UK COWCREDIT PROJECT

A UK DAIRY INITIATIVE TO REDUCE METHANE FROM ENTERIC FERMENTATION AND SUPPORT FARMERS

MOOTRAL

Document Prepared by Mootral SA

Project Title	*UK CowCredit project: A UK dairy initiative to reduce methane from enteric fermentation*
Version	*7*
Report ID	*002*
Date of Issue	*21-June-2023*
Project ID	*2072*
Monitoring Period	*1st March 2020 to 30th September 2022*
Prepared By	*Christelle Girard*
Contact	*Mootral SA | A-One Business Center | Z.A. La Pièce 1 - A5 | Route de l'Etraz | 1180 Rolle, Switzerland | +41 21 805 05 92* *Cgirard@mootral.com , www.mootral.com*

CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The UK CowCredit project (Project or Project activity) aims to involve the UK dairy industry with the purpose to reduce greenhouse gas (GHG) emissions from the livestock sector. The project activity introduces Mootral® natural feed supplement into dairy cattle diet aiming to reduce methane (CH_4) emissions from enteric fermentation by direct inhibition of methanogens in the rumen. The initial project activity instance was a dairy farm of around 400 dairy cows which has implemented the Mootral® natural feed supplement into the cattle diet starting on the 7th of May 2019. In this second monitoring period, 11 new PAIs were added to the initial instance. All of them are dairy farms located in the United Kingdom. This monitoring report covers the second monitoring period from the 1st of March 2020 to the 30th of September 2022. It still includes the initial project activity instance for the full monitoring period and gradually includes the new PAIs joining the project as from the 1st of January 2022. Around 5000 dairy cows are fed with Mootral® natural feed supplement at the end of the monitoring period.

The total GHG emissions reductions generated during in this monitoring period are 2,994 tCO2e.

1.2 Sectoral Scope and Project Type

The Project falls under the VCS Sectoral Scope: Livestock and manure management. The Project is a grouped project.

1.3 Project Proponent

Organization name	Mootral SA
Contact person	Christelle Girard
Title	Director - Carbon and Operations
Address	A-One Business Center, Z.A La Pièce 1/A5, 1180 Rolle, Switzerland
Telephone	+4179 827 93 53
Email	cgirard@mootral.com

1.4 Other Entities Involved in the Project

N / A

1.5 Project Start Date

The project start date is the 7th of May 2019.

1.6 Project Crediting Period

The project crediting period is 10 years from 07/05/2019 to 07/05/2029 (1st crediting period), twice renewable for a total of 30 years.[1]

1st Monitoring period: 7 May 2019 to 29 February 2020.

2nd Monitoring period: 1st March 2020 to 30th of September 2022

1.7 Project Location

This project activity is implemented within the geographical area of the United Kingdom.

A KML file with the geodetic coordinates of all PAIs is provided separately

1.8 Title and Reference of Methodology

The Project will use the VCS methodology: "VM0041 Methodology for the Reduction of Enteric Methane Emission from Ruminants through the Use of 100% Natural Feed Supplement". V1.0

1.9 Participation under other GHG Programs

The project activity has neither been registered nor is seeking registration under any other GHG programs.

1.10 Other Forms of Credit

The project activity neither has nor intends to generate any other form of GHG-related environmental credit for GHG emission reductions claimed under the VCS Program. Until today, there are no other programs in the UK under which the project is eligible to participate

[1] Because the project is using a new methodology it may apply the VCS version 3 crediting period option of 10 years twice renewable.

1.11 Sustainable Development Contributions

During the monitoring period, the project proponent has implemented the following activities having a positive impact in terms of SD contributions:

1. Recruit and supplement with a feed supplement about 5,000 cows and reduce their methane emission from enteric fermentation by approximately 20%, saving 2,994 tons of CO_2e. (SDG 13)

2. Setup a manufacturing facility in South Wales to produce the feed supplement creating 4 jobs since Q4.2021. This contributes to SDG 8

3. Increase R&D efforts in its R&D facility in South Wales by hiring young scientists to develop the new versions of the feed supplement. During the first semester 2022 the company has hired 6 new scientists < 35 years old. This contributes to SDG 9

Work contracts for all new Mootral employees for the monitoring period are made available to the VVB during the site visite in Abertillery

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	8.5	By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	Implemented activities to raise	During the monitoring period (2021-H1.2022) Mootral has set up a production unit in Abertillery (Wales, UK) to produce the feed supplement to be delivered to the PAIs and created jobs With an investment of 80 k GBP and the creation of 4 jobs in Blaenau-Gwent (South Wales) in a county where the rate of claiming any unemployment benefit is more than 25% higher than the national average and household revenue below national average. The minimum salary on site for unqualified positions is 20% higher minimum national salary. On Sept, 1st 2022, Mootral provides a paid occupation to 13 workers (R&D, manufacturing) https://www.nomisweb.co.uk/reports/lmp/la/1946157401/report.aspx?town=blaenau%20gwent	The initial investment took place during the crediting period. Cumulative results are the same than the ones obtained during this crediting period
2)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to decrease the emissions of CH4 from ruminants	By feeding up to 5000 cows with Mootral feed supplement , the UK CowCredit Project has prevented the release of 80.75 tonnes of methane (equivalent to 2,994 tonnes of carbon) into the atmosphere during the monitoring period	Prevented the release of 309 + 2,994 = 3,303 tonnes of carbon into the atmosphere
3)	9.5	Enhance of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending	Implemented activities to increase	Mootral invests significant amounts into R&D in its laboratory located in Wales (Albertillary) and offered high-level jobs to young academic reasearchers. During the first semester of 2022, 6 scientist jobs were created. All attributed to young scientists (<35 years old) Mootral pursues active research to develop and to produce new and more efficient versions of its current feed supplement.	Since the beginning of the project 6 new scientists were involved in high-level fundamental studies

2 SAFEGUARDS

2.1 No Net Harm

This project does not produce any net harm

2.2 Local Stakeholder Consultation

For the initial validation and during the first monitoring period, the project proponent had widely consulted the local stakeholders on a general basis as described in the PDD in addition to the stakeholders directly linked to the 1st instance.

During the second monitoring period and the addition of new instances to the project, the local stakeholder's consultation was focused on the new entities joining the project. From the initial list of stakeholders, the following were applicable to the new instances:

Stakeholders matrix

Farm number	People working at the farm	Nutritionnist	Feedmill Involved	Milk distributor	UK authorities
1	LSC on-going during all the crediting period as per below description	Involved with farm 1 and 12	none	None : farmer distributes his production	Done at validation
2		Involved with farm 2 and 4	none	Through the farmer	Done at validation
3		None	none	Through the farmer	Done at validation
4		Involved with farm 2 and 4	none	Through the farmer	Done at validation
5		None	none	Through the farmer	Done at validation
6		None	none	Through the farmer	Done at validation
7		None	none	None : farmer distributes his production	Done at validation
8		None	none	Through the farmer	Done at validation
9		None	none	Through the farmer	Done at validation
10		Involved with farm 10	none	Through the farmer	Done at validation
11		None	none	Through the farmer	Done at validation
12		Involved with farm 1 and 12	none	Through the farmer	Done at validation

The PAIs are independent farmers who joined the project on a voluntarily basis. They have been recruited through a recruitment campaign promoted through Mootral website and some advertisements into specialised professional reviews and magazines. The recruitment took place during 3 months at the end of 2021

They had received extensive information about the project through:

- Dedicated web site page
- Ad-hoc documentation: the Blue Book given to each candidate before any commitment
- Introduction call with a Mootral science team member, specialised in animal science

Each farm went through an individual on-boarding process lasting generally up to 3 months with numerous one -to-one calls and / or on-site visits with the project proponent staff (all calls and discussions are loggued and are available for verification). If a nutritionist was involved with one or more farms, he/she was integrated in the exchanges. During these calls/visits, they could express any concern or raise any question they may have, and they did.

The various steps of the project, their rights and obligations are documented in a contract they signed with the project proponent and supplier of the feed supplement. They have provisions to opt-out from the programme if they wish to do so without penalties.

During the visits to the farm, if the farmer delegates the use of the feed supplement to farm's staff, these staffs were consulted about the use of the feed supplement and their remarks collected by Mootral's visitors.

A phone hotline(with local number) is available for the stakeholders to report any concern or to seek advice on any aspects of the project. This hotline is permanently available during the life of the project during business hours and gives access to trained project proponent staff. It collects and answers any grievance or questions that may arise. Content of the discussion are loggued into a CRM " Streak" available internally to all Mootral staff involved in the project. No particular grievance was reported during the monitoring period.

Between 3 to 6 months after they joined, the project proponent organised a gathering event on-line where all participants could exchange about their experience in the project. (recording of the event is available). The event took place on the 11th of August. During this event they were informed about the yet-to-come steps for the verification process.

From the 29 of August to the 2nd of September 2022, the project proponent visited again 9 farms out of 12 to support the on-going verification process and support the farmers in the preparation of the VVB visits if any. An additional round of visits for the 2 remaining farms was done on the 12th of October. PAI's visit reports are available in records.

2.3 AFOLU-Specific Safeguards

This is not an AFOLU project.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

After the first monitoring period, the first PAI of this project continued to use the feed complement as per the agreed protocol and without interruption.

In autumn 2021, Mootral launched a recruitment campaign in UK through its website and some professional magazines to recruit more farms willing to join the project with the objective to have 5,000 dairy cows fed with the feed supplement in 2022.

From all candidates, 11 dairy farms were recruited based on objectives criteria: size, type of farming practices, capacity to provide relevant historical data and capacity to feed the cows with the supplement in a control manner.

Farms were on-boarded one after the other and started to feed their cows when they had completed the on-boarding process. The starting date for each PAI is listed in Annex A. However, the accounting for GHG reduction started on day 15 after the start of the feeding, considering that 14 days is the time required for diet adaptation. Most research indicates that ruminant total-tract digestibility ordinarily adjusts to diet within 10 to 14 days[2]

Only lactating cows are considered in the project. Each cow has a lactating cycle with roughly 10 months in lactation and 2 months without (the dry period which corresponds to the calving time). Dry cows are excluded from the programme and re-integrated when their lactating cycle starts again. 15 days per year are then again considered as adaptation time and deducted in the number of days for the crediting period

There were no changes to the project proponents or other entities during this monitoring period.

[2] Time required for adaptation of behavior, feed intake, and dietary digestibility in cattle. Richard J. Grant*, Heather M. Dann, and Melissa E. Woolpert, William H. Miner Agricultural Research Institute, Chazy, NY.

3.2 Deviations

3.2.1 Methodology Deviations

There are no methodology deviations for this project

3.2.2 Project Description Deviations

This project does not use any project description deviations.

3.3 Grouped Projects

The eligibility criteria for the inclusion of new project activity instances are:

1) All project activity instances meet the applicability conditions set out in the methodology VM0041 applied to the project.

2) All project activity instances introduced and applied Mootral® natural feed supplement into dairy cows diet as specified in the project description.

3) All project activity instances are dairy farms located within the United Kingdom.

4) All project activity instances are subject to the baseline scenario determined in the section 3.4 of the project design document. All farms used conventional feeding regime and management strategies that represent average UK dairy and farming operations without using any other feed supplement or additive to reduce enteric methane emissions before joining the project.

5) All project activity instances have characteristics with respect to additionality consistent with the initial instances and as described in section 3.5 of the project design document. For the second monitoring period, the number of animals fed with Mootral supplement is about 5000 heads while the project is capped to 350,000 animals and additionality was demonstrated in the project design documentation. No other equivalent project is currently taking place in the UK, therefore this project represents the level of penetration of this type of technology in UK. This level of penetration of this type of technology versus its maximal adoption potential remains far below the threshold where additionality ceases

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	GE_j

Data unit	MJ head^{-1} day^{-1} of dry matter
Description	Average monthly gross energy intake for a specific animal group
Source of data	Records and data from livestock operators and nutritionists from March 2020 for the 1st instance and from the date of on-boarding for the new instances until the continuation of the project activity
Value applied	Average monthly values applied See Table 3 Animal grouping parameters and data
Justification of choice of data or description of measurement methods and procedures applied	Gross energy intake is being calculated by dividing dry matter intake by the energy density of the feedstuff (using equation 4 from the applied methodology) The gross energy (GE) content of the diets is calculated based on the fat level of the diets, therefore the livestock operator or associated partners is demonstrating the fat content of the diet. Parameter to be updated with any change in the animal's feeding regime. Monthly records are being monitored and provided to the project proponent.
Purpose of Data	Calculation of baseline emissions
Comments	Calculated based on measured Dry Matter Intake (DMI)

Data / Parameter	DMI_j
Data unit	Kg head^{-1} day^{-1}
Description	Average dry mass of feed consumed by an animal in a given day
Source of data	Historical data covering 3 years before the start of the project as provided by each instance
Value applied	

Farm n°	Group	DMI (kg/head/day)
Farm 1	Group 1	21.91
Farm 1	Group 2	14.93
Farm 2	Group 1	23.24
Farm 3	Group 1	22.01
Farm 4	Group 1	23.36
Farm 5	Group 1	25.36
Farm 6	Group 1	24.33
Farm 7	Group 1	24.18
Farm 8	Group 1	22.62
Farm 9	Group 2	22.44
Farm 10	Group 1	24.66
Farm 11	Group 1	25.21
Farm 12	Group 1	26.60

Justification of choice of data or description of measurement methods and procedures applied	Data are being provided by the livestock operator and associated partners for each animal group. The farm records must document the average daily dry matter intake by animal grouping in the project.
Purpose of Data	Calculation of baseline emissions
Comments	Required to calculate gross energy intake for equation 3

Data / Parameter	Ym_j
Data unit	Dimensionless
Description	Percentage of feed energy converted to methane for each animal group
Source of data	Records and data from livestock operators and nutritionists from March 2020 for the 1st instance and from the date of on-boarding for the new instances until the continuation of the project activity. Default values provided in table 8 (Appendix III) of the methodology applied. Therefore, the source of the data for the PAis is the NDF records provided by the farms.
Value applied	Default values provided in table 8 (Appendix III) of the methodology applied based on the conversion of NDF percentage in the diet Default (unknown diet composition) 6.50% Diet with < 25% NDF 5.50% Diet with 25-30% NDF 6.25% Diet with 30-50% NDF 6.50% Diet with >50% NDF 7%
Justification of choice of data or description of measurement methods and procedures applied	Table 8 in Appendix III from the methodology provides Ym values derived from cattle with diets containing various levels of neutral detergent fibers (NDF). The NDF values of the feed used in the project must be available in order to use Table 8. Parameters to be updated at each change of feeding composition
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	NDF_j
Data unit	Dimensionless
Description	Forage quality indices (% Neutral detergent fibers)
Source of data	Records and data from livestock operators and nutritionists from March 2020 for the 1st instance and from the date of on-boarding for the new instances until the continuation of the project activity
Value applied	Average monthly values applied

	See Table 3 Animal grouping parameters and data
Justification of choice of data or description of measurement methods and procedures applied	Data must be provided by the livestock operator or associated partners for each animal group. The assessment of the quality of forages is typically provided by the farmer's nutritionist formulating the rations for the animals. NDF values are used to determine the Ym. Detailed information can be found in appendix III of the VCS Methodology used for this project activity.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	ED
Data unit	MJ per kg of dry matter
Description	Energy content of dry matter
Source of data	Default value
Value applied	See Table 3 Animal grouping parameters and data
Justification of choice of data or description of measurement methods and procedures applied	The typical energy density of feedstuff is: - 18.45 MJ kg'^{-1} may be used as a default for diets including edible oils with fat contents in the range of 4 to 6% - 19.10 MJ kg'^{-1} may be used as a default for diets including edible oils with fat contents below 4% Parameters to be updated at each change of feeding composition.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	EC
Data unit	MJ per kg of methane
Description	Energy content of methane
Source of data	Default value taken from IPCC 2006 guidance (Section 10.3.2)
Value applied	55.65
Justification of choice of data or description of measurement methods and procedures applied	This is a standard property of methane. In addition, the *IPCC Guidelines for National Greenhouse Gas Inventories* is internationally recognized, and the data provided in the guidelines is peer reviewed. Parameters to be updated each crediting period where new data exists.
Purpose of Data	Calculation of baseline emissions

Comments	N/A

Data / Parameter	$EF_{Enteric_{i,j}}$
Data unit	kg CH_4 per animal group
Description	Enteric methane emission factor for each animal group
Source of data	Calculated using results from 5.1 Baseline Emissions
Value applied	For the instances of project activity: See Table 4
Justification of choice of data or description of measurement methods and procedures applied	To allow for flexibility for potential projects, this methodology provides different options to calculate baseline emissions. For all PAIs option 2 has been applied using farm specific data. Parameters to be updated each crediting period where new data exists.
Purpose of Data	Calculation of baseline emissions
Comment	N/A

Data / Parameter	GWP of CH_4
Data unit	tCO_2/tCH_4
Description	Global warming potential of methane
Source of data	IPCC defaults
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	The IPCC Guidelines for National Greenhouse Gas Inventories is internationally recognized, and the data provided in the guidelines is peer reviewed. To be updated each crediting period where new data exist or accepted by Verra.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter:	$ERF_{Enteric\ j}$
Data unit:	Percentage (dimensionless)
Description:	Enteric emission reduction factor

Source of data:	Provided by the feed manufacturer for each animal group or calculated using equation 7 of the applied methodology. Data records and study report of farm operations. Study: Vrancken, H.,Suenkel, M.,Hargreaves, P.R.,Chew, L.and Towers,E.(2019) Reduction of Enteric Methane Emission in a Commercial Dairy Farm by a Novel Feed Supplement. Open Journal of Animal Sciences, 9, 286-296.
Value applied	20.7% applied for High-yielding-type of cows (above 8,000 liters of milk per year) 38.3 % factors applied for low-yielding-type of cows (below 8,000 liters of milk per year)
Justification of choice of data or description of measurement methods and procedures applied	As per validation and verification of the first crediting period, using peer-reviewed study: Vrancken, H.,Suenkel, M.,Hargreaves, P.R.,Chew, L.and Towers,E.(2019) Reduction of Enteric Methane Emission in a Commercial Dairy Farm by a Novel Feed Supplement. Open Journal of Animal Sciences, 9, 286-296.
Purpose of Data	Determination and calculation of project emissions
Comments	N/A

4.2 Data and Parameters Monitored

Data / Parameter:	N_{ij}
Data unit:	Number of animals (head)
Description:	Average number of head in each animal grouping *j* in the farm *i* consuming a supplement during the monitoring period.
Source of data:	Data records of livestock operations using the feed supplement. Livestock inventory records
Description of measurement methods and procedures to be applied:	Count by farm personnel recorded into farm's records system. Farms are usually using a farm management software, where all data are recorded. If not manual records are maintained. Each animal has a unique identification. Average monthly values are provided to the project proponent based on weekly average.
Frequency of monitoring/recording:	Weekly. Monthly averages are provided
Value applied	Average monthly number of cows per group. See Table 3 Animal grouping parameters and data

Monitoring equipment	Farm's software management system
QA/QC procedures to be applied:	Each farm record must list the number of animals in each group. Management and monitoring system to be established by the project proponent at the start of project. It could include data recording and verification procedures. Records are available to cross check against Farm's livestock inventory records, feed records, etc.
Purpose of data:	• Calculation of baseline emissions • Calculation of project emissions • Calculation of emission reduction
Calculation method:	No calculations are needed.
Comments:	Monitoring is established at the feed purchaser level. An appropriate and unique identification system for the purchasers, e.g. Project participant name, tax identification number, number of animals in each group, unique invoice number and date, would avoid double counting of emissions reduction claimed. At the time of reporting, baseline and project emissions shall be calculated based on livestock population, and other factors specific to the project and time period.

Data / Parameter:	Days
Data unit:	Days
Description:	Number of days project activity implemented in the specific animal grouping.
Source of data:	Data records of livestock operations using project feed supplement
Description of measurement methods and procedures to be applied:	Monthly records are available
Frequency of monitoring/recording:	Once for start date of supplement feeding and once for end date of supplement feeding, for each animal grouping.
Value applied	See Table 3 Animal grouping parameters and data
Monitoring equipment	Feed records from Farm's software management system
QA/QC procedures to be applied:	Management and quality control system to be established by the project proponent at the start of project. It could include data recording and verification procedures.
Purpose of data:	• Calculation of baseline emissions • Calculation of emission reduction

Calculation method:	Days = (End of crediting period – beginning of crediting period) *95.9%
Comments:	To consider the lactating cycle of the cows, 15 days are deducted from the number of days using the feed supplement per year of project to consider the re-acclimation time needed when the cow re-integrates the lactating group. An adjustment factor of 95.9% is applied to the number of days in the crediting period (350 days / 365 days= 95.9)

Data / Parameter:	j
Data unit:	Animal grouping
Description:	Animals at each farm *i* should be grouped based on a homogenous ruminant population characterization
Source of data:	Data records of livestock operations using project feed supplement.
Description of measurement methods and procedures to be applied:	Ruminant Population Characterization: Methane emissions from ruminants vary by animal type, weight, production phase (e.g., pregnant or lactating cow), feed type and seasonal conditions. Accounting for these variations in a ruminant population throughout the year is important to accurately characterize annual emissions. Project proponents must provide evidence at each validation and verification that emissions estimates are based on a homogenous population and the herd size and individual animal characteristics remain constant for a given period. Table 10.1 Representative Livestock Categories, in the IPCC 2006 report is an example of detailed characterization required for each livestock species.
Frequency of monitoring/recording:	Once for validation and at least once per monitoring period
Value applied	2 groups are considered across the PAIs Group 1: High-yielding-type of cows (above 8,000 liters of milk per year) Group 2: Low-yielding-type of cows (below 8,000 liters of milk per year)
Monitoring equipment	Farm's software management system
QA/QC procedures to be applied:	Management and quality control system to be established by the project proponent at the start of project. It could include data recording and verification procedures.
Purpose of data:	• Calculation of baseline emissions • Calculation of emission reduction
Calculation method:	No calculations are needed
Comments:	N/A

Data / Parameter:	FM
Data unit:	Kg
Description:	Amount of feed supplement purchased by the farm *i* during the monitoring period
Source of data:	Data records of livestock operations purchasing project feed supplement
Description of measurement methods and procedures to be applied:	Monitoring is established at the feed purchaser level. An appropriate and unique identification system for the purchasers, e.g. Client name, unique invoice number and date, feed purchase receipts, weights, etc. and/or; feed delivery records. Delivery notes and invoices need to be reconciled between buyer and seller to verify records integrity. Sales records should be cross-checked with both buyer and seller of the feed supplemental to make sure records are consistent.
Frequency of monitoring/recording:	Monthly
Value applied	See Table 5
Monitoring equipment	Farm records showing monthly-purchased complete feed and manufactured complete feed delivered to the farm
QA/QC procedures to be applied:	Management and quality control system to be established by the project proponent at the start of project. It could include data recording and verification procedures. Farm records or third-party managed data showing both monthly-purchased complete feed and manufactured complete feed delivered to each grouping
Purpose of data:	Calculation of project emissions
Calculation method:	No calculations are needed
Comments:	Necessary to measure in order to determine monthly volumes of the feed supplement purchased.

Data / Parameter:	EF_P
Data unit:	kg CO_2e kg^{-1}
Description:	Emission factor for production of feed supplement. GHG emitted per kg of feed. All activities involved at the manufacturer's production facility of the feed supplement.
Source of data:	Records and documentation provided by the feed manufacturer.

Frequency of monitoring/recording:	Monthly
Value applied	0.02993263
Monitoring equipment	Records provided by the production site
QA/QC procedures to be applied:	These values must be based on well-documented, reliable sources (e.g., national energy balances, government publications, industry associations, WRI/WBCSD GHG Protocol)
Purpose of Data	Determination and calculation of project emissions
Calculation method:	Electricity consumption from each production equipment based on the time of use and the declared power by the equipment manufacturer
Comments	N/A

Data / Parameter:	$EF_{T,l}$
Data unit:	tCO2e
Description:	Emission factor for transportation of feed supplement to the farm *l* during the monitoring period. GHG emitted per kg of feed.
Source of data:	Records and documentation provided by the feed manufacturer.
Frequency of monitoring/recording:	Monthly
Value applied	According to distance between production site and the farm See Table 6
Monitoring equipment	N/A
QA/QC procedures to be applied:	The project proponent must provide evidence to demonstrate the level of emission the monitoring period. These values must be based on well-documented, reliable sources (e.g., national energy balances, government publications, industry associations, WRI/WBCSD GHG Protocol)
Purpose of Data	Determination and calculation of project emissions
Calculation method:	No calculations are needed
Comments	N/A

Data / Parameter:	EF_{elec}
Data unit:	kg CO2e KWh^{-1}
Description:	Emission factor for electricity

Source of data:	UK Government Conversion Factors for greenhouse gas (GHG) reporting, [3]
Description of measurement methods and procedures to be applied:	Default values must be sourced from recognized, credible sources and be geographically and temporally relevant to project specifics. Estimation, reference values must be obtained from the relevant national GHG inventory. The value used should be consistent with the source of generation. In the absence of local or regional data, reference values may be obtained from the most recent version of the IPCC guidelines for National Greenhouse Gas Inventories.
Frequency of monitoring/recording:	Annual
Value applied	0.21233 kg CO2e KWh^{-1}
Monitoring equipment	N/A
QA/QC procedures to be applied:	N/A
Purpose of data:	Calculation of project emissions
Calculation method:	No calculations are needed
Comments	The latest approved versions of CDM tools "Tool to calculate the emission factor for an electricity system" may be used to determine Efelec where country or state/province data are not available. https://cdm.unfccc.int/methodologies/Pamethodologies/tools/am-tool-07-v7.0.pdf

Data / Parameter:	EFT
Data unit:	Kg per km or miles per kg of feed ($kgCO_2$ $kg^{-1}km^{-1}$)
Description:	Emission factor values for each mode of transport m
Source of data:	UK Government Conversion Factors for greenhouse gas (GHG) reporting,[4]
Description of measurement methods and procedures to be applied:	Default values must be sourced from recognized, credible sources and be geographically and temporally relevant to project specifics. These values must be based on well-documented, reliable sources. The range of appropriate data must be documented and the chosen data must be justified, using criteria that include data source (recognized and authoritative sources); geographic, temporal and technology specificity; conservativeness (i.e., does not overestimate emission reduction); and where the data is peer reviewed (preferred)

[3] UK Government Conversion Factors for greenhouse gas (GHG) reporting, https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021

[4] UK Government Conversion Factors for greenhouse gas (GHG) reporting, https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021

Frequency of monitoring/recording:	Monthly
Value applied	- HGV (all diesel), Rigid (>17 tonnes), 100% Laden, kg CO_2e/tonne/km (freighting goods): 0.1019 $kgCO_2$ $kg^{-1}km^{-1}$
Monitoring equipment	N/A
QA/QC procedures to be applied:	Where more than one recognized source is available, the most appropriate source must be selected, based on data quality indicators including technological appropriateness, regional specificity, and vintage of the data.
Purpose of data:	Calculation of project emissions
Calculation method:	No calculations are needed
Comments:	N/A

Data / Parameter:	D_i
Data unit:	Distance unit (e.g. kilometers, miles)
Description:	Total distance travelled by the product from the production site to the farm
Source of data:	Data provided by the project proponent or manufacturer
Description of measurement methods and procedures to be applied:	Distance travelled by transport mode delivering feed supplement consumed during the monitoring period to the project location, farm.
Frequency of monitoring/recording:	Monthly
Value applied	See Table 6
Monitoring equipment	N/A
QA/QC procedures to be applied:	N/A
Purpose of data:	Calculation of project emissions
Calculation method:	No calculations are needed
Comments:	N/A

4.3 Monitoring Plan

The monitoring plan involves the monitoring, collection, and reporting of all data described in Section 4.2 above. The responsibility for monitoring lies with the project proponent, Mootral SA and the dairy farms.

The project proponent has established a monitoring plan and GHG information system. The system includes online spreadsheets for obtaining, recording, compiling and analyzing data, parameters and other information important for quantifying and reporting GHG emissions.. Furthermore, people involved in the project received relevant training, to ensure that monitoring duties will be performed by trained staff.

A summary of roles and responsibilities is as follows:

Table 2 Project activity roles and responsibilities

Organisation	Roles	Activities
Mootral	Environmental Solution Provider	• Owner of the proprietary natural feed supplement, Mootral • Supplier of natural feed supplement for enteric methane emission reduction. • Technical support to the farmers for the proper use of the supplement • Carbon project proponent. • Project monitoring
Dairy Farms	Farmers	• Dairy farm feeding ruminants with the feed supplement • Providing data

Data required for the calculation of net emissions reductions are registered in either electronic form through the farm's software or on paper worksheets on the premises by the farmer or a farmer's collaborator, e.g., veterinarian or nutritionist. The farmer is responsible for uploading online all the necessary data. The farm has in place a management system allowing the farmer, among others, to control the feed quantity, animal number and milking cycle stage. The source of the data is the farm software when available, the manual records and the feed analysis reports when available. Online access allows periodic controls of the monitoring records by the project proponent. Data records can be cross-checked to ensure the results are consistent with the raw farm data.

The project proponent maintains a permanent contact with the farms through a technical support by phone and by email. An hotline (UK-based) is available in case of issues with the product (supply, delivery, usage etc) and can be reached during business hours.

A scientist in animal health from the project proponent is also permanently available to technically support the farmers

Support visits: During the first 6 months of use of the solution, a representative number of PAIs pertaining to the project are visited by a Mootral team to ensure that declared data are consistent

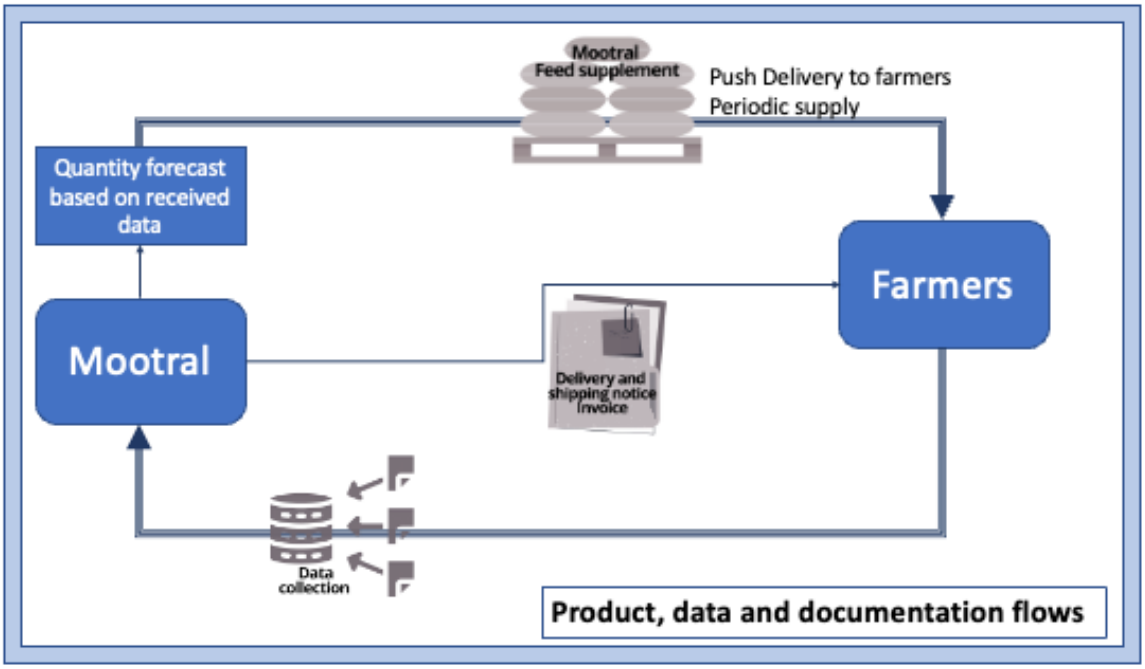
with the farm reality and product is used according to usage instructions. Deviations are followed up upon and shall be corrected.

The project proponent must be able to demonstrate the ruminants for which it is claiming emission reductions have been fed with the appropriate quantity of feed supplement. To do so, project proponent has provided detailed feeding records as per manufacturer instructions (applicability condition 3c) for each farm as well as proof of purchase/delivery of an appropriate quantity of the feed supplement. Proof of purchase may be provided through delivery receipts and invoices, which must contain batch information, or other identification information, that can trace the feed supplement back to the manufacturer.

Supply of Mootral product to the herd on a regular and consistent basis is validated by the auditor through a documentary audit of the supply chain / purchase process and a physical inventory of the product stocks at the farm

The monitoring process is further summarized below as a line diagram, 1. Also, a spreadsheet is available for the verification.

Figure 1 Monitoring process



Quality control and quality assurance procedures will guarantee the quality of monitored data. All data will be archived electronically and backed up regularly. All necessary documents are collected and centrally stored by the project proponent and be available for verification at any time. The data subject to monitoring and required for the determination and further verification are archived and stored in electronic format by the project proponent for at least two years for at least two years after the first crediting period.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The baseline emissions are calculated in accordance with the methodology VM0041. The baseline emissions are calculated using equation 3 in the methodology. Equation 3 becomes:

$$EF_{Enteric_{i,j}} = \left[GE_j \bullet Y_{m,j} \bullet N_{i,j} \bullet Days_{i,j}\right] \bullet EC^{-1}$$

Where:

$EF_{Enteric_{i,j}}$	Enteric CH4 emissions factor for each animal group j during the monitoring period (kg CH4 group^{-1})
GE_j	Average gross energy intake per animal group 1 and 2 in the farm *i* (MJ head^{-1} day^{-1})
Ym_j	Defined by the monthly average of NDF % in the feed
Days	Numbers of days each animal group in the farm is fed with the feed supplement minus the days of acclimation and the correction for leaving the group and coming back once a year
$N_{i,j}$	Average number of head in each animal grouping *j* in the farm *i* in the monitoring period (dimensionless)
EC	Energy content of methane (=55.65 MJ kg^{-1} of CH_4)
i	Identification of livestock farm (1)
j	Animal grouping (1,2)

Gross energy intake GE is calculated by multiplying dry matter intake by the energy density of the feedstuff:

$$GE_j = \left[DMI_j \bullet ED\right]$$

Where

DMI_j	Average dry mass of feed consumed by animal group 1 and 2 in a given day (Kg head^{-1} day^{-1})
ED	Energy Density. Average energy content of dry matter =19.10 MJ kg^{-1}

Table 3 Animal grouping parameters and data

Farm number	Group number	Days in the crediting period Adjusted according to lactation cycle and re-adaptation time *Days*	Average *DMI*	Average NDF content of the feed %	Average Fat content of the feed %	Energy density of feed MJ / kg Average *ED*	Average YM	MJ /Head/day Gross Energy *GE*	Average number of heads *N*	Global emissions of CH_4 for the crediting period (kg) *EFEnteric*	Global emission of CO_2e during this monitoring period (Ton CO_2e) *BE Enteric*
1	Group 1	904	21.91	30.76	4.37	18.45	6.50%	404.31	247.43	105,666.14	2,958.65
1	Group 2	904	14.93	30.76	4.37	18.45	6.50%	275.41	151.96	44,206.92	1,237.79
2	Group 1	148	23.24	30.95	5.30	18.45	6.50%	428.80	292.17	21,610.83	605.10
3	Group 1	132	22.01	34.13	3.02	19.10	6.50%	420.35	280.33	18,215.04	510.02
4	Group 1	105	23.36	36.58	4.55	18.45	6.50%	431.00	334.65	17,610.17	493.08
5	Group 1	159	25.36	36.47	4.12	18.45	6.50%	467.88	140.42	12,216.08	342.05
6	Group 1	161	24.33	38.58	3.46	19.10	6.50%	464.77	296.45	25,927.61	725.97
7	Group 1	96	24.18	36.15	3.78	19.10	6.50%	461.78	96.95	5,014.71	140.41
8	Group 1	152	22.62	33.12	4.20	18.45	6.50%	417.36	430.18	31,775.39	889.71
9	Group 2	198	22.44	39.78	4.30	18.45	6.50%	414.10	201.23	19,227.43	538.37
10	Group 1	170	24.66	31.79	4.76	18.45	6.50%	455.00	260.07	23,461.06	656.91
11	Group 1	115	25.21	31.40	4.98	18.45	6.50%	465.15	482.30	30,154.61	844.33
12	Group 1	190	26.60	29.79	4.19	18.45	6.25%	490.69	1,028.01	107,572.99	3,012.04
TOTAL										**462,659**	**12,954**

Table 4 Results

Dairy livestock group – All Project instances	$EF_{Enteric_{i,j}}$ during this monitoring period (kg CH_4)	$BE_{Enteric_j}$ during this monitoring period (TonCO_2e)
Group 1 (High-yield dairy cows)	399,225	11,178
Group 2 (Low-yield dairy cows)	63,434	1,776
Total	**462,659**	**12,954**

Attached are electronic spreadsheets as a separate file to facilitate the verification of the results.

5.2 Project Emissions

Project emissions are calculated according to Equation 6, as follows:

$$PE_{Enteric\ i} = \sum_{j=1}^{N}[EF_{Enteric_{ij}}] \bullet \left[1 - ERF_{Enteric_j}\right] \bullet \frac{GWP}{1000} + EFME_i$$

Where: 1) $\sum_{j=1}^{N}[EF_{Enteric_{ij}}] \bullet \left[1 - ERF_{Enteric_j}\right] \bullet \frac{GWP}{1000}$

Dairy livestock group	$ERF_{Enteric}$	$EF_{Enteric_{i,j}} \bullet (1- ERF_{Enteric}) \bullet \frac{GWP}{1000}$
Group 1 (High-yield dairy cows)	20.7%	8,864
Group 2 (Low-yield dairy cows)	38.3 %	1,096
Total		**9,960**

And 2) $\mathrm{EFME}_{\mathrm{i}} = \frac{\mathrm{FM}_{\mathrm{i}} \bullet \mathrm{EFP}}{1000} + \mathrm{EFT}_{\mathrm{i}}$

Where:

EFME**i** Total emissions associated with manufacturing and transport of the feed supplement in the farm i during the monitoring period (tCO2e)

FMi Amount of feed supplement purchased by the farm i during the monitoring period (kg)

EFP Emission factor for production of feed supplement (kg CO_2e kg-1)

EFT Emissions for transport of feed supplement consumed during monitoring period to the farm i (tCO_2e)

a) Manufacturing facility power consumption

The feed supplement is produced in Mootral's manufacturing facilities in Abertillery (Wales UK).

The power consumption is the sum of power needed to operate the various equipment used during the production of 180kg batches. Power of each device (in kWh) is the one declared by the equipment manufacturer. The total power used is calculate according to the duration of use of each equipment to produce one batch of 180kg

Batch size per campaign run= 180 kg

Total kWh per batch = 25.375 kWh

UK factor[5]: 1kwh= 0.21233 kg CO_2e

Energy used per kg of feed supplement production EFP = 0.0299 kg CO_2e

Table 5 Emissions from product manufacturing by project instance

Farm #	Quantity of feed consumed during monitoring period (kg) *FM*	Emissions from production during the crediting period (kg CO_2e) $FM_i \bullet EFP$
1	7,252.04	216.84
2	1,140.77	34.11
3	937.77	28.04
4	961.57	28.75
5	640.96	19.16
6	1,312.88	39.26
7	668.02	19.97
8	1,683.51	50.34
9	993.60	29.71
10	1,225.02	36.63
11	1,629.35	48.72
12	5,796.21	173.31
TOTAL	**24,241.71**	**724.83**

b) Emissions from the transport of Mootral feed supplement from the production facility to the farms

The feed supplement is shipped by trucks from the manufacturing facility to the farm. The distance between the manufacturing facility and each project instance is calculated by using Google map and considering the fastest way by road. These distances are shown in table 5

[5] UK Government Conversion Factors for greenhouse gas (GHG) reporting, https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021

The emissions are calculated based on trucks weighing more than 17 tonnes and fully loaded.

EFT = 0.1019 kg per km per kg of feed (kgCO2 $kg^{-1}km^{-1}$)

Table 6 Emissions from Transport to the farms

Farm #	Distance between Manufacturing facility and farm (Km)	Quantity of feed consumed during monitoring period (kg) *FM*	Emission from transportation during monitoring period, kg CO_2e **KM ● FM ● EFT**
1	365	7,252.04	269.73
2	474	1,140.77	55.10
3	387	937.77	36.98
4	474	961.57	46.44
5	143	640.96	9.34
6	147	1,312.88	19.67
7	146	668.02	9.94
8	432	1,683.51	74.11
9	133	993.60	13.47
10	467	1,225.02	58.30
11	140	1,629.35	23.24
12	170	5,796.21	100.41
TOTAL		**24,241.71**	**716.72**

According to the VCS methodology we need to calculate the following

$$EFME_i = \frac{FM_i \bullet EFP}{1000} + EFT_i$$

Where:

$EFME_i$ Total emissions associated with manufacturing and transport of the feed supplement in the farm i during the monitoring period (tCO_2e)

FM_i Amount of feed supplement purchased by the farm i during the monitoring period (kg)

EFP Emission factor for production of feed supplement (kg CO_2e kg^{-1})

EFT Emissions for transport of feed supplement consumed during monitoring period to the farm i (tCO_2e)

Table 6 Total Emissions from manufacturing and transport of the feed supplement to the farms during the crediting period

Farm #	Emissions from production during the crediting period (kg CO2e) - EFP	Emission from transportation during monitoring period, kg CO2e - EFT	Total Emissions during the monitoring period - EFME
1	216.84	269.73	486.57
2	34.11	55.10	89.21
3	28.04	36.98	65.02
4	28.75	46.44	75.20
5	19.16	9.34	28.50
6	39.26	19.67	58.92
7	19.97	9.94	29.91
8	50.34	74.11	124.45
9	29.71	13.47	43.17
10	36.63	58.30	94.92
11	48.72	23.24	71.96
12	173.31	100.41	273.71
TOTAL	**724.83**	**716.72**	**1,441.55**

From a) and b) we have for the crediting period

FM_i we delivered 24,241 kg of Mootral to the project instances

EFP 724 kg CO2e

EFT 716 kg CO2e

Therefore,

Total emissions:

$$EFME_i = \frac{FM_i \bullet EFP}{1000} + EFT_i$$

$$\mathbf{EFME_i = 1.441\ tCO2e}$$

The Tool for testing significance of GHG emissions in A/R CDM project activities describes that the GHG emissions by sources, possible decreases in carbon pools and leakage emissions not marked are considered insignificant if their sum is lower than 5% of net anthropogenic removals by sinks.

We have estimated that instances of the project activity has achieved a net reduction of **2,994 tCO2e.** The GHG emissions generated by feed production are considered insignificant as their sum is lower than 5% of net anthropogenic removals by sinks.

Therefore, significance of GHG emissions from feed production = 1.441 tCO2e / 2,994 tCO2e = 0.048% of Total emissions:

Attached are electronic spreadsheets and detailed documents as separate files to facilitate the verification of the results.

5.3 Leakage

In the context of the methodology applied for this project activity, leakage could potentially consist of a change in the number of animals in the livestock operation due to livestock performance impacts of introducing the supplement, thereby necessitating changes in livestock populations in non-project operations to fulfill market demand. However, supplements are expected to have an insignificant impact on livestock performance. Additionally, due to the economics of livestock production, it is unlikely that the costs and risks associated with increasing or decreasing the number of animals in the operation is justified from the minimal expected changes in animal performance alone. During the crediting period, no significant change has been observed at the project activity instances regarding the number of animals in the operation. Therefore, leakage is considered to be zero.

5.4 Net GHG Emission Reductions and Removals

Emissions reductions are quantified for each year according to Equation 11.

$$ER_{Enteric\ i} = \sum_{i=1}^{N}[BE_{Enteric\ i} - PE_{Enteric\ i}]$$

Where:

$ER_{Enteric\ i}$ = 12,932 – 9,943 = **2,994 tCO2e**

Table 7 Calculation of the instances of project's activity emissions and emissions reduction

Year	Estimated baseline emissions (tCO_2e)	Estimated project emissions (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions (tCO_2e)
Year 2020	1,362	1,009	0	353
Year 2021	1,624	1,204	0	420
Year 2022	9,968	7,747	0	2,221
Total	12,954	9,960	**0**	**2,994**

APPENDIX A: List of PAIs and starting dates

Farm Number	GPS position	Start feeding date	Start monitoring period	End monitoring period
1	54.09821707071506, -2.654489087752983	1-Mar-2020	1-Mar-2020	30-sept-2022
2	54.80959503421248, -3.2877022198815262	15-Apr-2022	29-Apr-2022	30-sept-2022
3	54.070793, -1.524726	1-May-2022	15-May-2022	30-sept-2022
4	54.810956098552644, -3.2852366147938517	30-May-2022	13-Jun-2022	30-sept-2022
5	51.65655516981721, -1.7257440087323686	3-Apr-2022	17-Apr-2022	30-sept-2022
6	50.9334740162931, -2.8814463898944145	1-Apr-2022	15-Apr-2022	30-sept-2022
7	50.96464948558571, -2.3409511269289687	19-Dec-2021	22-Jun-2022	30-sept-2022
8	54.22012754889688, -0.5116522641290551	10-Apr-2022	25-Apr-2022	30-sept-2022
9	51.01382, -2.56078	22-Feb-2022	8-Mar-2022	30-sept-2022
10	54.88137091134044, -3.1055493523657587	23-Mar-2022	6-Apr-2022	30-sept-2022
11	51.15984434694024, -2.6060496789800944	19-May-2022	2-Jun-2022	30-sept-2022
12	52.90925817997503, -2.5484445365318944	2-Mar-2022	16-Mar-2022	30-sept-2022