



**Verified Carbon
Standard**

UK COWCREDIT PROJECT

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

MOOTRAL

Project Title	UK CowCredit project: A UK dairy initiative to reduce methane from enteric fermentation
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1 PROJECT DETAILS

1.1 Summary Description 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 (CH₄) emissions from enteric fermentation by direct inhibition of methanogens in the rumen. The initial instance of the project activity is a dairy farm with 400 dairy cows which has implemented the Mootral® natural feed supplement into the cattle diet starting on the 7th of May 2019. The dairy farm is located in Lancashire in North West England, United Kingdom (UK).

The project is developed as a grouped project within the UK boundaries. Thus, the expansion of a project activity subsequent to project validation is allowed and each project activity instance shall follow the program eligibility criteria for its inclusion as detailed in section 1.4. The project activity intends to add more instances over the 10 years of the first crediting period. The project implementation results in a substantial net reduction of GHG emissions, because of the avoidance of CH₄ release into the atmosphere. Methane is a by-product of the enteric fermentation process and is expelled by the animal through belching. Prior to the start of the proposed project activity, there were no similar enteric methane reduction activities, therefore, this leads to CH₄ released into the atmosphere (“the business as usual”). Over the 10 years of the first crediting period, the project will generate an estimated annual average reduction of 215,050 tons of carbon dioxide equivalent (tCO₂e) and 2,150,500 tons over the 10 years of the first crediting period. The Project is quantified and will be monitored according to VCS methodology “VM0041 Methodology for the Reduction of Enteric Methane Emission from Ruminants through the Use of 100% Natural Feed Supplement” and falls under VCS Sectoral Scope 15, Livestock and manure management. For more information about the project equipment specifications please see the following link: <https://www.mootral.com/science/>.

1.2 Sectoral Scope and Project Type

The Project falls under the VCS Sectoral Scope: Livestock and manure management. The Project activity is a grouped project and is using the VCS methodology: “VM0041, Ver1.0, Methodology for the Reduction of Enteric Methane Emission from Ruminants through the Use of 100% Natural Feed Supplement”

1.3 Project Eligibility

The project meets all the criteria set out in the VCS program criteria for GHG and supported by the VM0041 methodology approved under the VCS Program. The project will reduce methane from enteric fermentation in dairy livestock operations which are permanent as long as the operations are part of the project. These reductions would not have happened if the project had

not been carried out. The project activity does not include carbon footprint assessments or carbon neutrality claims. The project is eligible under the scope of the VCS Program.

1.4 Project Design

The project has been designed as a grouped project. New project activity instances will comply with the set of criteria listed below.

Eligibility Criteria

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

- 1) All project activity instances must meet the applicability conditions set out in the methodology VM0041 applied to the project.
- 2) All project activity instances must introduce and apply Mootral® natural feed supplement into dairy cattle diet as specified in the project description.
- 3) All project activity instances must be on dairy farms within the United Kingdom.
- 4) All project activity instances are subject to the baseline scenario determined in the section 3.4 for the specified project activity and geographic area.
- 5) All project activity instances have characteristics with respect to additionality consistent with the initial instances and as described in section 3.5.

1.5 Project Proponent

Organization name	Mootral SA
Contact person	Elisavet Zoupanidou
Title	Senior Manager Carbon and Sustainability
Address	Avenue des Uttins 1, 1180 Rolle, Switzerland
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1.6 Other Entities Involved in the Project

N/A

1.7 Ownership

Mootral SA (hereafter “the project proponent”) has the ownership and legal right of the project activity. Project ownership arising by an agreement with the dairy livestock operation owners which vests project ownership in the project proponent. The project proponent is not expected to be the owner of the dairy livestock operations, unless there is documentation that legally proves the opposite. Mootral SA has the ownership and legal right of the *Mootral*® feed supplement leading to GHG emission reductions. An agreement/contract will be signed between each farm project activity instance and Mootral SA.

1.8 Project Start Date

The project start date is the 7th of May 2019. The initial instance of the project activity is a dairy farm with 400 dairy cows which has implemented the Mootral® natural feed supplement into the cattle diet starting on the 7th of May 2019.

1.9 Project Crediting Period

The project crediting period is 10 years from 07/05/2019 to 06/05/2029 (1st crediting period), twice renewable for a total of 30 years.¹

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	✓
Large project	

Year	Estimated reductions or GHG emission removals (tCO ₂ e)
Year 2019	500
Year 2020	50,000
Year 2021	150,000
Year 2022	250,000
Year 2023	250,000

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

Year 2024	250,000
Year 2025	250,000
Year 2026	300,000
Year 2027	300,000
Year 2028	350,000
Total estimated ERs	2,150,500
Total number of crediting years	10 (1st crediting period)
Average annual ERs	215,050

1.11 Description of the Project Activity

The project aims to reduce anthropogenic GHG emissions resulting from agricultural activities, dairy livestock operations, in the United Kingdom (UK). Ruminants, in particular, release methane (CH₄) as a result of their digestion process of feed material in the rumen. These are methane emissions from enteric fermentation and are significant contributors to GHG emissions and climate change.

The specific objective of the project activity is to reduce enteric methane emissions (CH₄) by introducing a natural feed supplement, Mootral®, into dairy cows' diet while maintaining the number of animals. This process results into a substantial net reduction of GHG emissions, because of the avoidance of CH₄ release into the atmosphere, which would occur under normal operating circumstances ("the business as usual").

The Mootral® feed supplement reduces methane emissions by direct inhibition of the activity of Archaea in the rumen, without affecting feed utilization or other microorganisms. The supplement is based on a proprietary combination of active compounds from garlic and flavonoids derived from citrus. Research shows a nearly complete inhibition of emitted methane in lab experiments that reaches up to 38% reduction under real farm conditions. Results from an in-vivo UK farm study (Vrancken et al., 2019) showed methane reduction of 38.3 % for Jersey cows and 20.7 % for Holstein-Friesian cows. Additionally, the Mootral® feed supplement improves rumen fermentation and increases productivity and health.

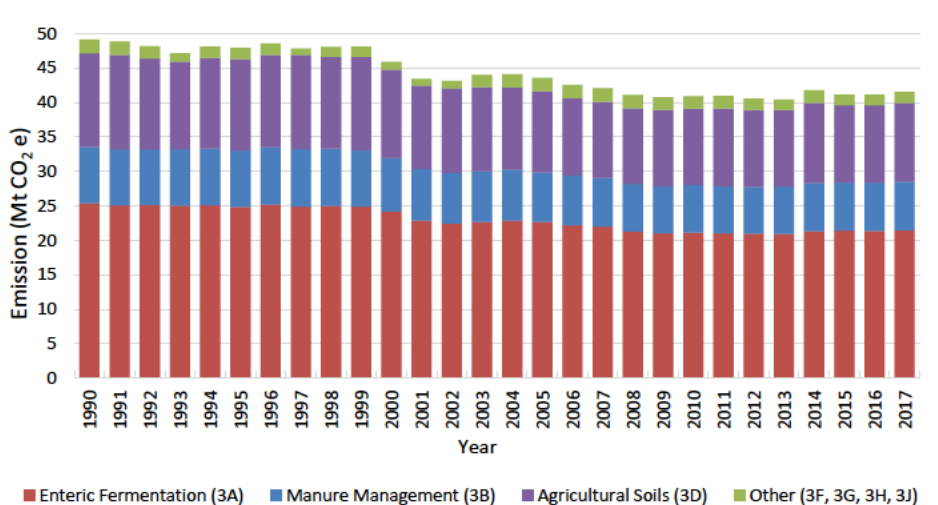
The dose of Mootral® feed supplement can be defined per animal weight (g/kg) or per feed dry matter (g/kg). Mootral® can be administered in various ways, for example mixed with the silage or integrated into pellets. The actual dosage and feeding technique are being adjusted based on the specific dairy operation conditions of the project. The implementation of the project results

in daily reductions equal to the emissions reduction factor provided by the manufacturer or directly measured on the dairy livestock operation.

At the United Nations Climate Change Conference in 2015, a key component of the global agreement was to protect food production whilst also reducing GHG emissions (UNFCCC, 2015)². Given the significance of CH₄ as a GHG, reducing enteric CH₄ emissions from ruminants could prove an important strategy for countries to meet reduction targets in global emissions and sustainable food production.

The *Figure 1* below shows agriculture’s contribution to total UK methane emissions. The major agricultural sources of methane are enteric fermentation (digestive processes) and N₂O emissions from manure management and fertilizer application. In the UK, the Agriculture sector is dominated by CH₄ emissions from livestock generated through enteric fermentation (animal digestion processes), and from N₂O emissions from manure management and fertiliser application.

Figure 1 Total emissions in the Agriculture sector^{3,4}



1.12 Project Location

This project activity is implemented within the geographical area of the United Kingdom. The first instance is located in Lancashire county in North West England, United Kingdom. Farm Coordinates: 54.0982° N, 2.6551° W

² UNFCCC. Available online: https://unfccc.int/sites/default/files/english_paris_agreement.pdf (accessed on November 2019)

³ ‘Other’ refers to the following IPCC sectors: Field Burning of Agricultural Wastes (3F), Liming (3G), Urea Application (3H), and Overseas Territory and Crown Dependency Agriculture Emissions (3J)

⁴ Source : UK NIR 2019 (Issue 2)

Geodetic coordinates will be provided for each additional project instance included in the grouped project.

1.13 Conditions Prior to Project Initiation

The baseline scenario for this activity is the situation existing prior to the starting date of the implementation of the feed supplement into the cows' regime. It provides the continued use of the 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. The activity allows any feeding practice when the feed supplement is being incorporated into the management strategy. GHG reductions are quantified by comparing actual project performance to a performance standard baseline. (see Section 3.4, *Baseline Scenario*).

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project is in compliance with relevant laws, statutes and other regulatory frameworks. This project activity is a voluntary initiative undertaken by "MOOTRAL SA" which is the project proponent.

Until today there are no local, state, or federal emissions trading programs or other regulatory binding requirements for the project activity. Also, there are no mandatory requirements in the United Kingdom enforcing the reduction of enteric methane emissions.

The project activity requires the usage of Mootral natural feed supplement. The supplement complies with the European regulatory framework as its ingredients are part of the EU catalogue of feed material⁵. Citrus extract is registered on the EU feed additives register⁶ and complies with the European Regulation European Regulation (EC) 767/2009 on additives for use in animal nutrition on the placing on the market and use of feed.⁷

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

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

1.15.2 Projects Rejected by Other GHG Programs

The project activity has not been submitted or rejected by any other GHG programs.

⁵ Garlic dried – 4.5.1 : www.feedmaterialsregister.eu/

⁶ https://ec.europa.eu/food/safety/animal-feed/feed-additives/eu-register_en

⁷ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009R0767>

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project activity is not required to be implemented under any local, state, or federal emission trading program or for any other regulatory requirement (see also Appendix I).

1.16.2 Other Forms of Environmental 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

1.17 Additional Information Relevant to the Project

Leakage Management

Not applicable.

Commercially Sensitive Information

All information related to the operation of the individual project activity instances is considered sensitive. Sensitive information will be provided used for validation but will not be included in the public version. The same is applicable to the individual project activity instances operation results sheets in emission reduction calculation spreadsheet. Information with regards to the feed supplement production and application is also considered sensitive and will not be included in the public version of the PDD.

Sustainable Development

The project activity is promoting sustainable development and is an action to combat climate change and its impacts, seeking to raise awareness and increase capacity on climate change mitigation and adaptation in the livestock sector. This activity is decarbonizing their operations and supply chains by reducing the carbon footprint of their products, services and processes. This intervention has the greatest potential to improve the environmental and social impact of the system as a whole. Methane emission from the enteric fermentation of ruminant livestock is a main source of greenhouse gas (GHG) emission within the value chain.

Furthermore, it is supporting and encouraging the continued viability of small-scale cattle farming, sustaining grower communities by developing partnerships with cooperatives and producer organizations supporting small farmers. The aim is to ensure sustainable food production systems and implement resilient agricultural practices that secures productivity and production, helps maintain ecosystems and strengthens capacity for adaptation to climate change.

Further Information

Not applicable.

2 SAFEGUARDS

2.1 No Net Harm

No potential negative environmental and socio-economic impacts have been identified for the project.

2.2 Local Stakeholder Consultation

In order to assess the adequacy of the local stakeholder consultation the Project Proponent informed all the local stakeholders relevant for the project activity. Project proponent has conducted many meetings to communicate project details to the stakeholders involved. The stakeholders are:

1. People working at the farm
2. Nutritionist of the farm
3. Feedmill
4. Milk distributor
5. UK Government

The stakeholder consultation for the project activity, took place before and during the project implementation. The meetings were organised by the project proponents by email invitation and held at the farm or at the stakeholder's premises. In March 2018 the project proponent with the milk distributor, performed a market research in some local cafes exploring the acceptance of the Mootral project where no negative comments were received. An opening event of the project was made on February 2019. For this purpose, the project proponent invited the relevant stakeholders for a meeting at the feedmill and at the farm. The national authorities were informed through email exchange (May 2019).

Additionally, the project has received since the beginning of its implementation public diffusion by several local and national press. The project proponent and farm personnel have attended several conferences in the UK, e.g., LONDON COFFEE FESTIVAL 2019, World Agri-Tech Innovation Summit 2019, where they presented the project and people were informed about the project. We gathered useful feedback from several stakeholder groups and there were no extra comment or concerns. Comments received verbally or by email. Overall, the project has high acceptance and support from the authorities as well as from the local and national community.

Regarding the mechanism for on-going communication with stakeholders involved with projects and interested stakeholders, they have access to timely and adequate information and open communication channels with project proponents. Besides all the media coverage, Mootral SA has in place a website (<https://www.mootral.com/participate/>) that invites stakeholders to send their comments and suggestions through the web. An ongoing communication with the farmer and the farm's collaborators secures the operation of the project activity

2.3 Environmental Impact

The mitigation activity considers registered dairy cattle operations and introduces Mootral® natural feed supplement into the animal’s diet aiming to reduce methane emissions from enteric fermentation. Thus, the project activity is not expected to have any adverse environmental impacts.

2.4 Public Comments

Following the procedures and guidelines established by the VCS Program this project was up for public comment from 5 Dec 2019- 5 Jan 2020 and no comments received

2.5 AFOLU-Specific Safeguards

Not applicable.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

VM0041 Methodology, version 1: Reduction of Enteric Methane Emission from Ruminants through the Use of 100% Natural Feed Supplement.

3.2 Applicability of Methodology

The project activity reduces enteric methane (CH₄) emissions through the inhibition of methanogenesis due to the introduction of *Mootral*® natural feed supplement into ruminants’ diet (dairy cows). Specific conditions which can be applicable to the methodology are shown in Table 1 below.

Table 1 Project compliance with applicability condition

No	Applicability Condition	Project compliance
1	Livestock producers must feed their animals a natural feed supplement which reduces enteric CH ₄ emissions by direct inhibition of methanogens in the rumen.	Dairy producers must feed their animals with the Mootral feed supplement. Proof of purchase is provided through delivery receipts and/or invoices for verification.
2	Livestock in the project boundaries must only include ruminant animals.	This project activity includes only dairy cattle.
3a	The active ingredients of the feed supplement must be 100% natural plant-based or macroalgae based and non-GMO. This includes extracted components of	This project activities include the application of Mootral® feed supplement. The project proponent

	plants. The feed manufacturer needs to provide a non-GMO certificate based on lab analysis.	provides a non-GMO report based on lab analysis.
3b	The feed supplement must have been demonstrated to comply with all feed and food regulations in each national or subnational (including local) jurisdiction in which it is consumed. Where conflict arises between regulations, the most stringent standard will apply.	The project activity requires the usage of Mootral natural feed supplement. The supplement complies with the European regulatory framework as described in section 1.14. The project proponent is providing the specific part of the regulations relevant to the supplement
3c	The feed supplement must have no significant negative health or performance impacts on the animal to which it is fed. Where conflict arises between regulations, the most stringent standard will apply.	The project proponent is providing studies demonstrating no significant negative health or performance impacts on the animal to which it is fed. If available health data exist during the project implementation of each instance, they can be used to prove no negative impact on the animals' health. ⁸
3d	The feed supplement must be used as per feeding instructions provided by the manufacturer. The instructions provide critical defining conditions to secure the default level of reduction of the enteric methane emissions, such as the feeding routine and dose of supplement per kg of DMI to the animal.	The monitoring process of this project activities will secure the applicability and usage of the feed supplement.
4	Emission reductions generated by the use of other feed supplements and/or activities (e.g. improving animal productivity or nutritional and management strategies), the objective of which does not lead to the inhibition of methanogenesis, cannot be claimed through this methodology. This is to prevent overestimation of emission reductions achieved.	Feed records provided by the farm or farm's nutritionist are used to demonstrate the use or not of other feed supplements.
5	The implementation of project activities must confirm that the herd of ruminants in a given operation is fed the project feed supplement. For this purpose, the project proponent must be able to trace the feed supplement from on-farm consumption.	The monitoring process of this project activities will secure the applicability and usage of the feed supplement. Additionally, the project proponent is the manufacturer of the feed supplement.
6	The feed manufacturer needs to provide proof of evidence for no increase in the manure emissions due to feed supplementation (e.g., evidence-based literature, peer-reviewed publications, study reports).	The project proponent is providing the results of a lab slurry analysis performed during the implementation of the first instance of this project activity. Public literature is used to

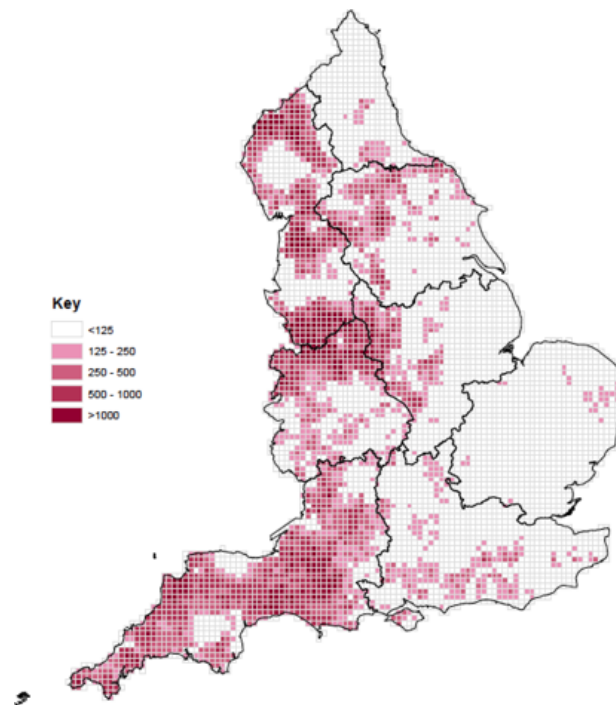
⁸ Vrancken, H., Suenkel, M., Hargreaves, P.R., Chew, L. and Towers, E. (2019) Reduction of Enteric Methane Emission in a Commercial Dairy Farm by a Novel Feed Supplement. Open Journal of Animal Sciences, 9, 286-296. Available data in ER calculation sheet also provided

		demonstrate this criterion by comparing the slurry analysis results against baseline values derived from public literature.
7a	Where project areas involve livestock farms that were operating prior to the start of project activities, reliable data (e.g., gross energy intake and dry matter intake) per animal group must be available for a minimum of three years if using baseline emissions Option 2 and two years if using baseline emissions Option 1.	Historical data are provided
7b	Where project areas involve livestock farms that no farm records and farming data are available, the project proponent must be able to provide evidence to substantiate the animal group to which each new project area is allocated according to the average group as described in national or regional statistical accounts (i.e., the baseline emissions will be considered as the average activity of where the project is located).	N/A

3.3 Project Boundary

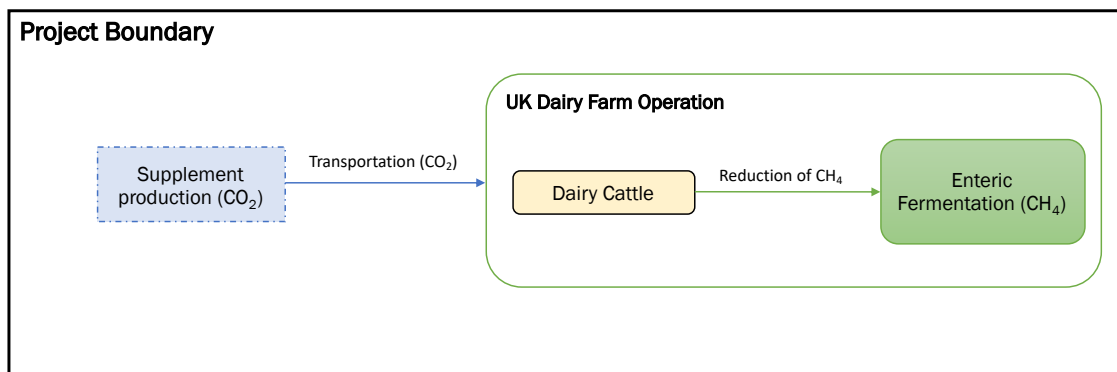
This project activity encompasses all the dairy cows in the UK; therefore, project boundary includes the dairy livestock operations in the UK. There are currently about 2 million dairy cows living on the UK's 14,550 dairy farms. The **Figure 2** below illustrates the spatial distributions of UK dairy cows.

Figure 2 Distribution of UK dairy cattle (2010)



Source: Defra Cattle Tracing System and June Survey of Agriculture
 Definition of dairy cattle is female dairy cattle over two years old with offspring i.e. the main milking herd.
 Crown Copyright. All rights reserved. Defra Licence no. 100018880 2011

The flow diagram provided below, *Figure 3*, illustrates the systems and emissions sources and GHGs included in the project boundary.

Figure 3 Project boundary flow diagram


The Table 2 below identifies and assesses the GHG sources in the baseline and project scenario.

Table 2 Relevant GHG sources included in the baseline and project scenario

Source	Gas	Included?	Justification/Explanation	
Baseline	CO ₂	No	Not included as per methodology	
	CH ₄	Yes	Main emission source	
	N ₂ O	No	Not included as per methodology	
	Other	No	Not included as per methodology	
Project	CO ₂	NO	Not included as per methodology	
	CH ₄	YES	Main emission source	
	N ₂ O	NO	Not included as per methodology	
	Other	NO	No other emissions expected	
	Supplement Production and Transport	CO ₂	YES	CO ₂ emitted from Mootral supplement transportation and production
		CH ₄	YES	CH ₄ may be emitted from combustion of fossil fuels during the processing.
		N ₂ O	NO	Not included as per methodology
		Other	NO	Not included as per methodology

The United Kingdom of Great Britain and Northern Ireland, commonly known as the United Kingdom (UK) or Britain, is a sovereign country in Western Europe. Lying off the north-western coast of the European mainland, the UK includes the island of Great Britain, the north-eastern part of the island of Ireland and many smaller islands. With an area of 242,500 square kilometres, the UK is the 78th-largest sovereign state in the world. It is also the 21st-most populous country, with an estimated 65.5 million inhabitants in 2016.

Figure 4 Geographical boundary of the country where the project activity is implemented



The initial instance of the project activity is a dairy farm with 400 dairy cows which has implemented the Mootral® natural feed supplement into the cattle diet starting the 7th of May 2019. The dairy farm is located on the territory of Lancaster, North West England, United Kingdom. It is farming business producing dairy products and has been farming dairy cattle since April 1960. The company's primary activities and products are fresh milk. The farm cows are fed on a mixture of grass, wheat and an additional blended feed, with the family growing grass and wheat across 20 hectares (50 acres) on-farm.

Figure 5 Geographical boundary of the project's activity first farm (instance)



3.4 Baseline Scenario

The baseline scenario for this activity is the situation existing prior to the starting date of the implementation of the fed supplement into the dairy cows' regime. It provides the continued use of the 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. The activity allows any feeding practice when Mootral® is being incorporated into the management strategy. GHG reductions are quantified by comparing actual project performance to a performance standard baseline.

3.5 Additionality

This project activity demonstrates and assesses the additionality of the project, in accordance with the applied methodology, taking into account the following:

The activity method for the demonstration of additionality, will need to demonstrate regulatory surplus. National legislations do not require dairy farms, including small and large operations, to report or reduce methane from enteric fermentation.

The activity method for the demonstration of additionality, will need to demonstrate the project activity has achieved a low level of penetration relative to its maximum adoption potential. According to the methodology the activity will need to reach 1.707 billion ruminants to not be considered additional. The maximum adoption of this activity is capped to 350,000 for the 1st crediting period.

Additionally, this project activity uses a new technology, *Mootral*[®] feed supplement, that has been commercially available for less than three years. The proposed project activity faces technological barriers that prevent its implementation and its uptake. This project activity requires the purchase of *Mootral*[®], which is an addition to the existing farmers' variable costs. Farmers make multiple decisions in the agricultural cycle about the adoption of products and practices. Farmers' decisions about whether and how to adopt new technology are often the result of a comparison of the uncertain benefits of the new invention with the uncertain costs of adopting it. For adoption to occur, farmers need to know that a technology exists, believe that it will improve productivity, and understand how to use it effectively. Given the early stage of *Mootral*[®] for reducing enteric methane emissions this project activity is consider additional.

3.6 Methodology Deviations

There is no methodology deviation.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline emissions are the emissions resulting from enteric fermentation in a dairy farm in the absence of the project activity. There are two approaches for the quantification of baseline emissions the applicability of each being dependent on data availability for each project activity instance. The project follows the two options 1 and 2 for determining the enteric emissions factor ($EF_{Enteric_j}$) as described in the methodology “VM0041 Methodology for the Reduction of Enteric Methane Emission from Ruminants through the Use of 100% Natural Feed Supplement” Depending on the availability of relevant livestock group data and measurements, each livestock group will choose the most appropriate option to determine the baseline emissions.

Emissions in the baseline scenario are estimated as the sum of annual emissions from enteric fermentation according to the following equation:

$$BE_{Enteric_i} = \sum_{j=1}^N [EF_{Enteric_{i,j}}] \bullet \frac{GWP}{1000}$$

Where:

$BE_{Enteric_i}$ Total baseline CH₄ emissions from livestock enteric fermentation for farm *i* (tCO₂e).

Where the project activity includes multiple farms, emissions in the baseline scenario are estimated as the sum of annual emissions from each farm *i*:
 $\sum_{i=1}^N [BE_{Enteric_i}]$

$EF_{Enteric_{i,j}}$ Enteric CH₄ emissions factor for each animal group *j* during the monitoring period (kg CH₄ group⁻¹)

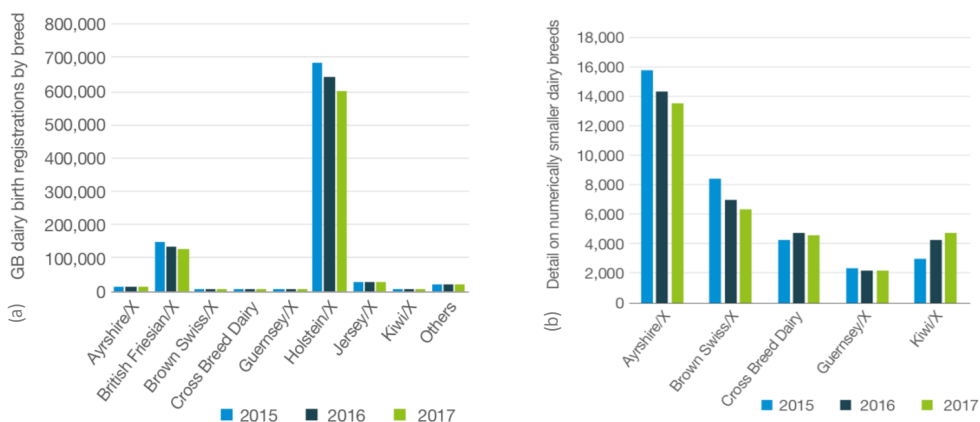
GWP	Global Warming Potential of methane (tCO ₂ /tCH ₄)
1000	kg per one metric tonne
<i>i</i>	Identification of livestock farm (1,2,...,N)
<i>j</i>	Animal grouping (1,2,...,N)

The important first step for each new instance (livestock farm *i*) is to identify all different animal groups (*j*) in the herd. Methane emissions are a function of dry matter intake (DMI) by cows. DMI is the amount of feed an animal consumes per day on a moisture-free basis and is determined by the energy available to the animal through food after accounting for losses in digestion, gases and urine (the metabolizable energy (ME)). The baseline emissions will be estimated for each animal group identified by the following livestock characteristics:

- By cattle type and breed. According to the UK National Inventory 2019, four categories are used for dairy cattle type: Dairy cows, dairy heifers, replacements > 1 year and dairy calves < 1 year. Predominant dairy cattle breeds in the UK are the Holstein-Friesian breed (90%) and other breeds include British-Friesian, Ayrshire, and Jersey cows. The **Figure 6** below illustrates the spatial distributions of UK dairy cows.
- UK production system and diet characterization will be based on farm data of DMI per animal group and of feed intake from grazing, forage, silage and concentrates. Dairy cattle are managed according to four regimes: year-round housing, winter housed and summer part-housed (overnight), winter housed and summer grazing, extended grazing (UK National Inventory Report, NIR 2019)⁹. Standard dietary components have been defined and associated with the outdoor grazing and indoor housing periods for each production system.

⁹ <https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2019>

Figure 6 Predominant cattle breeds for (a) dairy (b) detail on numerically smaller dairy breeds



The initial project activity instance is a commercial farm which has two breeds of dairy cows, around 280 Holstein-Friesian (HF) and 120 Jersey. The boundary of this farm encompasses the operations where the cows are raised and fed as well as the facility site. The cows are milked twice a day in a swing over parlour. The farm cows are fed on a mixture of grass, wheat and an additional blended feed, with the family growing grass and wheat across 20 hectares (50 acres) on-farm. The baseline scenario provides for the continued use of typical feeding and management strategies that represent average dairy business operations.

The project instance includes two different types of livestock groups:

- 1) dairy cows (lactating) Holstein-Friesian, and,
- 2) dairy cows (lactating) Jersey.

The baseline emissions have been calculated using Option 2 of the VCS methodology, VM0041, for each livestock group. Historical data are provided to demonstrate that the baseline using Option 2 does not represent a biased event as compared to the prior conditions at the farm, and therefore the $EF_{Enteric_{i,j}}$ reflects the average activity of the farm. The formula presented below would be subsequently adjusted for different livestock present on the farm. In solving for $EF_{Enteric_{i,j}}$ the following data is used representing year $y = 1$ for the 1st instance.

The emission factors for the two animal groups are calculated as follows:

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

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 grouping j in the farm i (MJ head⁻¹ month⁻¹) (see Table 3)

$Y_{m,j}$	Conversion factor (Y_m) indicates the proportion of the animal grouping j gross energy intake (GE) converted to enteric CH_4 energy. Energy of CH_4 as a percentage of GE (dimensionless). (=6.5%)
Days	Number of days per month for each animal in the group j during the monitoring period in farm i^{10} (see Table 3)
$N_{i,j}$	Average monthly number of head in each animal grouping j in the farm i in the monitoring period (dimensionless) (see Table 3)
EC	Energy content of methane (=55.65 MJ kg^{-1} of CH_4)
i	Identification of livestock farm (=1)
j	Animal grouping (=1,2)

And:

Gross energy intake GE is calculated by multiplying dry matter intake by the energy density of the feedstuff, using Equation 4:

$$GE_j = [DMI_j \cdot ED]$$

Where

DMI_j	Average monthly dry mass of feed consumed by animal group j in a given day ($Kg \text{ head}^{-1} \text{ day}^{-1}$)
ED	Energy Density. Average energy content of dry matter [$MJ \text{ kg}^{-1}$] = <ul style="list-style-type: none"> • 19.10 $MJ \text{ kg}^{-1}$ may be used as a default for diets including edible oils with fat contents below 4%.

Therefore, in this case we need to calculate the GE per group per month multiplying the DMI with the Energy Density 19.1, for example for the month of May 2019 it will be:

$$GE_1 = [DMI_1 \cdot ED] = 21 \cdot 19.1 = 403$$

And

$$GE_2 = [DMI_2 \cdot ED] = 15 \cdot 19.1 = 284$$

The emission factors for the two animal groups are calculated also per month, for example for the month of May 2019 it will be:

$$EF_{Enteric,i,j} = [GE_j \cdot Y_{m,j} \cdot N_{i,j} \cdot Days_{i,j}] \cdot EC^{-1}$$

$$EF_{Enteric,1,1} = [GE_1 \cdot 6.5\% \cdot 190 \cdot 11] \cdot 55.65^{-1} = 1312$$

¹⁰ Note that the number of days could be less than 365. For example, in the case of young cattle the number of days represents the length of stay in a specific group.

And

$$EF_{\text{Enteric}_{1,2}} = [GE_2 \cdot 6.5\% \cdot 103 \cdot 11] \cdot 55.65^{-1} = 501$$

Therefore, after repeating the same calculation for all months using the data on Table 3 we derive the total $EF_{\text{Enteric}_{i,j}}$ emission factors for the two groups and the total baseline emission are being calculated using the following equation:

$$BE_{\text{Enteric}_i} = \sum_{j=1}^N [EF_{\text{Enteric}_{i,j}}] \cdot \frac{GWP}{1000} = (46,035 \cdot \frac{25}{1000}) + (17,241 \cdot \frac{25}{1000}) = 1,582$$

Dairy livestock group - 1 st project instance	$EF_{\text{Enteric}_{i,j}}$ during the monitoring period	BE_{Enteric_j} during the monitoring period
Group 1 (Dairy cows, Holstein-Friesian)	46,035	1,151
Group 2 (Dairy cows, Jersey)	17,241	431
Total	63,276	1,582

Where:

Table 3 Animal grouping parameters and data

Animal Grouping													
Month	May 2019	June 2019	Jul 2019	Aug 2019	Sept 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020
Days	11	30	31	31	30	31	30	30	31	29	31	30	20
Average monthly number of heads in each animal grouping													
Number of lactating HF(N)	190	251	242	243	235	227	226	227	241	242	241	241	369
Number of lactating Jersey(N)	103	128	148	134	134	138	139	144	142	136	142	140	211
Month	May 2019	June 2019	Jul 2019	Aug 2019	Sept 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020
DMI of each animal grouping (kg/lactating cow/month):													
DMI of lactating HF	21	22	22	24	26	25	24	24	22	22	22	22	22

DMI of lactating Jersey	15	15	16	18	15	15	15	14	14	14	14	14	14
GEI of each animal grouping													
Lactating HF	403	428	426	456	495	478	458	458	414	428	420	420	420
Lactating Jersey	284	288	304	338	288	280	290	271	273	271	267	267	267

4.2 Project Emissions

Emissions in the project scenario are estimated as the sum of annual emissions from enteric fermentation, and from the production and transport of the supplement, according to the following equation:

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

Where:

$PE_{Enteric\ i}$ Total project enteric CH₄ emissions from livestock enteric fermentation for farm i , and the production and transport of the supplement used during the monitoring period (tCO₂e)

Where the project activity includes multiple farms, emissions in the project scenario are estimated as the sum of annual emissions from each farm i : $\sum_{i=1}^N [PE_{Enteric\ i}]$

$EF_{Enteric\ ij}$ Enteric CH₄ emissions factor for each animal group during the monitoring period as determined in section 4.1 (kg CH₄ group⁻¹)

$ERF_{Enteric\ j}$ Enteric CH₄ emissions reduction factor (default or determined percentage value). Supplement's percentage reduction of the enteric CH₄ per animal in an animal group j during the monitoring period.

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

GWP Global Warming Potential of methane (tCO₂/tCH₄)

1000 kg per one metric tonne

i Identification of livestock farm (1,2,...,N)

j Animal grouping (1,2,...,N)

There are two options to calculate the enteric methane emission reduction factor ($ERF_{Enteric}$)

- 1) Using the emission reduction factor provided by the Mootral supplement manufacturer (ERF_{Enteric} Option 1)
- 2) Determine the enteric methane emissions reduction factor for each animal group by performing direct enteric methane measurements (ERF_{Enteric} Option 2)

The initial project activity instance is using Option 1. The enteric methane emission reduction factor provided by the manufacturer of the feed supplement is supported by peer-reviewed literature and farm-specific emissions data that was determined by following the guidelines specified in Appendix II of the applied methodology.

Dairy livestock group	ERF _{Enteric}	EF _{Enteric<i>i,j</i>} • (1 - ERF _{Enteric}) • $\frac{GWP}{1000}$
Group 1 (Dairy cows, Holstein-Friesian)	20.7%	$46,035 \cdot (1 - 20.7\%) \cdot \frac{25}{1000} = 913$
Group 2 (Dairy cows, Jersey)	38.3 %	$17,241 \cdot (1 - 38.3\%) \cdot \frac{25}{1000} = 266$
Total	-	1,179

Where:

Table 4 Animal grouping parameters and data

Parameters PE _{Enteric} (tCO ₂ e)													
Month	May 2019	June 2019	Jul 2019	Aug 2019	Sept 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020
Lactating HF	26	74	74	80	81	78	72	72	72	69	73	70	72
Lactating Jersey	8	20	25	25	21	22	22	21	22	19	21	20	20

Emissions from the feed supplement are estimated by including all GHG sources from manufacturing and transport (Accounting for these GHG sources is not required for a project where such emissions are shown to be *de minimis*¹¹.)

These emissions must be estimated as follows:

¹¹ The pool or source may be excluded only if it is determined to be insignificant using appropriate approved tools for significance testing (e.g., the CDM “Tool for Testing Significance of GHG Emissions in A/R CDM Project Activities”, available at http://cdm.unfccc.int/EB/031/eb31_repan16.pdf).

$$EFME_i = \frac{FM_i \cdot EFP}{1000} + EFT_i \quad (8)$$

Where:

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

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 CO₂e kg⁻¹)

EFT Emissions for transport of feed supplement consumed during monitoring period to the farm i (tCO₂e)

The Mootral supplement for the first project instance is produced in the UK. The total annual emissions associated with manufacturing and transport of the feed supplement for the first project instance during the monitoring period is:

- Total energy used for pelleting process = 528.514 kg CO₂e
- Manufacturer Facility Unit E Mootral power consumption = 19 kg CO₂e
- Manufacturer Facility Unit G Mootral power consumption = 325 kg CO₂e

Therefore,

FM_i For one year we delivered 2,190 kg of Mootral to the feedmill and 64,825kg to the farm

EFP 28 kg CO₂e + 548 kg CO₂e + 688 kg CO₂e

EFT 148 kg CO₂e + 1,195 kg CO₂e

Therefore, total emissions are:

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

$$EFME_i = \frac{28 + 548 + 688 + 148 + 1,195}{1000}$$

$$EFME_i = 2.6 \text{ tCO}_2\text{e}$$

Where:

Table 5 Emissions from Transport to the feed mill

Transport from Manufacturer to Feedmill	
Distance, km	246
Total deliveries (01 Apr 2019 - 29 Feb 2020)	7

Total distance, km	1,722						
Total quantity per delivery, tonne	0.3	0.315	0.315	0.315	0.315	0.315	0.315
HGV (all diesel), Rigid (>7.5-17 tonnes), 50% Laden, kg CO2e/tonne/km (freighting goods)	0.27393						
Total emission per tonne delivered, kg CO2e/tonne/km	20.22	21.23	21.23	21.23	21.23	21.23	21.23
Total emission from transportation during monitoring period, kg CO2e	148						

And:

Table 6 Emissions from Transport to the farm

Transport from Feedmill to Brades														
Distance, km	152													
Total deliveries (01 Apr 2019 - 29 Feb 2020)	14													
Total distance, km	2,128													
Total quantity per delivered, tonne	4.00	4.85	1.00	4.88	5.00	5.00	4.98	5.00	5.13	5.00	5.00	5.00	5.00	5.00
HGV (all diesel), Rigid (>17 tonnes), 100% Laden, kg CO2e/tonne/km (freighting goods)	0.1212													
Total emission per tonne delivered, kg CO2e/tonne/km	73.72	89.39	18.43	89.85	92.15	92.15	91.69	92.15	94.45	92.15	92.15	92.15	92.15	92.15
Total emission from transportation during monitoring period, kg CO2e	1,195													

4.3 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. From the initial project activity instance, no significant change has been observed regarding the number of animals in the operation. Therefore, leakage is considered to be zero.

4.4 Net GHG Emission Reductions and Removals

Net GHG emission reductions are calculated as follows:

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

Where:

$ER_{Enteric\ i}$ Total GHG emission reductions due to project activities during the monitoring period (tCO₂e)

$BE_{Enteric\ i}$ Total baseline enteric CH₄ emissions from livestock enteric fermentation in the farm i during the monitoring period (tCO₂e)

$PE_{Enteric\ i}$ Total project enteric CH₄ emissions from livestock enteric fermentation in the farm i , and the production and transport of the supplement used during the monitoring period (tCO₂e)

i Identification of farm (1,2,...,N)

The initial project activity instance is achieving a net reduction of:

$$ER_{Enteric\ i} = 1,582 - 1,179 = 403 \text{ tCO}_2\text{e}$$

The *Table 7* below provides the ex-ante calculation (estimate) of baseline emissions, project emissions, leakage emissions and net GHG emission reductions from the potential expiration of the 1st instance of the project activity.

Table 7 Ex-ante calculation (estimate) of the first instance of project's activity emissions

Year	Estimated baseline emissions (tCO ₂ e)	Estimated project emissions (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions (tCO ₂ e)
------	---	--	--	--

Year 2019	1,582	1,179	0	403
Year 2020	1,582	1,179	0	403
Year 2021	1,582	1,179	0	403
Year 2022	1,582	1,179	0	403
Year 2023	1,582	1,179	0	403
Year 2024	1,582	1,179	0	403
Year 2026	1,582	1,179	0	403
Year 2027	1,582	1,179	0	403
Year 2028	1,582	1,179	0	403
Year 2029	1,582	1,179	0	403
Total	15,820	11,790	0	4,030

The *Table 8* below provides the ex-ante calculation (estimate) of baseline emissions, project emissions, leakage emissions and net GHG emission reductions from the potential expansion of the project activity including the 1st instance.

Table 8 Ex-ante calculation (estimate) of overall project activity's emissions

Year	Estimated baseline emissions (tCO ₂ e)	Estimated project emissions (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions (tCO ₂ e)
Year 2019	1,582	1,179	0	403
Year 2020	166,667	116,667	0	50,000
Year 2021	500,001	350,000	0	150,000
Year 2022	833,334	583,334	0	250,000
Year 2023	833,334	583,334	0	250,000
Year 2024	833,334	583,334	0	250,000
Year 2026	833,334	583,334	0	250,000
Year 2027	1,000,001	700,001	0	300,000
Year 2028	1,000,001	700,001	0	300,000
Year 2029	1,166,668	816,667	0	350,000
Total	7,166,674	5,016,672	0	2,150,000

5 MONITORING

5.1 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 operator and nutritionist from Jan 2017 until the continuation of the project activity and its 1 st instance.
Value applied	See Table 3
Justification of choice of data or description of measurement methods and procedures applied	<p>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)</p> <p>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.</p> <p>Parameter to be updated with any change in the animal's feeding regime. Monthly records are being monitored and provided to the project proponent.</p>
Purpose of Data	Calculation of baseline emissions
Comments	Calculated based on measured Daily 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	Records and data from livestock operator and nutritionist from Jan 2017 until the initiation of the project activity from the 1 st instance.
Value applied	See Table 3

Justification of choice of data or description of measurement methods and procedures applied	<p>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.</p> <p>Parameter to be updated with any changes in the animal's feeding regime.</p>
Purpose of Data	Calculation of baseline emissions
Comments	Required to calculate gross energy intake for equation 3

Data / Parameter	Y_{mj}
Data unit	Dimensionless
Description	Percentage of feed energy converted to methane for each animal group
Source of data	<p>UK NIR 2017 (Issue 2), Table A 3.3.4 "Dairy Cows Tier 2 Methane Emission Factors".</p> <p>The 1st instance of the project activity is using 6.5% as the diet is with an average of 30% NDF. Default values provided in table 8 (Appendix III) of the methodology applied. Therefore, the source of the data for the 1st instance is the NDF records provided by the farm nutritionist.</p>
Value applied	6.5%
Justification of choice of data or description of measurement methods and procedures applied	<p>National environmental agencies are accurate sources and comply with the VCS standards.</p> <p>Table 8 in Appendix III from the methodology provides Y_m 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.</p> <p>Parameters to be updated each crediting period where new data exists.</p>
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 operator and nutritionist from Jan 2017 until the continuation of the project activity and its 1 st instance.
Value applied	30% (average)
Justification of choice of data or description of measurement methods and procedures applied	<p>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.</p> <p>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.</p>
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	19.10 for 1 st instance of project activity as the diet includes edible oils with fat contents below 4% (Average 3.7%)
Justification of choice of data or description of measurement methods and procedures applied	<p>Farm specific values are used, when available, otherwise use the typical values provided below:</p> <p>The typical energy density of feedstuff is:</p> <ul style="list-style-type: none"> - 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% <p>Parameters to be updated each crediting period where new data exists.</p>
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	<p>This is a standard property of methane.</p> <p>In addition, the <i>IPCC Guidelines for National Greenhouse Gas Inventories</i> is internationally recognized, and the data provided in the guidelines is peer reviewed.</p> <p>Parameters to be updated each crediting period where new data exists.</p>
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 section 4.1						
Value applied	<p>For 1st instance of project activity:</p> <table border="1"> <tr> <td>Total per group HF per year</td> <td>46,035</td> </tr> <tr> <td>Total per group Jersey per year</td> <td>17,241</td> </tr> <tr> <td>Total per year</td> <td>63,276</td> </tr> </table>	Total per group HF per year	46,035	Total per group Jersey per year	17,241	Total per year	63,276
Total per group HF per year	46,035						
Total per group Jersey per year	17,241						
Total per year	63,276						
Justification of choice of data or description of measurement methods and procedures applied	<p>To allow for flexibility for potential projects, this methodology provides different options to calculate baseline emissions.</p> <p>For the 1st instance option 2 has been applied using farm specific data.</p>						

	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	25
Justification of choice of data or description of measurement methods and procedures applied	<p>The IPCC Guidelines for National Greenhouse Gas Inventories is internationally recognized, and the data provided in the guidelines is peer reviewed.</p> <p>To be updated each crediting period where new data exist or accepted by Verra.</p>
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter:	PE _{<i>i</i>}
Data unit:	kg CH ₄ head ⁻¹ day ⁻¹
Description:	Average project enteric CH ₄ emissions calculated by direct measurements using the chosen technology in farm <i>i</i> during the monitoring period (kg CH ₄ head ⁻¹ day ⁻¹)
Source of data:	Measured for each animal group. Data records and study report of farm operations.
Value applied	N/A
Justification of choice of data or description of	To quantify the project enteric CH ₄ an animal sample for each group is selected to perform the direct measurement. The project proponent

measurement methods and procedures applied	<p>needs to describe the required sampling protocols against objectives conditions. Sampling protocols should include sufficient numbers and sampling times to account for diurnal and postprandial variation in CH₄.</p> <p>All CH₄ measurement techniques are subject to experimental variation and random errors therefore it should be taken into account when reporting the final enteric CH₄ emission value.</p> <p>Detailed information can be found in appendix II.</p> <p>Parameter to be updated each crediting period or where the PE value is no longer representative (e.g., due to changes in feed regime, animal type, weight, production phase, geographic region, and management practices) new data must be collected.</p>
Purpose of Data	Determination and calculation of project emissions
Comments	Because this requires direct measurements of methane emissions project proponent or associated partner must demonstrate experience in methane measurement technologies (i.e., a professional in the area of animal science, livestock health and nutrition who has an M.Sc. or Ph.D. in the relevant discipline).

Data / Parameter:	$ERF_{\text{Enteric } j}$
Data unit:	Percentage (dimensionless)
Description:	Enteric emission reduction factor
Source of data:	<p>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.</p> <p>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.</p>
Value applied	20.7% and 38.3 % factors applied for the 1 st instance of the project activity
Justification of choice of data or description of measurement methods and procedures applied	For the 1 st instance the project proponent provided evidence to demonstrate the percentage enteric CH ₄ reduction for each animal group. Parameters from the feed manufacturer must apply the most conservative value of the uncertainty component.
Purpose of Data	Determination and calculation of project emissions

Comments	N/A
Data / Parameter:	EFProduction _{i,j}
Data unit:	kg CH ₄ head ⁻¹ day ⁻¹
Description:	Average project enteric CH ₄ emissions calculated by direct measurements using the chosen technology A in farm <i>i</i> during the monitoring period (kg CH ₄ head ⁻¹ day ⁻¹)
Source of data:	Measured for each animal group. Data records and study report of farm operations
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	<p>To quantify the project enteric CH₄ production per animal samples for each group are selected to perform the direct measurement (option 1). The project proponent needs to describe the required sampling protocols for the relevant project conditions. Sampling protocols should include sufficient numbers and sampling times to account for diurnal and postprandial variation in CH₄. In animal studies the most favoured and most scientific method is the calculation of sample size by power analysis (Charan and Kantharia, 2013).</p> <p>All CH₄ measurement techniques are subject to experimental variation and random errors, therefore it should be taken into account when reporting the final enteric CH₄ emission value.</p> <p>Detailed information on reporting such error can be found in Appendix II.</p> <p>Parameter to be updated each crediting period or where the value is no longer representative (e.g., feed regime, animal type, weight, production phase, geographic region, and management practices).</p>
Purpose of Data	Determination and calculation of baseline emissions
Comments	Because this requires direct measurements of methane emissions project proponent or associated partner must demonstrate experience in methane measurement technologies (i.e, at least one team member should be a professional in the area of animal science, livestock health and nutrition who has an M.Sc. or Ph.D. and working/research experience in the relevant discipline)
Data / Parameter:	EF _{i,j}

Data unit:	kg CH ₄ head ⁻¹
Description:	Average enteric CH ₄ emissions factor for each animal in the group <i>j</i> during the monitoring period (country or regional specific factors or table 4), (kg CH ₄ head ⁻¹ day ⁻¹)
Source of data:	Country or regional and population specific factors should be used when available, to better reflect the ruminants' population characteristics. Default values provided in Table 4 may be used as an alternative where regional values are not available.
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	<p>Country or regional specific EF values should be used, when available, to reflect the ruminant's characteristics. When not available, use the default values provided in Table 4.</p> <p>Parameters from any source (e.g., IPCC or national agencies) must apply the most conservative value of the uncertainty component, (i.e., a 50% reduction must be applied to values taken from Table 4)</p> <p>Parameter to be updated each crediting period where new data exists.</p>
Purpose of Data	Determination and calculation of baseline emissions
Comments	N/A

5.2 Data and Parameters Monitored

Data / Parameter:	N _{ij}
Data unit:	Number of animals (head)
Description:	Average number of head in each animal grouping <i>j</i> in the farm <i>i</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. The farm is using a farm management software, Uniform, where all data are recorded. Each animal has a unique identification and each time a cow

	is visiting the milk parlour individual data are being recorded. Average monthly values are provided to the project proponent.
Frequency of monitoring/recording:	Single value depending on the number of heads in each animal grouping using the natural feed supplement. Measured by daily or weekly average records.
Value applied	Average monthly number of cows per group used for the 1 st instance. See Table 3
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:	<ul style="list-style-type: none"> • 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, climatic conditions 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 for the 1 st instance
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
Monitoring equipment	Feed records from Farm's software management system
QA/QC procedures to be applied:	<p>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.</p> <p>The number of days could be less than 365. For example, in the case of young cattle the number of days represents the length of stay in a specific animal group.</p>
Purpose of data:	<ul style="list-style-type: none"> • Calculation of baseline emissions • Calculation of emission reduction
Calculation method:	No calculations are needed
Comments:	N/A

Data / Parameter:	j
Data unit:	Animal grouping
Description:	Animals at each farm <i>i</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:	<p>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.</p> <p>Project proponents must provide evidence at each validation and verification that emissions estimates are based on a homogenous</p>

	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. See also Table 3
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:	<ul style="list-style-type: none"> • Calculation of baseline emissions • Calculation of emission reduction
Calculation method:	No calculations are needed
Comments:	N/A

Data / Parameter:	FM
Data unit:	Kg per month
Description:	Amount of feed supplement purchased by the farm <i>i</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:	<p>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.</p> <p>Delivery notes and invoices need to be reconciled between buyer and seller to verify records integrity.</p> <p>Sales records should be cross-checked with both buyer and seller of the feed supplemental to make sure records are consistent.</p>
Frequency of monitoring/recording:	Monthly

Value applied	See Table 6
Monitoring equipment	Farm records showing monthly-purchased complete feed and manufactured complete feed delivered to the farm
QA/QC procedures to be applied:	<p>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.</p> <p>Farm records or third-party managed data showing both monthly-purchased complete feed and manufactured complete feed delivered to each grouping</p>
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 ₂ e 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	For the 1 st instance per kg produced : 28 kg CO ₂ e + 548 kg CO ₂ e + 688 kg CO ₂ e
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:	No calculations are needed
Comments	N/A

Data / Parameter:	EFT_i
Data unit:	tCO ₂ e
Description:	Emission factor for transportation of feed supplement to the feed mill or directly to the farm <i>I</i> 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	2.6 tCO ₂ e
Monitoring equipment	N/A
QA/QC procedures to be applied:	<p>The project proponent must provide evidence to demonstrate the level of emission the monitoring period.</p> <p>These values must be based on well-documented, reliable sources (e.g., national energy balances, government publications, industry associations, WRI/WBCSD GHG Protocol)</p>
Purpose of Data	Determination and calculation of project emissions
Calculation method:	No calculations are needed
Comments	N/A

Data / Parameter:	Qelec
Data unit:	MWh kg ⁻¹
Description:	Quantity of electricity used by production facility supplied by the grid per kg of feed supplement produced
Source of data:	Documentation and data provided by the feed manufacturer

Description of measurement methods and procedures to be applied:	<p>Electric utility bills provided by the manufacturer.</p> <p>For the production of the feed supplement, the monitoring would be for the manufacturer to provide the electricity consumption at the specific production line used for the manufacturing of the monthly quantity.</p> <p>Alternatively, where product line level data is not available the manufacturer can use a ratio based on the percentage the feed supplement represents in the total volume produced by the facility.</p>						
Frequency of monitoring/recording:	Monthly						
Value applied	<p>For one year:</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="2">Total Electricity Consumption, kWh per total Production Quantity, KG</th> </tr> </thead> <tbody> <tr> <td>Unit E</td> <td>108</td> </tr> <tr> <td>Unit G</td> <td>2,142</td> </tr> </tbody> </table>	Total Electricity Consumption, kWh per total Production Quantity, KG		Unit E	108	Unit G	2,142
Total Electricity Consumption, kWh per total Production Quantity, KG							
Unit E	108						
Unit G	2,142						
Monitoring equipment	Records provided by the production site						
QA/QC procedures to be applied:	To confirm the production of feed supplement monthly production output data, need to be available by the manufacturer.						
Purpose of data:	Calculation of project emissions						
Calculation method:	No calculations are needed						
Comments:	N/A						

Data / Parameter:	EF _{elec}
Data unit:	kg CO ₂ e kWh ⁻¹
Description:	Emission factor for electricity
Source of data:	UK Government Conversion Factors for greenhouse gas (GHG) reporting, https://www.gov.uk/government/publications/environmental-reporting-

	guidelines-including-mandatory-greenhouse-gas-emissions-reporting-guidance
Description of measurement methods and procedures to be applied:	<p>Default values must be sourced from recognized, credible sources and be geographically and temporally relevant to project specifics.</p> <p>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.</p>
Frequency of monitoring/recording:	Annual
Value applied	0.2556 kg CO ₂ e 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	<p>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.</p> <p>https://cdm.unfccc.int/methodologies/Pamethodologies/tools/am-tool-07-v7.0.pdf</p>

Data / Parameter:	TEF
Data unit:	Tonnes per km or miles per kg of feed (tCO ₂ kg ⁻¹ km ⁻¹)
Description:	Emission factor values for each mode of transport m
Source of data:	<p>UK Government Conversion Factors for greenhouse gas (GHG) reporting,</p> <p>https://www.gov.uk/government/publications/environmental-reporting-guidelines-including-mandatory-greenhouse-gas-emissions-reporting-guidance</p>
Description of measurement methods	Default values must be sourced from recognized, credible sources and be geographically and temporally relevant to project specifics.

and procedures to be applied:	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)
Frequency of monitoring/recording:	Monthly
Value applied	<ul style="list-style-type: none"> - HGV (all diesel), Rigid (>7.5-17 tonnes), 50% Laden, kg CO2e/tonne/km (freighting goods): 0.27393 - HGV (all diesel), Rigid (>17 tonnes), 100% Laden, kg CO2e/tonne/km (freighting goods): 0.12125
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 production site to the feedmill and then 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 m delivering feed supplement consumed during the monitoring period to the project location, farm. Where the feed supplement goes through a feedmill then the distance to the feedmill should be measured and not to the farm.
Frequency of monitoring/recording:	Monthly

Value applied	246 km to feedmill and 152 km to the farm
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

5.3 Monitoring Plan

The monitoring plan involves the monitoring, collection, and reporting of all data described in Section 5.2 above. Monitored data and parameters will depend on the baseline and project emissions options used for the calculation. The project proponent has established a monitoring plan and GHG information system. The system includes an online spreadsheet for obtaining, recording, compiling and analyzing data, parameters and other information important for quantifying and reporting GHG emissions. Detailed roles and responsibilities of the relevant staff involved in the project will be in place at the starting date of the crediting period. Furthermore, people involved in the project will receive relevant training, if required, to ensure that monitoring duties will be performed by trained staff. A summary of roles and responsibilities is provided on the table below:

Table 9 Project activity roles and responsibilities

Roles	Activities
Environmental Solution Provider	<ul style="list-style-type: none"> • Owner of the proprietary natural feed supplement, Mootral • Supplier of natural feed supplement for enteric methane emission reduction. • Carbon project proponent.
Farmers	<ul style="list-style-type: none"> • Dairy farm feeding ruminants with the feed supplement

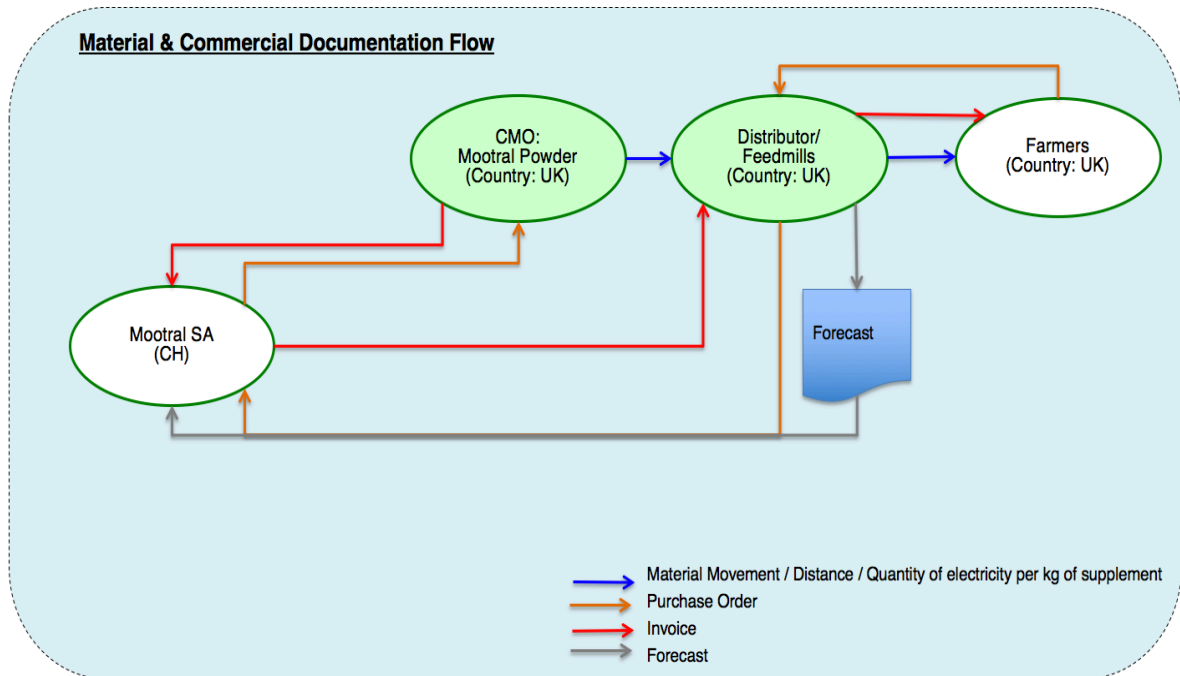
In order to ensure a successful operation of the project the project proponent is responsible for establishing a monitoring plan and GHG information system to ensure a successful operation of the project and the credibility and verifiability of the emission reductions. Also, independent verifiers will audit the projects and the management systems. The system includes criteria and procedures for obtaining, recording, compiling and analyzing data, parameters and other information important for quantifying and reporting GHG emissions. The monitoring process is

further summarized below as a line diagram, Figure 7 and a spreadsheet is also available for the validation. The approach planned for the project activity is applicable uniformly to all the upcoming project activity instances. Every new instance added to the group project will be monitored on the same way. For verification purposes, a representative sampling will be undertaken as part of a group project activity-wide sampling plan (by grouping and sampling across project activity instances) that is designed in line with the requirements of the “Guideline: Sampling and surveys for CDM project activities and programme of activities”, version 03¹². It is recommended that for activities that involve progressive implementation shall follow the stratified random sampling approach.

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 farms personnel or collaborators are responsible for collecting all data monitored on-site. The farmer has in place a management system allowing the farmer, among others, to control the feed quantity, animal number and lifecycle stage, milk yield. The project proponent will establish an online transparent system for the collection, computation and storage of data, including adequate record keeping and data monitoring systems. The online system ensures that all non-conformances are identified and recorded, and that the appropriate corrective action is taken to rectify all identified non-conformances, preventing their reoccurrence in the future. Valid management process descriptions must be made available and be observed by the farmer. Any change in the process frequency or any change made in the used technology must be reported and recorded online. The farmer or the project proponent need to identify the cause for the non-conformance. Where corrective actions are required, these will be acted upon within a reasonable timescale. Once the corrective action is complete, the project proponent together with the farmer validate the action, see whether it was effective, and then communicate potential improvements or actions which will stop the non-conformance from occurring again. Finally, the non-conformance is closed, and the project can continue as normal. 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.

Figure 7 Monitoring process

¹² https://cdm.unfccc.int/Reference/new_reg.html



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. In order to do so, project proponents must provide detailed feeding records as per manufacturer instructions (applicability condition 3c) for each farm as well as proof of purchase of an appropriate quantity of the feed supplement. Proof of purchase is provided through delivery receipts and invoices by the farmer. The project proponent has all the delivery noted from the feedmill to the farm and also the purchase orders placed by the farmer. These two elements as well as feed consumptions records provided by the nutritionist are used to as proof of the quantity consumed per month per animal group. Also, a spreadsheet is available for the verification and monthly checked by the project proponent.

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”

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 must be 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 must be archived and stored in electronic format by the project proponent for at least two years after the first crediting period.

APPENDIX I: ADDITIONAL INFORMATION RELEVANT TO THE PROJECT

Figure 8 VCUs eligibility in the UK

		T E W	+44 (0) 20 7215 5000 enquiries@beis.gov.uk www.gov.uk
Our ref: TO52019/09870			
1st July 2019			
Elsa Zoupanidou By email: ezoupanidou@mootral.com			

Dear Elsa Zoupanidou,

Thank you for your email dated 16th May, about UK Carbon Project Development. I have been asked to reply, and I would like to apologise for the delay in doing so.

Carbon offsets generated by programmes in the voluntary market offer consumers and companies the option to compensate for their emissions through a reduction or removal of an equivalent amount of emissions. The Government is not directly involved in developing projects in the voluntary markets; instead, these are implemented by voluntary programmes and standards.

The Government supports action to reduce emissions at all levels. In the 2018 Budget the government announced a Woodland Carbon Guarantee of up to £50m to purchase credits generated by planting trees, accredited through the UK's Woodland Carbon Code.

The Guarantee will incentivise the removal of emissions from within the land use sector, which lies outside of the scope of the EU ETS.

Thank you once again for taking the time to write, I hope you find this information helpful.

Yours sincerely

Emma Collin
BEIS MINISTERIAL CORRESPONDENCE UNIT

	T E W	+44 (0) 20 7215 5000 enquiries@beis.gov.uk www.gov.uk
Our ref: TOB2020\01012		
31st January 2020		
Elsa Zoupanidou		
By email: ezoupanidou@mootral.com		
Dear Elsa Zoupanidou,		
Thank you for your follow-up email dated 16th January, regarding the Voluntary Carbon Standard programme (VCS).		
I appreciate you flagging your interesting project to our attention and it is positive to see how industry is planning to engage with COP26.		
The Voluntary Carbon Standard programme is a private voluntary scheme which means it is not within the UK Government's remit to determine the issuance of Voluntary Carbon Units (VCUs). The VCS will determine the eligibility of your programme to generate VCUs dependent on your projects ability to meet standards. This can be found here: https://verra.org/project/vcs-program/rules-and-requirements/ .		
If your project generates VCUs these credits will be available for purchase worldwide by consumers on the voluntary market which could include UK businesses. The UK currently provides guidance for businesses to use offsets within the Environmental Reporting Guidelines . These can currently only be used as part of an organisation's net emissions figure.		
Thank you once again for taking the time to write, I hope you find this information helpful.		
Yours sincerely,		
Emma Collin BEIS CORRESPONDENCE UNIT		