Chicago Climate Exchange

CCX Agricultural Methane Gas Project Guidelines

I. Introduction

The purpose of this protocol is to address the measurement and verification of methane emissions reductions from the combustion of biogas for the Chicago Climate Exchange (CCX).

Topics covered in this document:

- Overall approach for crediting methane reductions from anaerobic digestion of animal manure as emission offsets;
- Protocol for measuring, recording, and verifying anaerobic digester methane recovery rates based on biogas flow and methane measurements; and,
- Protocol for verifying ex ante calculation of methane generation.

Topics not included:

- Accounting for (carbon dioxide) emissions reductions that may result from displacement of other fuels used in power production

II. Definitions

The CCX baseline calculation requires that a project baseline manure management practice be defined as “Liquid/Slurry”, “Deep Pit”, or “Anaerobic Lagoon.” Higher methane conversion factors (MCF’s) (Table B.5) result if a project is eligible to claim Anaerobic Lagoon status.

CCX has selected the following three most appropriate definitions and reference sources for the eligible practices that define the controlling factors as to which eligibility category may be used for baseline calculation purposes. These references include the IPCC 2000 good practice guidance document[1], the IPCC 2006 guidelines[2], and, for US projects, the US National GHG Inventory[3]. Simplified definitions are as follows:

1. Liquid/Slurry:
   Manure is stored as excreted or with some minimal addition of water to facilitate handling and is stored in either tanks or earthen ponds, usually for periods less than one year.

[1] IPCC 2000, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (May 2000).
[2] IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Chp. 10: Livestock Emissions).
[3] US EPA (2007) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005.

2. Pit Storage Below Animal Confinement:
   Collection and storage of manure usually with little or no added water typically below a slatted floor in an enclosed animal confinement facility. Typical storage periods range from 5 to 12 months, but must exceed one month.

3. Anaerobic Lagoons:
   Uncovered anaerobic lagoons are designed and operated to combine waste stabilization and storage. Lagoon supernatant is usually used to remove manure from the associated confinement facilities to the lagoon. Anaerobic lagoons are designed with varying lengths of storage (up to a year or greater), depending on the climate region, the volatile solids loading rate, and other operational factors.

   Manure management systems that utilize flush technologies to handle manure, or that combine scraped (or vacuumed) manure with more than minimal quantities of water in storage (for example, by mixing dairy parlor waste water with manure for handling or storage), and that have liquid manure storage systems with hydraulic retention times of greater than 90 days, may, for the purposes of the offset protocol, be categorized as "anaerobic lagoon" systems for baseline determination.

III. Applicability

Exchange Methane Offsets will be issued to owners of GHG emission reductions achieved by agricultural methane collection and combustion systems as provided below. Exchange Methane Offsets will be issued to owners of GHG emission reductions achieved by collection and combustion systems placed into operation in the on or after January 1, 1999.[4]

IV. Eligibility

For CCX purposes, anaerobic digesters are treated as providers of Exchange Methane Offsets. CCX eligibility requirements for methane reductions from anaerobic digesters include the following:

- A company must demonstrate clear ownership rights of the emission reductions from the destruction of methane in order to register the offsets with CCX.
- Projects eligible to earn offsets during the years 2003 through 2010 are those placed into service on or after January 1, 1999.
- Except as may be provided by CCX, procedures outlined in this protocol must be followed to quantify methane emission reductions.

[4] Agricultural methane collection systems include covered lagoons, anaerobic digesters, complete-mix and plug-flow digesters.

- Eligible animal manure biogas methane collection and combustion systems will be issued Offsets for methane collected and destroyed in accordance with this protocol.

Projects eligible for anaerobic digester offset credits must have prior (baseline) manure management practices (as defined in the IPCC 2000 good practice guidance document[5], the IPCC 2006 guidelines[6], and as further clarified below) where manure is handled as a liquid and with significant methane emitting potential, including:

1. Liquid/slurry storage
2. Pit storage below animal confinements (>1 month)
3. Uncovered anaerobic lagoons

Eligible projects with additional baseline manure management systems other than those listed above may include only that portion of the manure handled by eligible systems in any baseline emission and offset credit calculations.

Although the use of non-manure feedstocks may result in additional emission reductions, such use should be treated as a separate project activity and is not included in the specific calculation of agricultural methane offset credits for anaerobic manure digester projects.

V. Protocol

Baseline calculation

The emissions baseline is the amount of methane that would be emitted to the atmosphere during the crediting period in the absence of the anaerobic digester project. For each year during the crediting period, baseline emissions for all anaerobic digesters are calculated as specified in paragraph (a) and paragraph (b) below, and the lower of the two values will be used:

(a) Actual monitored amount of methane captured and destroyed by the project activity using existing CCX monitoring protocols and a GWP for methane of 21). The default methane combustion efficiency for flared biogas from anaerobic digesters is 90%. Higher efficiencies may be used if supported by manufacturer’s specifications or other acceptable data. The default methane combustion efficiency for biogas utilized by electricity gensets is 100%.

(b) The methane emission calculated ex ante based on the amount of the animal manure that would decay anaerobically in the absence of the project activity,

[5] IPCC 2000, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (May 2000)
[6] Table 10.18. Definitions of Manure Management Systems. 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

using the most recent country-specific IPCC tier 2 approach (for a description of the proposed calculation methods for projects in the U.S., see Appendix B).

Exclusion of nitrous oxide emissions from baseline calculations

Eligible projects, as defined above, utilize liquid manure management systems for baseline determination. Direct nitrous oxide emissions for these liquid manure management systems is expected to be relatively small based on IPCC and US National Inventory accounting methods and default emission factors; in most cases contributing significantly less than 5% of the total baseline GHG emissions. Therefore potential nitrous oxide emissions are excluded from baseline calculations. Projects that may reduce direct or indirect nitrous oxide emissions resulting in additional emission reductions would need to account for such reductions as a separate project activity.

Protocol for Quantifying Methane Emissions Reductions

Rates of methane capture and destruction at a biogas facility are a function of the following measurable quantities:

- The rate of biogas flow to the control device (flare station, power plant, or other facility that combusts collected biogas);
- The methane content of the recovered biogas; and
- The methane destruction efficiency in the control device.

Standard protocols for measuring the flow rate and methane content of recovered biogas are described below. An alternative method for measuring methane combustion rates at energy recovery facilities also is provided.

Biogas Flow Rate Measurements

Biogas flow rates are to be measured upstream of the control device by means of an installed flow meter device. The protocol for measuring biogas flow using a flow meter is described below.

Flow Meter Requirements

The following description of the types of flow meters and recommended flow meter installation points has been taken from the Solid Waste Association of North America's manual of practice for landfill gas operations and maintenance.[7]

The most common types of flow meters measure flow by sensing differential pressure. Examples include the orifice plate, pitot tube, venturi tube, and the averaging pitot tube (e.g., Annubar™). These flow meters measure flow using a standard mathematical formula without the need to modify the result based on proprietary device-specific information. The Annubar™ relies on proprietary information supplied by the manufacturer, such as a correction coefficient, chart, or flow computer to determine the flow. The flow meter may be read using a pressure gauge, or it may require a differential pressure transmitter which sends a signal to the flow computer or flow readout device. Instantaneous readings are typically recorded on a chart recorder.

Other types of flow meters such as hot wire anemometers produce an electronic signal based on the cooling effect on a filament caused by the gas flow. These devices are sensitive to the biogas flow rate, the moisture content, and the gas composition, and require re-calibration to yield accurate measurements when the gas composition changes. However, they are widely used within the biogas industry and are acceptable if calibrated to site conditions.

The flow meter should be installed along the header pipe at a location that provides a straight section of pipe sufficient to establish laminar gas flow, as turbulent flow resulting from bends, obstructions, or constrictions in the pipe can cause interference with flow measurements which rely on differential pressure. The most desirable location for the flow meter is downstream of the blower and upstream of the control device because the biogas is drier and under slight pressure instead of vacuum.

The following information regarding flow meter performance must be maintained and may be required by CCX to be included in Project Reports:

- Accuracy, precision per manufacturer;
- Proof of initial calibration;
- Means to correct for temperature and pressure.

Installed flow meters should be inspected, cleaned, and checked for accuracy using a portable instrument such as a pitot tube to measure the flow velocities along a transverse of the header pipe. The velocity measurements are then used to calculate a flow rate, which is typically accurate to within 2 percent in larger pipes (greater than 4 inch diameter). The inspection, cleaning, and flow verification should be done at least quarterly.

[7] Solid Waste Association of North America, 1997. Landfill gas operation and maintenance – manual of practice.

Recordkeeping

The following records of biogas flows to the control device are to be kept in order to verify methane emissions reductions:

- Type of flow meter;
- Date and location of flow meter installation;
- Dates and results of flow meter calibration;
- Copies of charts or diskettes on which flow rates were recorded;
- Monthly tabulations of number of hours control device was shut down (no offsets will be issued by CCX for periods during which the control device is not operated);
- Copies of field data used for flow measurement standardization, including barometric pressure, biogas temperature and pressure measurements, and biogas characteristics (percent methane, oxygen, water);
- Monthly tabulations of hourly biogas flow rate standardization calculations and results (in standard cubic feet per hour);
- Information on the portable instrument and procedures used to check the installed flow meter accuracy, including field measurements and flow calculations; and
- Records of third-party verification of flow measurements and procedures.

The above-listed records need to be kept readily accessible and on-site for at least 2 years after the date that annual methane emissions reductions for the site have been recorded at the CCX and may be required by CCX to be included in Project Reports.

Third-Party Verification of Gas Flow Measurements and Procedures

At least once per year, biogas flow measurements, records, and procedures should be verified as acceptable per the CCX protocol by a CCX-approved Verifier.

Methane Concentration Measurements

Offset providers who wish to use default factors (provided below) for methane concentration are required to provide laboratory analysis of methane concentration at least once per year. Offset providers who wish to receive credit for values in excess of the established default values must provide hourly averaged methane concentration data using the protocols described below.

Default values for methane concentration:

- o Entities able to provide laboratory analysis of methane concentration between 70.0% and 74.9% for biogas digesters will be assigned a default value of 70%.
- o Entities able to provide laboratory analysis of methane concentration between 65.0% and 69.9% for biogas digesters will be assigned a default value of 65%.
- o Entities able to provide laboratory analysis of methane concentration between 60.0% and 64.9% for biogas digesters will be assigned a default value of 60%.

Default values will be reevaluated on a yearly basis and will be adjusted according to the most current laboratory analysis.

The methane concentration of biogas is typically measured using instrumentation located inside the digester, as methane concentrations are an important parameter to be monitored during digester operations. Instruments collect samples from gases that accumulate near the roof of the digester and provide periodic or continuous biogas methane concentrations.

The following information regarding methane concentration measurement instrumentation must be submitted:

- Accuracy, precision per manufacturer;
- Proof of initial calibration;
- Records of periodic instrument calibration (according to the manufacturers instructions for calibration);
- Capability to record methane concentrations at least every 15 minutes for entities not using default values for methane content.

The gas analyzer instrument needs to be calibrated against a gas sample with a known methane concentration at least once per year. See instructions in the instrument manual for details on the calibration procedures, including instrument adjustments. A calibration gas with a methane concentration close to the concentration expected in the field (i.e., 60-70% methane) is optimal.

Recordkeeping

The following records of measured methane concentrations are to be kept in order to verify methane emissions reductions:

- Type of instrument.
- Dates and results of instrument calibration.

- Dates, times, and results of methane measurement.
- Records of laboratory analysis of methane concentration- at least once per year.
- For entities not using default methane concentration factors- monthly tabulations of unadjusted average methane concentration of recovered biogas during each hour of digester operation, based on the average methane concentration measured during four 15-minute periods.
- Records of third-party verification of methane measurements and procedures.

The above-listed records need to be kept readily accessible and on-site for at least 2 years after the date that annual emissions reductions credits for the site have been recorded at the CCX.

Third-Party Verification of Methane Measurements and Procedures

At least once per year, methane concentration measurements, records, and procedures should be verified as acceptable per the CCX protocol by a CCX-approved Verifier.

Use of Measured Data to Calculate Methane Emissions Reductions from Anaerobic Digesters

Methods for calculating the amount of methane recovered from anaerobic digesters and combusted are described below.

Methane concentrations should be measured at a minimum of once per year. Default factors will be applied to all offset providers who do not provide methane concentrations on an hourly basis as described below. Tabulated records of average hourly biogas flows (in standard cubic feet per hour) need to be matched against methane concentrations measured during the corresponding time period to determine hourly methane recovery rates, using the following equation:

[CH_4 recovered (standard ft^3/hour)] = [average biogas recovery rate (standard ft^3/hour)]x [average hourly %CH_4].

Calculated hourly methane flows should be tabulated and summed on a daily and monthly basis. Total annual methane recovery from the digester is to be tabulated using the monthly summaries of methane recovery.

In order to estimate the amount of methane combusted in metric tons per year (Mg/yr), the annual methane recovery rate in cubic feet per year needs to be converted to weight using the following formula:

CH_4 combusted (Mg/yr) = [CH_4 recovery (ft^3/yr)] x [16 (molecular weight of CH_4)] x [1Mg/10^6 g]* [1mol/24.04L @ STP] x [28.32L/1cf]

Third-Party Verification of Methane Combustion Rate Calculations

For offset providers who desire to use actual hourly methane concentrations all calculations of hourly, daily, monthly, and annual methane recovery rates, and metric tons of methane combusted, need to be verified as acceptable per the CCX protocol by a CCX-approved Verifier prior to submitting records of annual amounts of methane combusted.

Alternative Method for Calculating Methane Combustion Rates

Energy recovery facilities that use biogas as a fuel to generate electricity typically have detailed records of electrical generation rates in kilowatt-hours (kWhr) that can be used to calculate methane combustion rates. Information on the heat rate of the combustion unit in Btus per kilowatt hour (Btu/kWhr) can be used to calculate Btus of methane combusted. Typically, the high heating value of methane (1,012 Btus per cubic foot) is used to convert to a methane flow rate. The calculation can be summarized as follows:

Methane recovery (ft^3) = [kWhr of electricity produced from the biogas fuel] x [heat rate in Btu/kWhr] / [1012 Btu/ft^3 (HHV of methane)]

For estimating annual methane combustion rates, use the amount of electricity generated over a one-year period in the equation above. The heat rate used in the calculation should be from the most recent source test for the combustion device. If no source test information is available, the heat rate per the manufacturer's specifications should be used.

The following information regarding the measurement of methane combustion at energy recovery facilities must be submitted:

- Type, make, and model number of combustion unit(s);
- Number of combustion units that exclusively use biogas as fuel;
- Heat rate of combustion device(s) per manufacturer's specifications;

- Copy of a summary table from the most recent source test showing the measured heat rate of combustion device(s);
- Summary tables showing kWhr of electricity produced from biogas per month over the annual period;
- Type of electrical metering device; and
- Accuracy, precision, and calibration information on the metering device per manufacturer.

Prior to submitting methane recovery rates to be recorded as metric tons of methane combusted, all calculations of annual methane recovery rates need to be verified as acceptable per the CCX protocol by a CCX-approved Verifier.

Ex Ante Calculations of Baseline Methane Emissions for U.S. Manure Digester Projects

The following procedure for ex ante calculation of baseline methane emissions from manure digester projects in the U.S. follows the IPCC Tier 2 approach and emission factors used in the most recent U.S. Greenhouse Gas Inventory Report

The procedure includes the following general steps for each reporting period (annual reporting is recommended to account for seasonal variability in animal populations and baseline emissions):

1. Characterize the average livestock populations included in the anaerobic digester project for the reporting period;
2. Characterize the baseline manure management system(s) for the project;
3. For each livestock population category and baseline manure management system, multiply the number of animals by the appropriate emission factor for that state (from Tables B.2 and B.3), by the appropriate solids separation correction factor, by the proportion of manure from those animals used in the digester, by the number of days in the period (Equation 1);
4. Sum the estimates for all population categories and baseline manure management systems (Equation 1);
5. Multiply the total estimate of methane emission by the appropriate methane GWP for the reporting period (Equation 2).

$$CH_{4Manure} = \sum_{T,S} N_{(T)} \bullet EF_{(T,S,St)} \bullet SSCF_{(S)} \bullet MS_{(T,S)} \bullet P_{days}$$

(Equation 1)

(Equation 2) $$CO_2e_{Baseline} = \frac{CH_{4Manure} \bullet GWP_{Methane}}{1,000}$$;

Where:

CH_4Manure	=	CH_4 emissions from manure management (kg CH_4 · $period^{-1}$)
N(T)	=	Number of animals in livestock species/category T included in the project (head)
EF(T,S,St)	=	Methane emission factor for livestock category T, manure management system S, and state St (kg CH_4 · $head^{-1}$ · day^{-1}); from Tables B.2 and B.3.
SSCF(S)	=	Solids separation correction factor for manure management system S (unitless fraction)
MS(T,S)	=	Fraction of livestock category T's manure handled using manure management system S (unitless fraction)
Pdays	=	number of days in the reporting period (days)
$CO_{2eBaseline}$	=	Baseline emissions (Mg CO_2 equivalents · $period^{-1}$)
$GWP_{Methane}$	=	Global warming potential of methane (kg CO_{2e} · kg^{-1} CH_4)
1,000	=	Mass conversion factor (kg CO_{2e} · Mg^{-1} CO_{2e})

Livestock Categories

Livestock categories (T) included in this method are listed in Table B.1. For market swine (finishing operations), the use of a population-wide average animal weight is an acceptable conservative alternative.

Table B.1 – Livestock categories and waste characteristics included in baseline methane emission calculations and emission factor derivation1

Livestock Category, T	***Average TAM***[2]	***Total Kjeldhal N Excretion Rates, N_{ex}***	***Maximum Methane Generation Potential, B_o***	***Volatile Solids, VS***
Units	*(kg)*	*(kg/day per 1,000 kg mass)*	*(m3 CH4/kg VS)*	*(kg/day per 1,000 kg mass)*
Dairy Cattle				
Dairy Cows	604	0.44	0.24	(from Table B.4)
Dairy Heifer	476	0.31	0.17	(from Table B.4)
Beef Cattle				
Feedlot Steers	420	0.30	0.33	(from Table B.4)
Feedlot Heifers	420	0.30	0.33	(from Table B.4)
Swine				
Market < 60 lbs	16	0.60	0.48	8.8
Market 60-119 lbs	41	0.42	0.48	5.4
Market 120-179 lbs	68	0.42	0.48	5.4
Market >180 lbs	91	0.42	0.48	5.4
Breeding	198	0.24	0.48	2.6

[1]Data From Table A-157, Appendix 3.9, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2004
[2]Typical Animal Mass

Emission Factors

State-specific methane emission factors (EF(T,S,St)) for each livestock category (T) and baseline manure management system (S) included in this method are listed in Tables B.2 and B.3. Emission factors were derived as in Equation 3 using typical animal mass (TAM) and maximum methane generation potential (Bo) data from Table A.1, and using state-specific data for volatile solids production rates (VS) and methane conversion factors (MCF) for the different baseline manure management systems from Tables B.4 and B.5.

$$EF_{(T,S,St)} = TAM_{(T)} \bullet \frac{VS_{(T,St)}}{1{,}000} \bullet B_{o(T)} \bullet 0.67 \bullet \frac{MCF_{(S,St)}}{100}$$

(Equation 3)

Where:

- EF(T,S,St) = CH_4 emission factor for livestock category T, manure management system S and state St (kg $CH_4 \cdot head^{-1} \cdot day^{-1}$); from Tables B.2 and B.3.
- TAM(T) = Typical animal mass for livestock species/category T (kg $\cdot$ $head^{-1}$)
- VS(T,St) = Volatile solids production rate for each livestock category and state (kg VS $\cdot$ $day^{-1} \cdot$ 1,000 kg^{-1} animal mass)
- Bo(T) = Maximum CH_4 generation potential for livestock category T (m^3 $CH_4 \cdot kg^{-1}$ VS)
- MCF(S,St) = Methane conversion factor for baseline manure management system S, and state St (%)
- 0.67 = CH_4 volume to mass conversion factor (kg $CH_4 \cdot m^{-3}$ CH_4)
- 1,000 = VS conversion factor (kg animal mass $\cdot$ 1000 kg^{-1} animal mass)
- 100 = MCF percentage conversion factor

Solids Separation Correction Factor

For baseline liquid slurry storage or anaerobic lagoon manure management systems that separate manure solids prior to the input of liquid manure, a default solids separation correction factor (SSCF) of 0.8 must be used to calculate baseline emissions. Project specific correction factors may be used if supported by manufacturer's specifications or other acceptable data. For those systems that do not separate solids, or that utilize simple gravity separation of sand and other non-manure solids, the SSCF is equal to 1.

For projects which did not use solids separation in the baseline case, but subsequently utilize solids separation prior to the input of liquid manure to the digester, the separated solids must be handled in a manner that ensures negligible production of methane (e.g., aerobic composting, use as animal bedding, or daily spread), otherwise, the appropriate solids separation correction factor must be used to calculate baseline emissions.

Sample Baseline Emission Values

Tables B.6 and B.7 give annual baseline GHG emissions, as metric tons of CO_{2e} per head, for liquid slurry/pit storage and anaerobic lagoon manure management systems by livestock category (T) and state, assuming no solids separation and a global warming potential for methane of 21.

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Table B.2 – Methane emission factors (EF(T,S,St)) for liquid slurry/pit storage baseline manure management systems (S) by livestock category (T) and State (St); (kg CH_4 · $head^{-1}$ · day^{-1}).

State	Dairy Cow	Dairy Heifer	Feedlot Steers	Feedlot Heifers	Market Swine <60 lbs.	Market Swine 60-119 lbs.	Market Swine 120-179 lbs.	Market Swine >180 lbs.	Breeding Swine
Alabama	0.317	0.142	0.143	0.138	0.017	0.027	0.045	0.061	0.064
Alaska	0.146	0.051	0.051	0.049	0.006	0.010	0.016	0.022	0.023
Arizona	0.562	0.196	0.195	0.189	0.024	0.038	0.063	0.084	0.088
Arkansas	0.300	0.148	0.132	0.128	0.016	0.026	0.043	0.057	0.060
California	0.342	0.139	0.139	0.134	0.017	0.027	0.045	0.060	0.062
Colorado	0.186	0.082	0.081	0.079	0.010	0.016	0.026	0.035	0.037
Connecticut	0.195	0.079	0.089	0.086	0.011	0.017	0.028	0.038	0.040
Delaware	0.243	0.099	0.110	0.107	0.013	0.021	0.035	0.047	0.049
Florida	0.429	0.193	0.193	0.188	0.024	0.037	0.062	0.082	0.086
Georgia	0.315	0.141	0.142	0.138	0.017	0.027	0.045	0.061	0.063
Hawaii	0.630	0.220	0.219	0.212	0.027	0.043	0.071	0.094	0.099
Idaho	0.245	0.086	0.085	0.082	0.011	0.017	0.027	0.037	0.038
Illinois	0.222	0.099	0.100	0.097	0.012	0.019	0.032	0.043	0.045
Indiana	0.215	0.096	0.097	0.094	0.012	0.019	0.031	0.041	0.043
Iowa	0.204	0.091	0.092	0.089	0.011	0.018	0.029	0.039	0.041
Kansas	0.268	0.118	0.117	0.113	0.014	0.023	0.038	0.050	0.053
Kentucky	0.250	0.112	0.113	0.109	0.014	0.022	0.036	0.048	0.050
Louisiana	0.383	0.189	0.168	0.163	0.021	0.033	0.054	0.073	0.076
Maine	0.159	0.065	0.072	0.070	0.009	0.014	0.023	0.031	0.032
Maryland	0.225	0.092	0.103	0.099	0.012	0.020	0.033	0.044	0.046
Massachusetts	0.189	0.077	0.086	0.083	0.011	0.017	0.027	0.037	0.038
Michigan	0.182	0.081	0.082	0.079	0.010	0.016	0.026	0.035	0.036
Minnesota	0.188	0.084	0.085	0.082	0.010	0.016	0.027	0.036	0.038
Mississippi	0.330	0.148	0.149	0.144	0.018	0.029	0.047	0.063	0.066
Missouri	0.251	0.112	0.113	0.110	0.014	0.022	0.036	0.048	0.050
Montana	0.177	0.078	0.077	0.075	0.010	0.015	0.025	0.033	0.035
Nebraska	0.224	0.099	0.098	0.094	0.012	0.019	0.032	0.042	0.044
Nevada	0.271	0.095	0.094	0.091	0.012	0.018	0.030	0.041	0.043
New Hampshire	0.172	0.070	0.078	0.075	0.010	0.015	0.025	0.033	0.035
New Jersey	0.216	0.088	0.098	0.095	0.012	0.019	0.031	0.042	0.044
New Mexico	0.344	0.120	0.120	0.116	0.015	0.023	0.038	0.052	0.054
New York	0.177	0.072	0.081	0.078	0.010	0.015	0.026	0.034	0.036
North Carolina	0.277	0.124	0.125	0.121	0.015	0.024	0.040	0.053	0.056
North Dakota	0.182	0.080	0.079	0.077	0.010	0.015	0.026	0.034	0.036
Ohio	0.205	0.092	0.092	0.089	0.011	0.018	0.029	0.039	0.041
Oklahoma	0.303	0.150	0.133	0.129	0.017	0.026	0.043	0.058	0.060
Oregon	0.241	0.084	0.084	0.081	0.010	0.016	0.027	0.036	0.038
Pennsylvania	0.206	0.084	0.094	0.091	0.011	0.018	0.030	0.040	0.042
Rhode Island	0.201	0.082	0.091	0.088	0.011	0.018	0.029	0.039	0.041
South Carolina	0.311	0.140	0.140	0.136	0.017	0.027	0.045	0.060	0.063
South Dakota	0.203	0.089	0.089	0.086	0.011	0.017	0.029	0.038	0.040
Tennessee	0.268	0.120	0.121	0.117	0.015	0.023	0.038	0.052	0.054
Texas	0.345	0.171	0.152	0.147	0.019	0.030	0.049	0.066	0.069
Utah	0.277	0.097	0.096	0.093	0.012	0.019	0.031	0.041	0.043
Vermont	0.165	0.067	0.075	0.073	0.009	0.014	0.024	0.032	0.033
Virginia	0.230	0.103	0.103	0.100	0.013	0.020	0.033	0.044	0.046
Washington	0.247	0.086	0.086	0.083	0.011	0.017	0.028	0.037	0.039
West Virginia	0.207	0.084	0.094	0.091	0.011	0.018	0.030	0.040	0.042
Wisconsin	0.185	0.083	0.083	0.081	0.010	0.016	0.026	0.035	0.037
Wyoming	0.179	0.079	0.078	0.075	0.010	0.015	0.025	0.034	0.035

Table B.3 – Methane emission factors (EF(T,S,St)) for anaerobic lagoon baseline manure management systems (S) by livestock category (T) and State (St); (kg $CH_4 \cdot head^{-1} \cdot day^{-1}$).

State	Dairy Cow	Dairy Heifer	Feedlot Steers	Feedlot Heifers	Market Swine <60 lbs.	Market Swine 60-119 lbs.	Market Swine 120-179 lbs.	Market Swine >180 lbs.	Breeding Swine
Alabama	0.624	0.280	0.281	0.272	0.034	0.054	0.090	0.120	0.125
Alaska	0.510	0.178	0.177	0.171	0.022	0.034	0.057	0.076	0.080
Arizona	0.837	0.293	0.291	0.281	0.036	0.056	0.094	0.125	0.131
Arkansas	0.630	0.311	0.277	0.269	0.034	0.054	0.090	0.120	0.126
California	0.692	0.281	0.280	0.271	0.035	0.054	0.090	0.120	0.126
Colorado	0.560	0.246	0.244	0.236	0.030	0.047	0.079	0.105	0.110
Connecticut	0.567	0.231	0.258	0.249	0.031	0.049	0.082	0.110	0.115
Delaware	0.604	0.246	0.275	0.266	0.033	0.053	0.087	0.117	0.122
Florida	0.640	0.287	0.288	0.280	0.035	0.055	0.092	0.123	0.129
Georgia	0.622	0.279	0.280	0.272	0.034	0.054	0.089	0.119	0.125
Hawaii	0.814	0.285	0.283	0.273	0.035	0.055	0.091	0.122	0.128
Idaho	0.721	0.252	0.251	0.242	0.031	0.049	0.081	0.108	0.113
Illinois	0.591	0.264	0.266	0.258	0.032	0.051	0.084	0.113	0.118
Indiana	0.584	0.261	0.262	0.254	0.032	0.050	0.083	0.112	0.117
Iowa	0.576	0.257	0.259	0.251	0.032	0.050	0.082	0.110	0.115
Kansas	0.625	0.275	0.273	0.264	0.034	0.053	0.088	0.118	0.123
Kentucky	0.602	0.270	0.271	0.263	0.033	0.052	0.086	0.116	0.121
Louisiana	0.641	0.316	0.282	0.273	0.035	0.055	0.091	0.122	0.128
Maine	0.517	0.210	0.235	0.227	0.029	0.045	0.075	0.100	0.105
Maryland	0.589	0.240	0.268	0.259	0.033	0.051	0.085	0.114	0.119
Massachusetts	0.561	0.228	0.255	0.247	0.031	0.049	0.081	0.109	0.114
Michigan	0.551	0.246	0.248	0.240	0.030	0.047	0.079	0.105	0.110
Minnesota	0.561	0.251	0.252	0.245	0.031	0.048	0.080	0.107	0.112
Mississippi	0.626	0.281	0.282	0.273	0.034	0.054	0.090	0.120	0.126
Missouri	0.610	0.272	0.274	0.266	0.033	0.053	0.087	0.117	0.122
Montana	0.553	0.243	0.241	0.233	0.030	0.047	0.078	0.104	0.109
Nebraska	0.600	0.264	0.262	0.253	0.032	0.051	0.084	0.113	0.118
Nevada	0.744	0.260	0.259	0.250	0.032	0.050	0.083	0.111	0.117
New Hampshire	0.535	0.218	0.243	0.235	0.030	0.047	0.077	0.104	0.108
New Jersey	0.587	0.239	0.267	0.258	0.033	0.051	0.085	0.114	0.119
New Mexico	0.785	0.275	0.273	0.264	0.034	0.053	0.088	0.118	0.123
New York	0.544	0.221	0.247	0.239	0.030	0.047	0.079	0.105	0.110
North Carolina	0.614	0.275	0.276	0.268	0.034	0.053	0.088	0.118	0.124
North Dakota	0.561	0.247	0.245	0.237	0.030	0.048	0.079	0.106	0.111
Ohio	0.574	0.257	0.258	0.250	0.031	0.049	0.082	0.110	0.115
Oklahoma	0.632	0.312	0.278	0.269	0.034	0.054	0.090	0.120	0.126
Oregon	0.707	0.247	0.246	0.238	0.030	0.048	0.079	0.106	0.111
Pennsylvania	0.575	0.234	0.261	0.253	0.032	0.050	0.083	0.111	0.117
Rhode Island	0.575	0.234	0.261	0.253	0.032	0.050	0.083	0.111	0.117
South Carolina	0.624	0.280	0.281	0.272	0.034	0.054	0.090	0.120	0.125
South Dakota	0.584	0.257	0.255	0.246	0.032	0.050	0.082	0.110	0.115
Tennessee	0.610	0.274	0.275	0.267	0.034	0.053	0.088	0.117	0.123
Texas	0.639	0.316	0.281	0.272	0.035	0.055	0.091	0.122	0.127
Utah	0.751	0.263	0.261	0.252	0.032	0.051	0.084	0.112	0.118
Vermont	0.527	0.214	0.240	0.232	0.029	0.046	0.076	0.102	0.107
Virginia	0.592	0.266	0.267	0.259	0.033	0.051	0.085	0.114	0.119
Washington	0.717	0.251	0.249	0.241	0.031	0.048	0.080	0.107	0.112
West Virginia	0.570	0.232	0.259	0.251	0.032	0.050	0.082	0.110	0.116
Wisconsin	0.560	0.250	0.251	0.244	0.031	0.048	0.080	0.107	0.112
Wyoming	0.554	0.244	0.241	0.234	0.030	0.047	0.078	0.104	0.109

Table B.4 – Volatile solids production rates (VS(T,St)) by livestock category (T) and State (St)1 used for derivation of methane emission factors (EF(T,S,St)); (kg VS · day^{-1} · 1,000 kg^{-1} animal mass).

State	Dairy Cow	Dairy Heifer	Feedlot Steers	Feedlot Heifers
Alabama	8.47	6.81	3.87	3.99
Alaska	10.87	6.81	3.82	3.95
Arizona	10.87	6.81	3.82	3.95
Arkansas	8.55	7.56	3.81	3.93
California	9.35	6.81	3.83	3.96
Colorado	8.64	6.81	3.81	3.94
Connecticut	8.41	6.13	3.87	4.00
Delaware	8.41	6.13	3.87	4.00
Florida	8.47	6.81	3.87	3.99
Georgia	8.47	6.81	3.87	3.99
Hawaii	10.87	6.81	3.82	3.95
Idaho	10.87	6.81	3.82	3.95
Illinois	8.51	6.81	3.88	4.00
Indiana	8.51	6.81	3.88	4.00
Iowa	8.51	6.81	3.88	4.00
Kansas	8.64	6.81	3.81	3.94
Kentucky	8.47	6.81	3.87	3.99
Louisiana	8.55	7.56	3.81	3.93
Maine	8.41	6.13	3.87	4.00
Maryland	8.41	6.13	3.87	4.00
Massachusetts	8.41	6.13	3.87	4.00
Michigan	8.51	6.81	3.88	4.00
Minnesota	8.51	6.81	3.88	4.00
Mississippi	8.47	6.81	3.87	3.99
Missouri	8.51	6.81	3.88	4.00
Montana	8.64	6.81	3.81	3.94
Nebraska	8.64	6.81	3.81	3.94
Nevada	10.87	6.81	3.82	3.95
New Hampshire	8.41	6.13	3.87	4.00
New Jersey	8.41	6.13	3.87	4.00
New Mexico	10.87	6.81	3.82	3.95
New York	8.41	6.13	3.87	4.00
North Carolina	8.47	6.81	3.87	3.99
North Dakota	8.64	6.81	3.81	3.94
Ohio	8.51	6.81	3.88	4.00
Oklahoma	8.55	7.56	3.81	3.93
Oregon	10.87	6.81	3.82	3.95
Pennsylvania	8.41	6.13	3.87	4.00
Rhode Island	8.41	6.13	3.87	4.00
South Carolina	8.47	6.81	3.87	3.99
South Dakota	8.64	6.81	3.81	3.94
Tennessee	8.47	6.81	3.87	3.99
Texas	8.55	7.56	3.81	3.93
Utah	10.87	6.81	3.82	3.95
Vermont	8.41	6.13	3.87	4.00
Virginia	8.47	6.81	3.87	3.99
Washington	10.87	6.81	3.82	3.95
West Virginia	8.41	6.13	3.87	4.00
Wisconsin	8.51	6.81	3.88	4.00
Wyoming	8.64	6.81	3.81	3.94

[1]Data from Table A-158, Appendix 3.10, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2004

Table B.5 – Methane conversion factors ($MCF_{(S,St)}$) by baseline manure management system (S) and State (St)[1] used for derivation of methane emission factors ($EF_{(T,S,St)}$); (percent).

State	Liquid/Slurry and Deep Pit	Anaerobic Lagoon
Alabama	38.5	75.8
Alaska	13.8	48.3
Arizona	53.2	79.3
Arkansas	36.1	75.9
California	37.7	76.2
Colorado	22.2	66.7
Connecticut	23.9	69.4
Delaware	29.7	73.9
Florida	52.2	77.8
Georgia	38.3	75.6
Hawaii	59.7	77.1
Idaho	23.2	68.3
Illinois	26.9	71.5
Indiana	26.0	70.6
Iowa	24.7	69.7
Kansas	31.9	74.5
Kentucky	30.4	73.2
Louisiana	46.1	77.2
Maine	19.5	63.3
Maryland	27.6	72.1
Massachusetts	23.2	68.7
Michigan	22.0	66.7
Minnesota	22.8	67.9
Mississippi	40.1	76.1
Missouri	30.4	73.8
Montana	21.1	65.9
Nebraska	26.7	71.5
Nevada	25.7	70.5
New Hampshire	21.0	65.5
New Jersey	26.4	71.9
New Mexico	32.6	74.4
New York	21.7	66.6
North Carolina	33.7	74.6
North Dakota	21.7	66.9
Ohio	24.8	69.5
Oklahoma	36.5	76.1
Oregon	22.8	67.0
Pennsylvania	25.2	70.4
Rhode Island	24.6	70.4
South Carolina	37.8	75.8
South Dakota	24.2	69.6
Tennessee	32.6	74.2
Texas	41.6	77.0
Utah	26.2	71.1
Vermont	20.2	64.5
Virginia	27.9	72.0
Washington	23.4	67.9
West Virginia	25.3	69.8
Wisconsin	22.4	67.7
Wyoming	21.3	66.0

[1]Data from Table A-165, Appendix 3.10, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2004

Table B.6 – Baseline annual GHG emissions for ***liquid slurry/pit storage*** manure management systems (*S*) by livestock category (*T*) and state, assuming $GWP_{Methane}$ = 21 and no solids separation; (metric tons CO_2e per head per year).

State	Dairy Cow	Dairy Heifer	Feedlot Steers	Feedlot Heifers	Market Swine <60 lbs.	Market Swine 60-119 lbs.	Market Swine 120-179 lbs.	Market Swine >180 lbs.	Breeding Swine
Alabama	2.43	1.09	1.09	1.06	0.13	0.21	0.35	0.47	0.49
Alaska	1.12	0.39	0.39	0.38	0.05	0.08	0.12	0.17	0.18
Arizona	4.31	1.51	1.50	1.45	0.18	0.29	0.48	0.64	0.68
Arkansas	2.30	1.13	1.01	0.98	0.13	0.20	0.33	0.44	0.46
California	2.62	1.07	1.06	1.03	0.13	0.21	0.34	0.46	0.48
Colorado	1.43	0.63	0.62	0.60	0.08	0.12	0.20	0.27	0.28
Connecticut	1.50	0.61	0.68	0.66	0.08	0.13	0.22	0.29	0.30
Delaware	1.86	0.76	0.85	0.82	0.10	0.16	0.27	0.36	0.38
Florida	3.29	1.48	1.48	1.44	0.18	0.28	0.47	0.63	0.66
Georgia	2.42	1.08	1.09	1.06	0.13	0.21	0.35	0.46	0.49
Hawaii	4.83	1.69	1.68	1.62	0.21	0.33	0.54	0.72	0.76
Idaho	1.88	0.66	0.65	0.63	0.08	0.13	0.21	0.28	0.29
Illinois	1.70	0.76	0.77	0.74	0.09	0.15	0.24	0.33	0.34
Indiana	1.65	0.74	0.74	0.72	0.09	0.14	0.24	0.31	0.33
Iowa	1.56	0.70	0.70	0.68	0.09	0.13	0.22	0.30	0.31
Kansas	2.05	0.90	0.89	0.87	0.11	0.17	0.29	0.39	0.40
Kentucky	1.92	0.86	0.86	0.84	0.11	0.17	0.28	0.37	0.39
Louisiana	2.93	1.45	1.29	1.25	0.16	0.25	0.42	0.56	0.59
Maine	1.22	0.50	0.56	0.54	0.07	0.11	0.18	0.24	0.25
Maryland	1.73	0.70	0.79	0.76	0.10	0.15	0.25	0.33	0.35
Massachusetts	1.45	0.59	0.66	0.64	0.08	0.13	0.21	0.28	0.29
Michigan	1.39	0.62	0.63	0.61	0.08	0.12	0.20	0.27	0.28
Minnesota	1.44	0.65	0.65	0.63	0.08	0.12	0.21	0.28	0.29
Mississippi	2.53	1.13	1.14	1.10	0.14	0.22	0.36	0.49	0.51
Missouri	1.93	0.86	0.87	0.84	0.11	0.17	0.28	0.37	0.39
Montana	1.36	0.60	0.59	0.57	0.07	0.12	0.19	0.26	0.27
Nebraska	1.72	0.76	0.75	0.72	0.09	0.15	0.24	0.32	0.34
Nevada	2.08	0.73	0.72	0.70	0.09	0.14	0.23	0.31	0.33
New Hampshire	1.31	0.53	0.60	0.58	0.07	0.11	0.19	0.25	0.27
New Jersey	1.65	0.67	0.75	0.73	0.09	0.14	0.24	0.32	0.34
New Mexico	2.64	0.92	0.92	0.89	0.11	0.18	0.30	0.39	0.41
New York	1.36	0.55	0.62	0.60	0.08	0.12	0.20	0.26	0.28
North Carolina	2.12	0.95	0.96	0.93	0.12	0.18	0.31	0.41	0.43
North Dakota	1.40	0.61	0.61	0.59	0.08	0.12	0.20	0.26	0.28
Ohio	1.57	0.70	0.71	0.68	0.09	0.14	0.22	0.30	0.31
Oklahoma	2.32	1.15	1.02	0.99	0.13	0.20	0.33	0.44	0.46
Oregon	1.85	0.65	0.64	0.62	0.08	0.12	0.21	0.28	0.29
Pennsylvania	1.58	0.64	0.72	0.69	0.09	0.14	0.23	0.31	0.32
Rhode Island	1.54	0.63	0.70	0.68	0.09	0.13	0.22	0.30	0.31
South Carolina	2.38	1.07	1.07	1.04	0.13	0.21	0.34	0.46	0.48
South Dakota	1.56	0.68	0.68	0.66	0.08	0.13	0.22	0.29	0.31
Tennessee	2.06	0.92	0.93	0.90	0.11	0.18	0.30	0.39	0.41
Texas	2.65	1.31	1.16	1.13	0.14	0.23	0.38	0.50	0.53
Utah	2.12	0.74	0.74	0.71	0.09	0.14	0.24	0.32	0.33
Vermont	1.26	0.51	0.58	0.56	0.07	0.11	0.18	0.24	0.26
Virginia	1.76	0.79	0.79	0.77	0.10	0.15	0.25	0.34	0.35
Washington	1.89	0.66	0.66	0.64	0.08	0.13	0.21	0.28	0.30
West Virginia	1.58	0.64	0.72	0.70	0.09	0.14	0.23	0.31	0.32
Wisconsin	1.42	0.63	0.64	0.62	0.08	0.12	0.20	0.27	0.28
Wyoming	1.37	0.60	0.60	0.58	0.07	0.12	0.19	0.26	0.27

Table B.7 – Baseline annual GHG emissions for anaerobic lagoon manure management systems (S) by livestock category (T) and state, assuming GWP Methane = 21 and no solids separation; (metric tons CO_{2e} per head per year).

State	Dairy Cow	Dairy Heifer	Feedlot Steers	Feedlot Heifers	Market Swine <60 lbs.	Market Swine 60-119 lbs.	Market Swine 120-179 lbs.	Market Swine >180 lbs.	Breeding Swine
Alabama	4.78	2.15	2.15	2.09	0.26	0.41	0.69	0.92	0.96
Alaska	3.91	1.37	1.36	1.31	0.17	0.26	0.44	0.59	0.61
Arizona	6.42	2.24	2.23	2.16	0.28	0.43	0.72	0.96	1.01
Arkansas	4.83	2.38	2.12	2.06	0.26	0.41	0.69	0.92	0.96
California	5.30	2.16	2.15	2.08	0.26	0.42	0.69	0.92	0.97
Colorado	4.29	1.89	1.87	1.81	0.23	0.36	0.60	0.81	0.85
Connecticut	4.35	1.77	1.98	1.91	0.24	0.38	0.63	0.84	0.88
Delaware	4.63	1.88	2.10	2.04	0.26	0.40	0.67	0.90	0.94
Florida	4.91	2.20	2.21	2.14	0.27	0.42	0.70	0.94	0.99
Georgia	4.77	2.14	2.15	2.08	0.26	0.41	0.68	0.92	0.96
Hawaii	6.24	2.18	2.17	2.10	0.27	0.42	0.70	0.93	0.98
Idaho	5.53	1.93	1.92	1.86	0.24	0.37	0.62	0.83	0.87
Illinois	4.53	2.02	2.04	1.97	0.25	0.39	0.65	0.87	0.91
Indiana	4.47	2.00	2.01	1.95	0.25	0.39	0.64	0.86	0.90
Iowa	4.42	1.97	1.98	1.92	0.24	0.38	0.63	0.84	0.88
Kansas	4.79	2.11	2.09	2.02	0.26	0.41	0.67	0.90	0.95
Kentucky	4.62	2.07	2.08	2.02	0.25	0.40	0.66	0.89	0.93
Louisiana	4.91	2.43	2.16	2.09	0.27	0.42	0.70	0.94	0.98
Maine	3.96	1.61	1.80	1.74	0.22	0.35	0.57	0.77	0.80
Maryland	4.51	1.84	2.05	1.99	0.25	0.39	0.65	0.87	0.91
Massachusetts	4.30	1.75	1.96	1.89	0.24	0.37	0.62	0.83	0.87
Michigan	4.23	1.89	1.90	1.84	0.23	0.36	0.60	0.81	0.85
Minnesota	4.30	1.92	1.93	1.88	0.24	0.37	0.61	0.82	0.86
Mississippi	4.80	2.15	2.16	2.10	0.26	0.42	0.69	0.92	0.97
Missouri	4.68	2.09	2.10	2.04	0.26	0.40	0.67	0.89	0.94
Montana	4.24	1.86	1.85	1.79	0.23	0.36	0.60	0.80	0.84
Nebraska	4.60	2.02	2.01	1.94	0.25	0.39	0.65	0.87	0.91
Nevada	5.70	2.00	1.98	1.92	0.24	0.38	0.64	0.85	0.89
New Hampshire	4.10	1.67	1.86	1.80	0.23	0.36	0.59	0.79	0.83
New Jersey	4.50	1.83	2.05	1.98	0.25	0.39	0.65	0.87	0.91
New Mexico	6.02	2.11	2.09	2.02	0.26	0.41	0.67	0.90	0.94
New York	4.17	1.70	1.90	1.83	0.23	0.36	0.60	0.81	0.85
North Carolina	4.70	2.11	2.12	2.05	0.26	0.41	0.68	0.90	0.95
North Dakota	4.30	1.89	1.88	1.81	0.23	0.37	0.61	0.81	0.85
Ohio	4.40	1.97	1.98	1.92	0.24	0.38	0.63	0.84	0.88
Oklahoma	4.84	2.39	2.13	2.06	0.26	0.42	0.69	0.92	0.97
Oregon	5.42	1.90	1.88	1.82	0.23	0.37	0.61	0.81	0.85
Pennsylvania	4.41	1.79	2.00	1.94	0.24	0.38	0.64	0.85	0.89
Rhode Island	4.41	1.79	2.00	1.94	0.24	0.38	0.64	0.85	0.89
South Carolina	4.78	2.15	2.15	2.09	0.26	0.41	0.69	0.92	0.96
South Dakota	4.48	1.97	1.95	1.89	0.24	0.38	0.63	0.84	0.88
Tennessee	4.68	2.10	2.11	2.04	0.26	0.40	0.67	0.90	0.94
Texas	4.90	2.42	2.15	2.09	0.27	0.42	0.70	0.93	0.98
Utah	5.75	2.01	2.00	1.93	0.25	0.39	0.64	0.86	0.90
Vermont	4.04	1.64	1.84	1.78	0.22	0.35	0.58	0.78	0.82
Virginia	4.54	2.04	2.04	1.98	0.25	0.39	0.65	0.87	0.91
Washington	5.49	1.92	1.91	1.85	0.24	0.37	0.61	0.82	0.86
West Virginia	4.37	1.78	1.99	1.92	0.24	0.38	0.63	0.85	0.89
Wisconsin	4.29	1.92	1.93	1.87	0.23	0.37	0.61	0.82	0.86
Wyoming	4.25	1.87	1.85	1.79	0.23	0.36	0.60	0.80	0.84

VI. Offset Calculation

Issuance of offsets shall occur at a rate of 21 metric tons CO_2 per metric ton of methane.

The overall approach to quantifying methane emissions reductions described in this report is to rely on the lesser of measured or calculated quantities of methane collected through the operation of an anaerobic digester and destroyed by combustion in a flare or energy recovery facility. Details on acceptable methods for recording rates of methane emissions reduction from combustion of biogas produced from anaerobic digestion of animal manures are provided.

Although there are no regulations currently requiring the control of biogas emissions from the treatment of animal manures using anaerobic digestion or other methods, the USEPA's National Resource Conservation Service has published a guidance document for the operation of three categories of anaerobic digesters, including: (1) covered anaerobic lagoons; (2) complete mix digesters; and (3) plug flow digesters. The guidance document contains practice standards that should be followed at anaerobic digester facilities seeking to earn offsets through methane emissions reductions. The standards are included as Appendix F of a handbook on the use of biogas technologies for managing livestock manure, which is available on the web at http://www.epa.gov/outreach/agstar/library/handbook/appendixf.pdf.

VII. Third Party Verification

Agriculture Methane Emission Destruction

This protocol provides the methods to be employed in quantifying methane combustion by agricultural methane Projects. The Project Verifier must document (among other items):

(1) the Project Owner's clear ownership rights to Greenhouse Gas emission reductions associated with sites included in the Project;
(2) eligibility of the site to earn CCX XMOs,
(3) records of methane content and total gas flows or total electricity generation and engine manufacturer's efficiency rating (if applicable).
(4) baseline practice,
(5) average livestock populations for the crediting period, emissions factor, solid separation factor, manure proportion and the number of days in the period.

XMO Project Registration, Verification and Project Reports

Registration of each CCX XMO Project must be accompanied by a Project eligibility statement prepared by a CCX-approved Verifier. The Project Registration Filing must include a signed attestation that the entity registering as the CCX Project Owner holds full legal title to the Greenhouse Gas mitigation rights registered as CCX Exchange Offsets that are associated with the facilities included in the registered Project. The filings must contain an attestation by a CCX-approved Verifier as to the quantity of mitigation achieved and Exchange Offset issuance that is prepared in conformance with the rules provided herein, and with the verification protocols prescribed by the Exchange.

VIII. Verification Outline

Overview

- Provide a general introduction to the project
- Provide a description of the scope of work
- Provide the contact information for the following parties
    - Project Owner
    - Project Aggregator
    - CCX-Approved Verifier
- Site Description
    - Provide a detailed description of the biogas unit including the location, size, operating status etc.
    - Provide a detailed description of the geographic boundaries of the project.
        - Provide site map of the facilities
        - Provide sufficient site photographs, including collection and control systems.

Project Eligibility

- Provide a description of the projects eligibility to participate in CCX as a provider of offset credits
- Provide a description of the project owner's eligibility to participate in CCX.

Biogas Collection and Combustion System

- Provide a description of the digester system
- Provide a description of the gas collection systems
- Provide a description of the gas combustion system
- Provide a description of the flow rate meters, monitoring information, maintenance and calibration
- Provide a description of methane concentration measurement devices, monitoring information, maintenance and calibration
- Provide a description of the control device and monitoring information
- Complete the following table of CCX verification criteria

Requirement	Verified (y/n)	Comments
Flow meters		
Type, make and model of device		
Flow meter location		
Records of flow meter		

calibration		
Capability to record flow every 15 minutes		
Means to correct for temperature and pressure		
Monthly tabulation of daily gas flow rate*		
Information on portable instrument and procedures used to check installed flow meter accuracy, including field measurements and flow calculations		
Records of third party verification of flow measurements and procedures		
Methane Concentration		
Type, make and model of metering device		
Gas concentration measurement location		
Dates and results of instrument calibration		
Dates and results of methane measurement		
Monthly tabulations of measured methane concentrations*		
Records of third party verification of methane measurements and procedures		
Control Device		
Type, make and model of device		
Monthly tabulation of operating hours of control device*		
Heat rate of combustion device per		

manufacturers specification		
Copy of summary table from recent source test showing the measured heat rate of the combustion device		
Summary of monthly electricity production over the annual period*		
Type, make and model of electrical metering device		
Accuracy, precision and calibration information on the metering device per manufacturer		

* Provide data in an appendix.

CCX Offset Issuance Calculations

- Provide a description and calculation of methane generation using the ex ante calculation procedures of the CCX protocol.
- Provide a description and calculation of methane combusted.
- Complete the following table for the monitoring period.

Date (monthly)	Gas to control device (scf)*	Methane Content (%)	Total Methane (scf)	Methane combusted (Mg)

*Add columns for additional control devices

- Provide a summary table presenting the direct measured and calculated methane reductions and the offset credit amount.
- Provide conclusions and recommendations regarding project and specifically address any areas of concern.

CCX Project Forms

- Provide a completed offset project verification statement.
- Provide a completed methane project attestation by project owner.

References

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[http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf]

ISO 2006. Greenhouse Gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements (ISO 14064-2).
[http://www.iso.ch/iso/en/commcentre/pressreleases/2006/Ref994.html]

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US EPA 2006. EPA Climate Leaders Draft Offset Protocol, Project Type: Managing Manure with Biogas Recovery Systems (October 2006)
[http://epa.gov/climateleaders/docs/ClimateLeaders_DraftManureOffsetProtocol.pdf]

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[http://www.ghgprotocol.org/templates/GHG5/layout.asp?type=p&MenuId=OTAy]