

5. Greenhouse Gas Emissions Reductions

DAIRY DIGESTER RESEARCH AND DEVELOPMENT PROGRAM 2015

Project Plan: Briefly describe the proposed project and explain how it will result in reduction of GHG emissions annually compared to existing practices for the dairy.

GHG Emissions Reduction Calculations: Use the **California Air Resources Board (CARB) Compliance Offset Protocol - Livestock Projects** to determine your project's baseline emissions and offset (emissions reductions due to implementing the project). Please ensure to use same variable names and symbology as in the protocol.

The protocol may be found at the California Air Resources Board Compliance Offset Protocol Livestock Projects webpage:-

<http://www.arb.ca.gov/regact/2010/capandtrade10/coplivestockfin.pdf>

Show your calculations in detail and provide explanations for all values assigned to variables as appropriate. Provide proper justification for any assumptions made in the calculation process. Greenhouse Gas (GHG) calculations should include destination and GHG impacts of all products and byproducts from the project; estimates for both the upstream and downstream emissions consistent with the CARB Compliance Offset Protocol should be included as well, e.g., transportation of feedstock and products, production of low-carbon fuels, renewable electricity, heat or power used on site, digestate, liquid products/effluents, fertilizer. Refer to Table 4.1 in the CARB Compliance Offset Protocol – Livestock Projects to determine all emission flows to be included. Provide a qualitative discussion of potential upstream/downstream impacts of methane that are in addition to those requested in the CARB Compliance Offset Protocol – Livestock Projects. Examples of all estimates for methane production and release include: fraction of methane produced that is not captured by the power generation engine, methane destruction efficiency of engine (or prime mover), loss of methane (fugitive emission) during conditioning/clean-up of bio-gas, amount of methane in tail gas of RNG upgrade system (methane slip), plan for disposing of methane slip, plan for temporary storage of specific quantity of methane to be subsequently fed to the electric power generator, etc.

Calculate emissions in metric tonnes of carbon dioxide equivalent (MTCO₂e). Provide your calculated results in the following three formats:

1. Total GHG emissions reduction per year,
2. GHG reduction per unit energy-corrected milk (calculation method provided in following section) produced by operation, and,
3. GHG reduction per \$ CDFA grant money invested.

Failure to provide plausible and transparent calculation factors may be grounds for the denial of application.



Please complete and submit the accompanying Greenhouse Gas Reductions Supporting Data Sheet and the Summary of Greenhouse Gas Emissions Reductions.

Use additional sheets as necessary to complete this section.

**GREENHOUSE GAS EMISSIONS SUPPORTING DATA SHEET**

Annual greenhouse gas emissions estimates are based upon previous 12 months' data for the dairy operation. Complete the table below and provide values for the variables requested using data for the proposed project/dairy operation for each month, to be summed to obtain annual emissions reduction estimates. Re-use the table below for each month as needed.

Refer to the California Air Resources Board Compliance Offset Protocol – Livestock Projects for a complete explanation of these variables and proper units. Refer to the [California Climate Data Archive](http://www.calclim.dri.edu/pages/stationmap.html) (<http://www.calclim.dri.edu/pages/stationmap.html>) for a local temperature dataset applicable to your project. Identify clearly the database and temperature source used from the CA Climate Data Archive in your calculation.

Variable	Definition	Value
Month	Specify name of month.	
L	Livestock category [†] (refer to Table A.2. and A.3. of the CARB Compliance Offset Protocol – Livestock Projects) specific to your project. If more than one category applies, denote each category as L ₁ , L ₂ , L ₃ (i.e. L _n), etc.	
P _{Ln}	Annual average population of each appropriate livestock category 'L _n '.	
VS _{Ln}	Volatile solids produced by livestock category 'L _n ' on a dry matter basis (kg/animal/day).	
VS _{Table}	Volatile solid excretion from lookup table (Table A. 3 and Table A. 5 of the CARB Compliance Offset Protocol – Livestock Projects).	
VS _{avail-1, AS}	Previous month's volatile solids available for degradation in anaerobic system 'AS' (kg). e.g. If calculating for March, this value pertains to February.	
VS _{deg-1, AS}	Previous month's volatile solids degraded by	



	anaerobic system 'AS' (kg).	
T_2	Monthly average ambient temperature (K).	
$Mass_{Ln}$	Average live weight for appropriate livestock category. Indicate if value is from site specific data or Appendix A, Table A.2 of the CARB Compliance Offset Protocol – Livestock Projects.	
$B_{0,Ln}$	Maximum methane producing capacity of manure for appropriate livestock category 'L'.	
$MS_{AS, Ln}$	% of manure from appropriate livestock category 'L' sent to anaerobic manure management (storage/treatment) system 'AS'.	
$MS_{Ln, nAS}$	% of manure from appropriate livestock category 'L' in non-anaerobic manure management (storage/treatment) system.	
MCF_{nAS}	Methane Conversion Factor (%) for non-anaerobic storage/treatment system. Please refer to Table A.6.a for MCF values specific to your project.	
GWP	Global Warming Potential of methane based on radiative forcing, integrated up to 100 years † †	25
$Milk_A$	Annual milk production in liters.	
ECM	Energy-Corrected Milk (kg/cow/day) ^{† † †}	
$Fund_R$	Total funds requested from CDFA.	

Note:

[†]Please see Appendix A, Table A.2 and A.3 of the CARB Compliance Offset Protocol – Livestock Projects to determine appropriate livestock category ‘L’ for your operation.

^{††}The value for GWP has been updated to 25 by the Intergovernmental Panel for Climate Change in 2007 (Fourth Assessment). CARB Compliance Offset Protocol is based on a GWP of 21 as per previous IPCC reports. Please use 25 for GHG emissions calculations using the methodology outlined in the CARB Compliance Offset Protocol – Livestock Projects.

^{†††}Please use the equation below to calculate for energy-corrected milk:

ECM (kg/cow/d) = ((((((milk fat % * 41.65) + (milk true protein % * 24.13) + (milk lactose% * 21.60) - 11.72) / 1000) * 2.204)) * (milk, kg/d))) / (0.721),

where the values that are multiplied by the milk components (i.e. fat, protein and lactose) are their energetic values and the value that it is divided by (i.e. 0.721 Mcal/kg) is the energy value of 1 kg of standard milk. Standard milk is defined for this program as 3.75% fat, 3.0% true protein and 4.9% lactose.

SUMMARY OF GREENHOUSE GAS EMISSION REDUCTIONS

Directions: Each section of this document must have a response. After you complete this document, save it to your computer, and attach to your application. Provide for 10-years *only*, and choose the box when your project will begin emission reductions. ***Please note that estimated reductions are based upon project baseline methane calculations for the operation, and may change if there are changes in the herd size.*** Please account for any projected herd size changes at the dairy operation in 10-year future estimated GHG reductions calculations.

Applicant Name	
Project Name/Location	

A. Estimated GHG Reductions (MTCO₂e Per Year)

	(2015)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	(2026)	Total	Total MTCO ₂ e per Grant \$
Anaerobic Digestion														
Cumulative Total														



B. MTCO₂e Reductions per Unit Energy-Corrected Milk Produced by Dairy Operation

	(2015)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	(2026)	Total	Total MTCO ₂ e per Grant \$
Anaerobic Digestion														
Cumulative Total														

C. MTCO₂e Reductions per \$ CDEA Grant

	(2015)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	(2026)	Total	Total MTCO ₂ e per Grant \$
Anaerobic Digestion														
Cumulative Total														