - Each herd recording event; or - Daily
Milking cow live weight	The average live weight of milking cows by class.	Kg	Herd records, farm scales or sale receipts.	Variable frequency as required by relevant calculations.
Average lactation length	Average number of days per year an individual milking cow is in lactation	Days per year per milking cow	Herd recording data	- each herd recording event; or - Daily

Parameter	Description	Unit	Measurement Procedure	Measurement Frequency
Time milking cows spend in area (Td)	Average hours per day milking cows spend in the area that effluent is collected and directed to project pond.	Hours	Recorded in log book.	- Milk collection frequency; or - Daily
Feed used and type	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 DGAS Calculator.	From delivery records.	Feed supplies recorded after delivery with balance calculated by season (spring/summer/autumn/winter), with home-grown pasture utilisation back-calculated.
Fraction of effluent collected	Fraction of effluent sent to pre-treatment screening and the project pond after removing the average fraction of effluent spread daily on land from a sump	Fraction	Where no effluent is spread daily on land from a sump the value is 1. Where effluent is spread daily on land from a sump the fraction is estimated from sump design documents and log book records.	- Daily
Pre-treatment screening	Solid removal efficiency from effluent using pre-treatment	Fraction	In accordance with section 3.5.	For direct measurement solids removal needs to be measured for a one week period each season (four times per

Parameter	**Description**	**Unit**	**Measurement Procedure**	**Measurement Frequency**
	methods.			year).
Tier 3 Method for calculating VS – Physical measurement				
Milking cow numbers	Number of milking cows in an area where manure is collected and directed to the project pond.	Number	Record numbers and enter into farm records.	Once every 4-8 weeks as part of a herd recording event.
Time milking cows spend in area	The number of days per year and hours per day that cows spend in areas where effluent is collected for transfer to project ponds.	Days or Hours as appropriate	Recorded in log book.	In accordance with the Effluent and Manure Management Database.
Volume of effluent	The volume of effluent entering the project pond.	L	- From sump volumes; or - Via suitable calibrated meter that can be used with effluent (e.g. non-contact magnetic meter).	Four times per year to cover all four seasons, with at least one full week of data collection per season.

Parameter	Description	Unit	Measurement Procedure	Measurement Frequency
VS concentration of effluent	The VS concentration of effluent entering the project pond.	mg / L or g/L	A sufficient number of sub-samples to provide average effluent concentrations. *Note:* A typical sub-sampling protocol would involve the collection of at least 40 sub-samples collected throughout the whole pump-out period of an agitated sump.	Four times per year to cover all four seasons, with at least one full week of data collection per season.
Data collection for abatement calculations				
$Q_{biogas,h}$	Quantity of biogas sent to combustion device h.	m^3	The standards and protocol for measurement are outlined below.	Continuous monitoring – an average value in a time interval not greater than one hour.
DE_h	Methane destruction efficiency for device h.	%	*Flares* Measured efficiency (enclosed flares only): Duplicate compliance testing, measured every 6 months, by a NATA accredited	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
			emission stack testing company, using a method based on US EPA Method 18 or US EPA Method 3 C; Default (open or enclosed flares): a default destruction efficiency of 0.98 is applied *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 A default destruction efficiency is	

Parameter	Description	Unit	Measurement Procedure	Measurement Frequency
			applied (0.98) *Gas Boiler* A default destruction efficiency is applied (0.98)	
W_{CH4}	The proportion of the volume of biogas that is methane, as a percentage.	$m^3 CH_4 / m^3$	A default methane proportion may be applied. The default methane proportion of the gas is 70%. Otherwise the methane fraction must be measured, as described below. 1.Continuous, using an inline gas analyser; or 2. Monthly, where samples of the biogas are collected and sent to a laboratory for analysis.	Continuous (inline gas analyser) or monthly sampling (laboratory analysis).
Q_i	Quantity of fuel used for the operation of gas capture and combustion equipment	For liquid fuels, measured in kilolitres (kL), or for gaseous fuels, measured in m^3 unless	For each fuel used (diesel, LPG, etc.) the amount must be estimated as a proportion of totals for the project	If estimated from invoices, then estimate from total amount of fuel used per annum

Parameter	Description	Unit	Measurement Procedure	Measurement Frequency
		otherwise specified in the NGER (Measurement) Determination.	activities. Manufacturer's specifications will assist with these estimates for the gas capture and combustion component.	
Electricity produced	Quantity of electricity produced by methane combustion in internal combustion engine generator.	MWh	Meter data, recording electricity produced by internal combustion engine generator (if electricity is 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.
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	N/A – assumed value.

Parameter	Description	Unit	Measurement Procedure	Measurement Frequency
			- a default value of 36% .	

3.15 Measuring the quantity of biogas sent to combustion device h ($Q_{biogas, h}$)

$Q_{biogas, h}$ must be measured in accordance with the following requirements:

(1) 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).

(2) Subject to subsection (1), 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) the meter is to be accurate to +/- 5% for flow measurement.

(3) 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) All measurements must comply with the National Measurement Act.

3.16 Measuring the proportion of volume of biogas that is methane (W_{CH_4})

(1) The percentage of methane in biogas (W_{CH_4}),is either:

(a) the default value prescribed in the NGER (Measurement) Determination; or

(b) the composition of biogas at the project site measured using an inline gas analyser; or

(c) the composition of biogas resulting from the analysis of biogas samples in a NATA accredited laboratory.

(2) Where subsection (1) (b) applies, the following requirements apply:

(a) 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

(b) measurement of the methane fraction must occur at the same time as flow measurement.

(3) Where subsection (1) (c) applies, the following requirements apply:

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

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

(c) 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

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

(e) gas samples must be analysed using US EPA Method 3 gas chromatography or mass spectrometry.

Part 4 Monitoring and Reporting

Division 4.1 Project monitoring

4.1 Application

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

4.2 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 two 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; and

(c) calibrated by the manufacturer or an accredited third-party calibration service with the frequency recommended by 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 4.2 Record-keeping requirements

4.3 Information for calculating the baseline

Tier one method for calculating VS

(1) A project proponent that elects to use the tier 1 method for calculating VS must make and keep records of:

(a) cow numbers and classes;

(b) milk production and length of lactation/dry-off period for seasonal operation;

(c) time cows spend in areas where effluent is collected for transfer to project ponds;

(d) efficiency of pre-treatment (screening) systems;

(e) number of project ponds;

(f) pond dimensions; and

(g) calculation of VS.

Tier 2 Method for calculating VS

(2) A project proponent that elects to use the tier 2 method for calculating VS must make and keep records of:

(a) cow number and classes;

(b) milk production and length of lactation/dry-off period for seasonal operation;

(c) time cows spend in areas where effluent is collected for transfer to project ponds;

(d) type and quantity of feed;

(e) number of project ponds;

(f) pond dimensions;

(g) calculation of VS;

(h) value of emissions of methane from ponds used in the project; and

(i) total methane emissions from all cattle classes, calculated using the Faecal Methane Workbook of the DGAS Calculator.

Tier 3 Method for calculating VS

(3) A project proponent that elects to use the tier 3 method for calculating VS must make and keep records of:

(a) cow number and classes;

(b) time cows spend in areas where effluent is collected for transfer to project ponds;

(c) volume of effluent;

(d) laboratory analysis sheet of VS concentration;

(e) number of project ponds;

(f) pond dimensions; and

(g) calculation of VS.

4.4 General information

(1) In addition to the information specified in section 4.3, the following information must be made and kept:

(a) receipts and specifications relating to the gas capture and combustion equipment;

(b) all maintenance records relevant to the gas capture system, monitoring equipment and combustion devices;

(c) logs of operations of the gas management system including notation of all shut-downs, start-ups, process adjustments;

(d) evidence of corrective measures taken if instruments do not meet performance specifications;

(e) independent audit records and results; and

(f) if default values are not used, NATA certificates from the testing laboratory as evidence of measured methane destruction efficiency.

4.5 Information about combustion devices

(1) The following information must be recorded and kept in relation to each combustion device:

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

(b) combustion device monitoring data for the device; and

(c) combustion device calibration data for the device.

4.6 Information about monitoring devices

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

- (a) the model, serial number and calibration procedures for the instrument; and
- (b) gas flow meter calibration data for each flow meter.

4.7 Information about gas composition

(1) The following information must be kept in relation to on-site analysis of gas composition:

- (a) the model, serial number and calibration procedures for the gas analyser;
- (b) gas analyser calibration data for each gas analyser; and
- (c) gas quality data, including particulate content and humidity.

4.8 Information about direct and indirect measurement

(1) The following information must be kept 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 DGAS;
- (b) all values and calculations used in baseline calculations;
- (c) all values and calculations used in to calculate net greenhouse gas abatement;
- (d) monthly and annual CO_2-e tonnage calculations;
- (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 temperature measurement device for each device; and
  - (iii) methane content of gas for each measurement.
- (f) for paragraph (e) (iii), the following information must be included:
  - (i) the date, time and location of measurement;
  - (ii) notes of non-compliance to performance specifications; and
  - (iii) remedial actions taken to correct instrument.
- (g) evidence of fuel use; and

(h) if Equations 3.1 and 3.2 are used, evidence of the amount of the electricity produced by the internal combustion engine generator.

Division 4.3 Offsets report requirements

4.9 Information required in offsets reports

(1) The following information is required to be provided in every offsets report:

(a) net greenhouse gas abatement number (A);

(b) independent audit report;

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

(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) (DE_h);

(f) total amount of fuel used by the project, in kilolitres (kL), cubic metres (m_3), or kilowatt hours (kWh); and

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