METHANE RECOVERY PROJECT HOUBENSTEYN YSSELSTEYN, LIMBURG THE NETHERLANDS

Document Prepared by everi GmbH

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Methane Recovery Project Houbensteyn Ysselsteyn (hereafter referred to as project Houbensteyn) is a methane recovery project through controlled anaerobic digestion from animal manure as well as from agricultural and industrial waste, that takes place on the estate of the project Houbensteyn Milieu BV located in the Province of Limburg, the Netherlands. Houbensteyn Milieu BV is a family-run company founded in 1999 and which belongs to the Houbensteyn group, specialized in the production of healthy food and green energy. The project activity involves power generation using Combined Heat and Power engines (CHP) to produce electricity and heat with the biogas generated. Furthermore, the project activity mitigates GHG emissions by replacing fossil fuels with decentral renewable thermal energy.

Prior to the implementation of the project activity, pig manure was stored in open storage tanks over 6 months before being used as fertilizer for farmlands. The manure when kept in open pits, tanks or lagoons undergo anaerobic fermentation and release greenhouse gases (CH_4, CO_2 and N_2O) to the atmosphere. Furthermore, waste from agricultural production processes and industrial food wastes were commonly disposed of on waste landfill sites. The open rotting of this organic matter was causing uncontrolled and uncaptured methane emissions on the dump sites. Using of these wastes in the biogas power plants does have a further methane emission reduction potential in addition to the effect from using the animal manure. In addition, before commissioning the biogas plant, livestock stalls and piglet food were heated by natural gas. The use of fossil fuels causes CO_2 emissions which are reduced when substituted by utilizing the waste heat of the biogas power plant.

The current PD is an update of the first PD in the frame of the renewal of the crediting period of Project Houbensteyn. The Methane Recovery Project Houbensteyn Ysselsteyn was validated by TÜV Rheinland Group on August 25th, 2007 as domestic GHG offset project according to JI standards and has published an addendum on February 2009 to also fulfil VCS requirements. The project proponent has chosen the VCS Project Description Template instead of the UNFCCC CDM PDD form, according to section 3.4.1 of VCS Standard Version 4.1.

The annual average estimation of GHG emission reductions from the project activity is 12,708 t CO_2e/year. The total estimation of GHG emission reductions over the second crediting period of 10 years is 127,080 t CO_2e/year.

1.2 Sectoral Scope and Project Type

The project has a total electrical generation capacity of less than 15 MW_{el}, thermal generation capacity less than 45 MW_{th} and will generate emission reductions less than 60 ktCO_2e per year for the methane avoidance component. Therefore, the project is in accordance with small-scale limits.

The types/categories of the project are classified as follow:

Methane avoidance component:

Type III:	Other project activities
Category III.D:	Methane Recovery in animal manure management systems
Sectoral Scope 13:	Waste handling and disposal

Fuel replacement component:

Type I:	Renewable energy projects
Category I.C:	Thermal energy production with or without electricity
Sectoral Scope 1:	Energy industries (renewable/non-renewable sources)

The project is not a debundled component of a larger project activity.

1.3 Project Eligibility

The project is an agricultural biogas project that captures greenhouse gases (especially methane) generated from animal manure and industrial waste under anaerobic conditions. The methane is used via biogas generator units for electricity and heat generation. The heat produced displaces fossil fuels, which according to Version 4.1 of the VCS Standard is eligible.

1.4 Project Design

The project is not a grouped project.

1.5 Project Proponent

Organization name	Houbensteyn Milieu BV
Contact person	Martin Houben
Title	Owner and Managing Director
Address	Ysselsteynseweg 69, 5813 BK, Ysselsteyn Limburg - The Netherlands

Telephone	+ 31 6 532 11 287
Email	Martin.houben@hgroep.nl

1.6 Other Entities Involved in the Project

Organization name	everi GmbH
Role in the project	Carbon consultant, author of the Project Description report
Contact person	Pauline Kalathas
Title	Senior carbon project developer
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1.7 Ownership

The project owner of the project is Houbensteyn Milieu BV. The approval of Environmental Impact Assessment of the project owner is evidence for legislative right. Besides, the purchasing contract of CHPs or the purchasing power agreement are evidence for the ownership of the plant, equipment and power generation.

1.8 Project Start Date

The start of commissioning of the first CHP was the 01st of May 2006.

1.9 Project Crediting Period

The starting date of the crediting period is set to the 01st of May 2006. The project uses a crediting period of 10 years which ended on 30th of April 2016. In accordance with Verra's approval letter dated July 6th, 2021 to request the renewal of the project crediting period, the starting date of the second crediting period of 10 years is set to the 01st of May 2016 and will end on 30th of April 2026.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	x
Large project	

Year (2nd Crediting Period)	Estimated GHG emission reductions or removals (tCO_2e)
01.05.2016 - 31.12.2016	8,472
01.01.2017 - 31.12.2017	12,708
01.01.2018 - 31.12.2018	12,708
01.01.2019 - 31.12.2019	12,708
01.01.2020 - 31.12.2020	12,708
01.01.2021 - 31.12.2021	12,708
01.01.2022 - 31.12.2022	12,708
01.01.2023 - 31.12.2023	12,708
01.01.2024 - 31.12.2024	12,708
01.01.2025 - 31.12.2025	12,708
01.01.2026 - 30.04.2026	4,236
Total estimated ERs	127,080
Total number of crediting years	10
Average annual ERs	12,708

1.11 Description of the Project Activity

Anthropogenic GHG's, specifically methane is released into the atmosphere via decomposing of animal manure when it is stored in open basins below the animal stables, or in tanks and lagoons open to the atmosphere. This manure handling system is characterized by its low investment costs, poor environmental performance and high rates of GHG emissions.

With regard to the project activity, the situation prior to the project implementation was that the cattle and pig manure was stored in open storage pits over 6 months before being used as fertilizer for farmlands. The cattle and pig manure when kept in open-top basins, tanks or lagoons open to the atmosphere undergoes anaerobic fermentation and releases greenhouse gases (methane, CO_2 and N_2O) to the atmosphere and produce bad smell for the neighborhood.

The owner and operator of the biogas plant is Houbensteyn Milieu BV, which was established in 1961. The managing director of the company is Martin Houben.

The project activity is an anaerobic digestion setup with a grid connected Combined Heat and Power plant (CHP) attached, using primarily pig manure for fermentation, as well as co-ferments such as liquid and solid food wastes, maize, and grain. Thus, the primary energy generated in the digester is biogas, which is then burned in the CHP units.

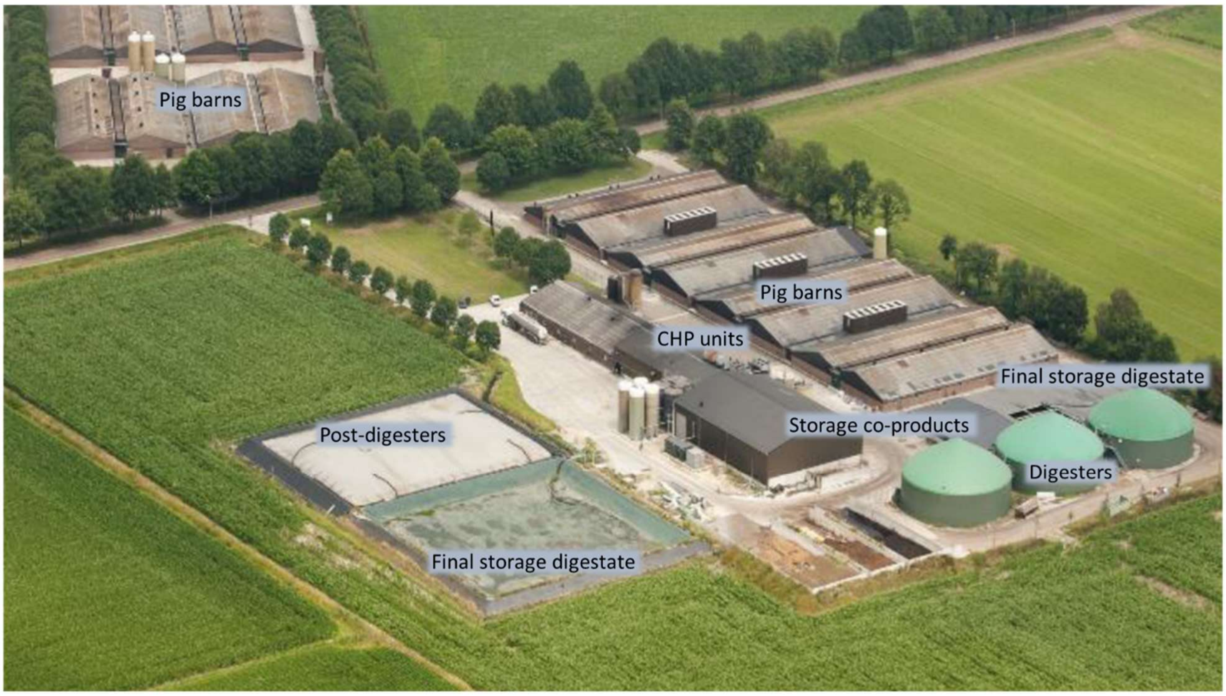

Figure 1: Biogas site with project technology installed from Houbensteyn Milieu BV

The project technology is based on anaerobic digestion in fermenters kept on temperature around 37-40°C using part of the waste heat of the CHP units. The fermenters receive a daily load of organic materials such as manure and co-ferments and maintains among others a steady population of methanogenic bacteria that converts organic acids into biogas.

The bacterial decomposition of the organic material that takes place in anaerobic lagoons, is a process in which certain bacteria species that develop under the absence of oxygen, decompose the complex organic structure, and produce simpler ones such as methane, CO_2, water, etc, obtaining energy and other components necessary for their growth. The gas emission resultant from the anaerobic digestion is a mixture called biogas. The main component of the biogas is methane.

The biogas is used for electricity and heat production in a CHP plant with a total electric capacity of 1.75 MW_{el} and a total thermal capacity of 2.1 MW_{th}. It consists of 4 CHP units as described in the table below. The electricity produced is fed into the national electricity grid. The heat produced is used for heating the digesters, for pre-heating the food for piglets, for the hygienization of the digestate.

CHP Units	Electric capacity installed (kW_{el})	Thermal capacity installed (kW_{th})	Electric efficiency (%)	Start of operation date	Comments
CHP 1 - MAN LE 312	530	627	37.8	2005	Original 346 kW_{el}, in 2016 upgraded
CHP 2 - MAN LE 312	530	627	37.8	2006	Original 346 kW_{el}, in 2016 upgraded
CHP 3 - MAN LE 312	346	421	37.5	2006	
CHP 4 - MAN LE 312	346	421	37.5	2005	

Table 1: Data of installed CHP units from Houbensteyn Milieu BV

All of the manure coming from the pig barns is transported by trucks to the biogas system. This applies to the Houbensteyn Milieu BV's manure as well as to the manure coming from external farms.

Furthermore, following technical installations have been built on the biogas site:

- 3 digesters (à 2,000 m^3)
- 1 post-digesters (5,000 m^3)
- 2 digestate storage lagoons (2,000 and 5,000 m^3)
- storage space for solid substrates (2,000 m^2)

After digestion, the so-called digestate is sanitize in an hygienization unit in order to comply with regulations for product export (Regulation (EC) No 1069/2009 Animal by-products) so that veterinary risks are reduced[1]. In the Netherlands, this is common practice on farms, as the processing of manure surpluses is mandatory due to intensive livestock farming and the resulting excess of nutrients that pollute the ground water.

1.12 Project Location

[1] Manure a valuable resource, https://edepot.wur.nl/498084 p. 24

The project activity takes place on the estate of the project owner Houbensteyn Milieu BV in Ysselsteyn, Limburg, southeastern part of the Netherlands. The geographical coordinates are N 51° 29' 40.633" E 5° 55' 48.705".

Figure 2: Map of The Netherlands with marked project location

Figure 3: Area map with marked project site

1.13 Conditions Prior to Project Initiation

The scenario existing prior to the start of the implementation of the project activity is:

Before the project activity, pig manure generated at the project owner's farm and other participating farms located around the biogas plant were left to decay in pits and storage tanks in aerobic conditions. Hence, greenhouse gases (GHG) generated from animal manure were released directly into atmosphere.

In addition, the heat generated with biogas technologies would have been produced by power plants using fossil fuels, which would also lead to GHG emissions.

The baseline scenario is the same as the scenario existing prior to the start of the implementation of the project activity. Please refer to Section 3.4 (Baseline Scenario) for details.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project has been operational since 2006 and has obtained the Environmental Impact Assessment approval from governmental authorities. This demonstrate that project is compliant with laws, status and other regulatory frameworks in the Netherlands.

The Dutch system pursues a so-called "All-in-one Permit" approach. This approach serves as a facilitation and simplification of bureaucratic procedures and replaces several individual permits. This is regulated in Annex I of the Decree on Environmental Law and the General Provisions Environmental Law Act (Wabo)[2].

According to this, companies are audited step by step and compliance with all laws is ensured. Accepted companies receive the necessary Environmental Permit (called omgevingsvergunning) and the Activity Decree, the license to operate (called activiteitenbesluit).

Both of these documents are hold by the PP and the PP is therefore authorized to have the co-fermentation biogas plant built and in operation.

The project is therefore in compliance with all:

1. building regulations concerning the design of the plant and its safety precautions (especially unwanted leakage, fire safety, odor and noise pollution),
2. environmental regulations (groundwater protection),
3. labor regulations (safety measures to protect workers) and
4. (renewable) energy regulations.

Also, the transports of the waste and the manure are reviewed and approved. Likewise, the generation and supply of electricity and heat are following all laws.

Furthermore, the project activity is in compliance with further laws: These are, on the one hand, European regulations and, on the other hand, Dutch laws. This involves laws that regulate the handling of emissions, the trading of these, the handling of natural resources, agricultural practices, and additional construction regulations.

In particular, these are:

European laws
Treaty on the Functioning of the European Union, sect. 191 et seqq.
Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources

[2] Netherlands Enterprise Agency, RVO: Https://Business.Gov.Nl/Regulation/Applying-For-All-In-One-Permit-Physical-Aspects/

Directive (EU) 2018/2001 of the European Parliament and the Council of 11 December 2018 on the promotion of the use of energy from renewable sources
Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC Consolidated text: Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC
Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work Consolidated text: Council Directive of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (89/391/EEC)

Dutch laws	Translation of Dutch laws
Wet van 6 november 2008, houdende regels inzake een vergunningstelsel met betrekking tot activiteiten die van invloed zijn op de fysieke leefomgeving en inzake handhaving van regelingen op het gebied van de fysieke leefomgeving. Wet algemene bepalingen omgevingsrecht (Wabo)	Act of 6 November 2008, containing rules on a permit system with regard to activities that affect the physical living environment and on enforcement of regulations in the field of the physical living environment. General Provisions Environmental Law Act (Wabo).
Besluit van 25 maart 2010, houdende regels ter uitvoering van de Wet algemene bepalingen omgevingsrecht (Besluit omgevingsrecht)	Decree of 25 March 2010, containing rules for the implementation of the General Provisions Environmental Law Act (Environmental Law Decree)
Regeling van de Minister van Landbouw, Natuur en Voedselkwaliteit van 4 november 2005, nr. TRCJZ/2005/3295, houdende regels ter uitvoering van de Meststoffenwet (Uitvoeringsregeling Meststoffenwet)	Regulation of the Minister of Agriculture, Nature and Food Quality of 4 November 2005, no. TRCJZ/2005/3295, containing rules for the implementation of the Fertilizers Act (Implementation Regulations for the Fertilizers Act)
Besluit van 29 augustus 2011 houdende vaststelling van voorschriften met betrekking tot het bouwen, gebruiken en slopen van bouwwerken (Bouwbesluit 2012), Stb. 2011, 416, laatstelijk gewijzigd bij het Besluit van 22 december 2021 tot wijziging van het Bouwbesluit 2012 en het Besluit bouwwerken leefomgeving in verband met hernieuwbare energie bij ingrijpende renovatie (Stb. 2021, 658)	Decree of 29 August 2011 establishing regulations with regard to the construction, use and demolition of structures (Building Decree 2012), Stb. 2011, 416, last amended by the Decree of 22 December 2021 amending the Building Decree 2012 and the Buildings and Living Environment Decree in connection with renewable energy in the event of major renovation (Stb. 2021, 658)

Dutch laws	Translation of Dutch laws
Wet van 18 maart 1999, houdende bepalingen ter verbetering van de arbeidsomstandigheden (Arbeidsomstandighedenwet 1998)	Act of March 18, 1999, containing provisions for the improvement of working conditions (Working Conditions Act 1998)

1.15 Participation under Other GHG Programs

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

The project is not registered under any other GHG program.

Methane Recovery Project Houbensteyn Ysselsteyn has never applied to any other greenhouse gas program outside of the Voluntary Carbon Standard VCS. The Project Proponent confirms that credits generated in the current monitoring period do not form part of any other national or international scheme.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG programs and therefore, is not included in any publicly available rejection list of other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Before the implementation of the project activity, Methane recovery project Houbensteyn Ysselsteyn has been planned based on the UNFCCC criteria for JI projects according to Article 6 of the Kyoto Protocol and subsequent decisions of the Joint Implementation Supervisory Committee with regard to JI modalities and procedures and the application of approved methodologies. This should allow the conversion of the project into a JI project at a later stage. However, the project has never been converted into a JI project and hence, is not listed as a JI project on the UNFCCC website.

The project has then been adapted to the VCS requirements and has published the corresponding addendum in 2009 in order to generate voluntary carbon units.

Project activity does not claim emission reductions from production of electric energy. In this aspect, it has no influence on projects that have binding emission limits under the EU ETS. Agricultural anaerobic digestion is not considered in the greenhouse gas inventory of the Netherlands, so the emission reductions caused by the avoided uncontrolled decay of waste or manure will not be counted towards the greenhouse gas emission inventory of the Netherlands (see Appendix A for the evidence for no double counting).

The project is currently not part of any other GHG program, emission trading scheme or environmental credit, that means double counting can be exempted. The project also receives no other form of incentives for the activities that cause the emission reduction.

1.16.2 Other Forms of Environmental Credit

The project has not sought or received another form of environmental credits.

1.17 Additional Information Relevant to the Project

Leakage Management

According to the applicable methodology AMS III.AO Version 01, leakage effects are to be considered only if the project technology is the equipment transferred from another activity or the existing equipment is transferred to another activity.

The present project technology consists in new equipment not transferred from another activity and the existing equipment will not be transferred to another activity. Thus, neither a leakage management plan nor leakage and risk mitigation measures are required.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Sustainable Development

The project contributes to achieve nationally defined sustainable development priorities, which are set out in the “Sustainable development goals: the situation for the Netherlands”[3].

The project activity contributes to generating electricity and heat from renewable sources, that helps in country energy security, reduces the GHG emissions and encourages clean, renewable and efficient technologies. Furthermore, the project activity contributes to enhancing local employment by providing direct and indirect employment generation during construction and operation phases. Other positive impacts of the project activity are the improved quality of digestated manure compared to manure and the reduction of odor emissions in the vicinity spreading the digestate.

Further Information

No further relevant information has been identified.

[3] See https://www.cbs.nl/en-gb/publication/2018/10/the-sdgs-the-situation-for-the-netherlands, p. 35/36 (Renewable energy) and p. 50 (Climate policy)

2 SAFEGUARDS

2.1 No Net Harm

The Houbensteyn project has been formally and finally approved by the responsible regional authorities of the Netherlands in accordance with the Dutch building law "Wet op de Ruimtelijke Ordening". This act provides the set of rules which regulates the impact assessment of plants or projects on the environment. The approval covers the installation and operation of the biogas power plant including all components such as storage, feeders, fermenters, CHP modules, etc.

The project activity contributes to a significant higher ecological sustainability compared to a reference scenario without manure's treatment by using biogas plants.

Hence, the Houbensteyn project has no relevant negative environmental and socio-economic impacts and contributes positively by providing environment friendly power generation leading to sustainable development of the region.

2.2 Local Stakeholder Consultation

The Project is already registered with VCS (VCS ID 336). The Local Stakeholder Consultation process was already conducted in line with the requirements during the project registration. As during the authorization process for the project, public stakeholders have the right during the operation phase of the biogas plant to litigate against the project at the administrative court in case the installation have a negative impact on their well-being. In the same way, public stakeholders have the possibility to contact directly and at any time the company of Houbensteyn Milieu BV in case they feel directly or indirectly disturbed by the project activity.

Since the biogas installation impacted positively the region on an economical, environmental and a social level, the stakeholders still give till today positive feedback and consider the project as an example that can motivate other communities to generate renewable energies using the local manure and reducing this way the GHG emissions as well as odor. No complain or litigation has taken place during the first crediting period of the project. Over 10 times a year, Houbensteyn Milieu BV is welcoming various stakeholder groups as companies, children's classes, regional politicians, etc. to visit the biogas plant. Furthermore, the communication with stakeholders as neighbours or business partners takes place in the day-to-day life, in particular via Martin Houben, the owner of the biogas plant who lives in the area.

2.3 Environmental Impact

Prior to the implementation of the project activity, the Houbensteyn project has been formally and finally approved by the responsible regional authorities of the Netherlands in accordance with the Dutch building law "Wet op de Ruimtelijke Ordening". This act provides the set of rules

which regulates the impact assessment of plants or projects on the environment. The approval covers the installation and operation of the biogas power plant including all components such as storage, feeders, fermenters, CHP modules, etc.
A full environmental impact assessment (EIA) has been conducted in order to comply with the Dutch environmental requirements. The planned project capacity as described in the first PD was about 47,000 t substrate input.

The limit set in the law is already expressing the public opinion of the stakeholders that no severe environmental impacts need to be expected from biogas plants of this size. Indeed, the environmental impact check did not identify significant impacts to the environment.

2.4 Public Comments

It is not required to post a project for public consultation at crediting period renewal. Hence, this section is not applicable to the project activity.

2.5 AFOLU-Specific Safeguards

The project is not an AFOLU project. Hence, this section is not applicable to the project activity.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Three small-scale methodologies according to the CDM standards of the UNFCCC are used in the project:

Type III, other project activities:

- AMS III.AO “Methane recovery through controlled anaerobic digestion” (Version 1.0), referring to the capture of methane gases from biomass or other organic matter.
- AMS III.D *“Methane recovery in agricultural and agro-industrial activities”* (Version 11), referring to the capture of methane gases from decomposing manure. The actual version is named “*Methane recovery in animal manure management systems*” (Version 21).

Type I, Renewable Energies:

- AMS I.C, *“Thermal energy for the user with or without electricity”* (Version 09), referring to the utilization of the waste heat to replace fossil energy. The actual version is named *“Thermal energy production with or without electricity”* (Version 21).

The methodologies also refer to the latest approved version of the following tools:

- Project and leakage emissions from anaerobic digesters, Tool 14 (Version 02)

– Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period, Tool 11 (Version 03.0.1)

3.2 Applicability of Methodology

The project meets all the relevant applicability conditions for small scale project activity and the selected methodologies, as described in the tables below.

Applicability conditions for small-scale project activity

As per paragraph 11 of General guidelines for SSC CDM methodologies, version 23, for the following requirements, project participants and coordinating/managing entities shall refer to applicable provisions for project activity eligibility for small-scale project activities in the project standard:

(a) Eligibility of project activities as small-scale CDM project activities;

(b) Output capacity of renewable energy equipment.

The CDM project standard for project activities, Version 3.0 in paragraph 119 requires selection of project type and output capacity. The project belongs to:

(a) Type I: Renewable energy project activities with a maximum output capacity of 15MW (or an appropriate equivalent).

The project has installed Combined Heat and Power (CHP) engines which have an installed capacity less than 15 MW.

(b) Type III: Other project activities not included in Type I or Type II that result in GHG emission reductions not exceeding 60 kt CO2e per year in any year of the crediting period.

The project activity implements the methane avoidance component and results in emission reductions which are less than 60kt CO_2e. Therefore, the project meets all the relevant applicability conditions for small-scale project activity.

The applicability conditions of the different methodologies used for the project activity are described and justified in the tables below:

Table 2: Applicability conditions for AMS-III.AO Version 1.0

Applicability Criteria AMS-III.AO		Justification
1	This methodology comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS), or in an animal waste management system (AWMS), or in a	The Project is to avoid the emissions of methane to the atmosphere from biomass (agriculture residue) that would have been left to decay anaerobically in an AWMS. In the project activity, controlled biological treatment of biomass or other organic matters is introduced through anaerobic digestion in

	Applicability Criteria AMS-III.AO	Justification
	wastewater treatment system (WWTS). In the project activity, controlled biological treatment of biomass or other organic matters is introduced through anaerobic digestion in closed reactors equipped with biogas recovery and combustion/flaring system. The following conditions apply:	closed reactors equipped with biogas recovery and combustion/flaring system
	(a) Digestion of biomass or other organic matter (excluding animal manure and sludge generated in the wastewater treatment works) as a single source of substrate is included;	Not applicable. The project entails the co-digestion of manure and waste with other biomass substrates.
	(b) Co-digestion of multiple sources of biomass substrates, e.g. MSW, organic waste, animal manure, wastewater, where those organic matters would otherwise have been treated in an anaerobic treatment system without biogas recovery is also eligible;	The project entails the co-digestion of manure and waste with other biomass substrates which would otherwise have been treated in anaerobic conditions without biogas recovery.
	(c) If for one or more sources of substrates, it cannot be demonstrated that the organic matter would otherwise been left to decay anaerobically, baseline emissions related to such organic matter shall be accounted for as zero, whereas project emissions shall be calculated according to the procedures presented in this methodology for all co-digested substrates;	In the baseline scenario, manure is left to decay under anaerobic conditions for more than 6 months per year. Project emissions are calculated according to the procedures presented in AMS-III.D, AMS.I.C and AMS-III.AO. Regarding agricultural and industrial waste, it cannot be demonstrated that the organic matter would otherwise been left to decay anaerobically in the absence of the project. Therefore, it is excluded from the project and baseline emissions related to waste will be accounted for as zero.
	(d) Project participants shall apply the procedures related to the “competing use for the biomass” according to the latest” General guidance on leakage in biomass project activities”	Not applicable. The manure used in the project activity could not be used for other purposes in the absence of the project.
	(e) Project activities treating animal manure as single source substrate shall apply AMS-III.D “Methane recovery in animal manure management systems”, similarly projects only treating wastewater and/or sludge generated in the wastewater treatment works shall apply AMS-III.H “Methane recovery in wastewater treatment”	The project entails the co-digestion of manure with other biomass substrates. Manure is not treated as single source substrate.

Applicability Criteria AMS-III.AO		Justification
	(f) The project activity does not recover or combust landfill gas from the disposal site (unlike AMS-III.G “Landfill methane recovery”) and does not undertake controlled combustion of the waste that is not treated biologically in a first step (unlike AMS-III.E “Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment”). Project activities that recover biogas from wastewater treatment shall use methodology AMS-III.H.	Not applicable. The project activity does not recover or combust landfill gas and does not undertake controlled combustion of waste or recover biogas from wastewater treatment.
2	Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO2 equivalent annually.	The project activity is expected to achieve emission reductions less than 60 kt CO_2 equivalent annually, as stated in section 1.10 above.
3	The location and characteristics of the disposal site of the biomass used for digestion in the baseline condition shall be known, in such a way as to allow the estimation of its methane emissions. Guidelines in AMS-III.G, AMS-III.D, AMS-III.E (concerning stockpiles) and AMS-III.H (as the case may be) shall be followed in this regard. Project activities for co-digestion of animal manure shall also meet the requirements under paragraphs 1 and 2(c) of AMS-III.D. The following requirement shall be checked ex ante at the beginning of each crediting period: (a) Establish that identified landfill(s)/stockpile(s) can be expected to accommodate the waste to be used for the project activity for the duration of the crediting period; or (b) Establish that it is common practice in the region to dispose off the waste in solid waste disposal site (landfill/stockpile).	The location and characteristics of the disposal site of the biomass used for digestion in the baseline condition is known and included in the boundary of the project. The requirements under paragraphs 1 and 2(c) of AMS-III.D v16[4] are met and are explained in the Table below. It is not anymore common practice in the region of North Brabant to dispose off the waste in solid waste disposal site such as landfills.
4	The project participants shall clearly define the geographical boundary of the region referred to in 3(b), and document it in the CDM-PDD. In defining the geographical boundary of the	The geographical boundary of the region referred to in 3(b) is clearly defined in section 3.3 below. Most of the manure suppliers are

[4] AMS-III.AO, Version 1 was approved at EB58 on 26/11/2010. By that time, the valid version of AMS-III.D was Version 16. Paragraphs 1 and 2(c) of that version correspond to paragraphs 3 and 4(c) of AMS-III.D Version 21.0.

	Applicability Criteria AMS-III.AO	Justification
	region, project participants should take into account the source of waste, i.e. if waste is transported up to 50 km, the region may cover a radius of 50 km around the project activity. In addition, it should also consider the distances to which the final product after digestion will be transported. In either case, the region should cover a reasonable radius around the project activity that can be justified with reference to the project circumstances but in no case, it shall be more than 200 km. Once defined, the boundary should not be changed during the crediting period(s).	located within a radius of around 20 km from the biogas site.
5	In case residual waste from the digestion is handled aerobically and submitted to soil application, the proper conditions and procedures (not resulting in methane emissions) for storage and transportation and soil application must be ensured.	The digestate will be exported to other farms or abroad and will be submitted to soil application as fertilizer. In the Netherlands, low emission application of untreated manure and liquid digestate as fertilizer in agriculture land is the most popular technology[5].
6	In case residual waste from the digestion is treated thermally/mechanically, the provisions in AMS-III.E related to thermal/mechanical treatment shall be applied.	Not applicable since residual waste from the digestion is not treated thermally /mechanically as defined under AMS-III.E.
7	In case residual waste from the digestion is stored under anaerobic conditions and/or delivered to a landfill, emissions from the residual waste shall to be taken into account and calculated as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".	Not applicable since residual waste from the digestion is not stored under anaerobic conditions and/or delivered to a landfill.
8	In case the outflow from the digestion is discharged to a subsequent wastewater treatment system or to the natural water receiving body, relevant procedure in AMS-III.H shall be followed to estimate the resultant project emissions.	Not applicable since the outflow from the digestion is not discharged to a subsequent wastewater treatment system or to the natural water receiving body.

[5] Livestock Manure Treatment Technology of the Netherlands and Situation of China, Wageningen Livestock Research, 2017, https://edepot.wur.nl/423982 , p. 19

	Applicability Criteria AMS-III.AO	Justification
9	Technical measures shall be used to ensure that all biogas captured from the digester is combusted/flared.	All biogas generated is combusted in the generation system. A flaring system is not included in the project activity. The project operator has an official license to operate the biogas plant without a flare since there is a total of 4 CHPs installed on site. In case of failure of 1 CHP (because of maintenance or other technical problems) where the biogas produced cannot be processed, the biogas is first stored in the biogas membrane and then, once the gas storage is full, fed to another on-site CHP. Therefore, technical measures used ensure that all biogas capture from the digester is combusted.
10	All the applications to utilise the recovered biogas detailed in paragraph 3 of AMS-III.H[6] are eligible for use under this methodology. The relevant procedure in AMS-III.H shall be followed in this regard. Paragraph 4 AMS-III.H Version 19.0 The recovered biogas from the above measures may also be utilised for the following applications instead of combustion/flaring: (a) Thermal or mechanical,[7] electrical energy generation directly; (b) Thermal or mechanical, electrical energy generation after bottling of upgraded biogas, in this case additional guidance provided in the appendix shall be followed; or (c) Thermal or mechanical, electrical energy generation after upgrading and distribution, in this case additional guidance provided in the appendix shall be followed:	The recovered biogas is utilized in Combined Heat and Power plant (CHP) for thermal and electrical energy generation. Thus, it corresponds with application (a) of AMS-III.H. Paragraph 5 of AMS-III.H Version 19.0 establishes that if the recovered biogas is used for project activities covered under paragraph 4(a), that component of the project activity can use a corresponding methodology under Type I." Since the generation of electricity is not part of the project activity, the Type I methodology corresponding to the energy generation is AMS-I.C. "Thermal energy production with or without electricity Version 21.0".

[6] Correspond to paragraph 4 of AMS-III.H Version 19.0
[7] For example, combusted in a prime mover such as an engine coupled to a machine such as grinding machine.

Applicability Criteria AMS-III.AO		Justification
	(i) Upgrading and injection of biogas into a natural gas distribution grid with no significant transmission constraints; (ii) Upgrading and transportation of biogas via a dedicated piped network to a group of end users; or (iii) Upgrading and transportation of biogas (e.g. by trucks) to distribution points for end users; (d) Hydrogen production; (e) Use as fuel in transportation applications after upgrading.	

Table 3: Applicability conditions for AMS-III.D, Version 21.0

Applicability Criteria AMS-III.D		Justification
2	The methodology AMS-III.D. covers project activities involving the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant.	The project is a centralized plant which treats animal manure from several farms to achieve methane recovery and gainful use of the recovered methane.
3	This methodology is only applicable under the following conditions: a) The livestock population in the farm is managed under confined conditions;	All the livestock (pig and cattle) manure of the farms implied in the project activity as suppliers are managed under confined conditions.
	b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise "AMS-III.H Methane recovery in wastewater treatment" shall be applied;	Unhindered discharge of manure or the streams obtained after treatment into natural water resources does not take place. Such a procedure is illegal according to European

	Applicability Criteria AMS-III.D	Justification
		Directive 2006/118/EC[8] and the Dutch Manure and Fertilisers Act 2016[9]. "AMS-III.H Methane recovery in wastewater treatment" is therefore not applicable.
	c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C;	The annual average temperature in Wanroij is about 10.8°C.[10]
	d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month and if anaerobic lagoons are used in the baseline, their depths are at least 1 m;	Prior to the implementation of the project activity, pig and cattle manure was stored in storage pits and/or tanks over 6 months before being used as fertilizer for farmlands.
	e) No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario.	No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario, as this is not required by law.

	Applicability Criteria AMS-III.D	Justification
4	The project activity shall satisfy the following conditions: a) The residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of “AMS-III.AO Methane recovery through controlled anaerobic digestion". In the case of soil application, proper conditions and procedures (not resulting in methane emissions) must be ensured;	The project activity is an anaerobic digestion setup with a grid connected Combined Heat and Power plant (CHP) attached using primarily pig and cattle manure for fermentation, as well as co-ferments such as liquid and solid food wastes, maize and grain. Therefore, all residual waste from the animal manure management system is handled aerobically. In the case of soil application, all proper conditions and procedures required by European und Dutch law are obeyed and will not result in methane emissions.
	b) Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared;	In the project activity, the technical measures ensure that all biogas produced by the digester is used, particularly the installation of several CHP units.

[8] http://data.europa.eu/eli/dir/2006/118/2014-07-11
[9] https://www.pbl.nl/sites/default/files/downloads/pbl-2017-evaluation-of-the-manure-and-fertilisers-act-2016-2779.pdf
[10] https://www.worldweatheronline.com/lang/es/wanroij-weather-averages/north-brabant/nl.aspx

Applicability Criteria AMS-III.D		Justification
	c) The storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester. If the project proponent can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.	The storage time of the manure after removal from the animal barns, including transportation will not exceed 45 days before being fed into the anaerobic digester.
5	Projects that recover methane from landfills shall use "AMS-III.G Landfill methane recovery" and projects for wastewater treatment shall use AMS-III.H. Projects for composting of animal manure shall use "AMS-III.F Avoidance of methane emissions through composting". Project activities involving co-digestion of animal manure and other organic matters shall use the methodology "AMS-III.AO Methane recovery through controlled anaerobic digestion".	The project activity involves co-digestion of animal manure and other organic matters and uses the methodology "AMS-III.AO Methane recovery through controlled anaerobic digestion".
6	Utilization of the recovered biogas in one of the options detailed in AMS-III.H is also eligible under this methodology. The respective procedures in AMS-III.H shall be followed in this regard. If the recovered biogas is used to power auxiliary equipment of the project activity, it should be taken into account accordingly, using zero as its emission factor; however, energy used for such purposes is not eligible as an SSC CDM Type I project component.	The project activity involves power generation using Combined Heat and Power engines (CHP) to produce electricity and heat with the biogas generated. AMS-III.AO with AMS-III.D are applied to the proposed project activity.
7	New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the "General guidelines for SSC CDM methodologies".	The project activity does not involve anymore new facilities as it is already in operation. The project activity involves capacity additions compared to the previous PD and is eligible as it complies with the related and relevant requirements in the "General guidelines for SSC CDM methodologies", as described in section 3.4 of the current PD.
8	The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the	The requirements concerning demonstration of the remaining lifetime of the replaced equipment are met and described in section 3.4 of the current PD.

Applicability Criteria AMS-III.D		Justification
	"General guidelines for SSC CDM methodologies".	
9	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO2 equivalent annually from all Type III components of the project activity.	The emission reductions from the recovery and destruction of methane (Typ III component of the project activity) are 12,708 t CO_2e/a, which is less than 60 kt CO_2e/a.

Table 4: Applicability conditions for AMS-I.C, Version 21.0

Applicability Criteria AMS-I.C		Justification
2	This methodology comprises renewable energy technologies that supply users i.e. residential, industrial or commercial facilities with thermal energy that displaces fossil fuel use. These units include technologies such as solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.	The project activity will capture biogas (a renewable fuel) from the project's manure treatment system and utilize it for thermal energy generation to substitute fossil fuel in the hygienization and for space heating and pre-heating piglets' food. Therefore, the project activity meets this applicability criterion.
3	Biomass-based cogeneration and trigeneration systems are included in this category.	The project activity is a biomass-based cogeneration system. Therefore, this is applicable to the project activity.
4	Emission reductions from a biomass cogeneration or trigeneration system can accrue from one of the following activities: (a) Electricity to a grid; (b) Electricity and/or thermal energy production for on-site consumption or for consumption by other facilities; (c) Combination of (a) and (b).	The project activity is a biomass-based cogeneration system. Emission reductions accrue from (b) the thermal energy production for on-site consumption and for consumption by other facilities.
5	Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.	The project activity is already implemented and did not involve any retrofit or modification of an existing facility.
6	In the case of new facilities (Greenfield projects) and project activities involving capacity additions the relevant requirements related to determination of baseline scenario	The project activity involves capacity additions compared to the previous PD. The relevant requirements related to determination of baseline scenario provided in the "General

	Applicability Criteria AMS-I.C	Justification
	provided in the "General guidelines for SSC CDM methodologies" for Type-II and Type-III Greenfield/capacity expansion project activities also apply.	guidelines for SSC CDM methodologies" for Type-II and Type-III have been assessed under section 3.4. The current baseline scenario is still valid.
7	The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal (see paragraph 9 for the applicable limits for cogeneration and trigeneration project activities).	The total installed/rated thermal energy generation capacity of the project equipment is less than 45 MW thermal (=2.1 MW).
8	For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel, shall not exceed 45 MW thermal (see paragraph 9 for the applicable limits for cogeneration project activities).	The project activity is not a co-fired system. Therefore, this is not applicable to the project activity.
9	The following capacity limits apply for biomass cogeneration and trigeneration units: (a) If the emission reductions of the project activity are on account of thermal and electrical energy production, the total installed thermal and electrical energy generation capacity of the project equipment shall not exceed 45 MW thermal. For the purpose of calculating the capacity limit the conversion factor of 1:3 shall be used for converting electrical energy to thermal energy (i.e. for renewable energy project activities, the installed capacity of 15 MW(e) is equivalent to 45 MW thermal output of the equipment or the plant); (b) If the emission reductions of the project activity are solely on account of thermal energy production (i.e. no emission reductions accrue from the electricity component), the total installed thermal energy production capacity of the project equipment shall not exceed 45 MW thermal; (c) If the emission reductions of the project activity are solely on account of electrical energy production (i.e. no emission reductions	(a) The emission reductions of the project activity are not on account of thermal and electrical energy production. Therefore (a), this is not applicable to the project activity. (b) The emission reductions of the project activity are solely on account of thermal energy production (no emission reductions accrue from the electricity component). The total installed thermal energy production capacity is 2.1 MW thermal. (c) The emission reductions of the project activity are not on account of any electrical energy production. Therefore (c), this is not applicable to the project activity.

	Applicability Criteria AMS-I.C	Justification
	accrue from the thermal energy component), the total installed electrical energy generation capacity of the project equipment shall not exceed 15 MW.	
10	The capacity limits specified in paragraphs 7 to 9 above apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project shall comply with capacity limits specified in the paragraphs 7 to 9, and shall be physically distinct from the existing units.	The project activity satisfies paragraph 4(b). Therefore, this is not applicable to the project activity.
11	If solid biomass fuel (e.g. briquette) is used, it shall be demonstrated that it has been produced using solely renewable biomass and all project or leakage emissions associated with its production shall be taken into account in the emissions reduction calculation.	The project activity satisfies paragraph 4(b). Therefore, this is not applicable to the project activity.
12	Where the project participant is not the producer of the processed solid biomass fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of the renewable biomass to account for any emissions associated with solid biomass fuel production. Such a contract shall also ensure that there is no double-counting of emission reductions.	The project activity satisfies paragraph 4(b). Therefore, this is not applicable to the project activity.
13	If electricity and/or thermal energy produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into that ensures there is no double-counting of emission reductions.	The electricity produced is not part of the project activity. The thermal energy produced by the project activity is not delivered to a third party.
14	If the project activity recovers and utilizes biogas for producing electricity and/or thermal energy and applies this methodology on a standalone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity (e.g. physical leakage of the anaerobic	The project activity recovers and utilizes biogas for heat generation. However, AMS-I.C is not used on a standalone basis but with AMS-III.D, which bases on AMS-III-AO.

	Applicability Criteria AMS-I.C	Justification
	digester, emissions due to inefficiency of the flaring), shall be taken into account either as project or leakage emissions as per relevant procedures in the tool "Emissions from solid waste disposal sites" and/or "Project emissions from flaring". In the event that the biomass fuel (solid/liquid/gas) is sourced from an existing CDM project, then the emissions associated with the production of the fuel shall be accounted with that project.	All the project or leakage emissions are considered.
15	If project equipment contains refrigerants, then the refrigerant used in the project case shall have no ozone depleting potential (ODP).	This is not applicable to the project activity.
16	Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources, provided: (a) Charcoal is produced in kilns equipped with methane recovery and destruction facility; or (b) If charcoal is produced in kilns not equipped with a methane recovery and destruction facility, methane emissions from the production of charcoal shall be considered. These emissions shall be calculated as per the procedures defined in the approved methodology "AMS-III.K: Avoidance of methane release from charcoal production by shifting from traditional open-ended methods to mechanized charcoaling process". Alternatively, conservative emission factor values from peer reviewed literature or from a registered CDM project activity can be used, provided that it can be demonstrated that the parameters from these are comparable e.g. source of biomass, characteristics of biomass such as moisture, carbon content, type of kiln, operating conditions such as ambient temperature.	This is not applicable to the project activity.
17	In cases where the project activity utilizes biomass, sourced from dedicated plantations, applicability conditions prescribed in the tool "Project emissions from cultivation of biomass" shall apply.	This is not applicable to the project activity.

Table 5: Applicability conditions for Tool 14, Version 02.0

Applicability Criteria Tool 14		Justification
1	The following sources of project emissions are accounted for in this tool: (a) CO_2 emissions from consumption of electricity associated with the operation of the anaerobic digester; (b) CO_2 emissions from consumption of fossil fuels associated with the operation of the anaerobic digester; (c) CH_4 emissions from the digester (emissions during maintenance of the digester, physical leaks through the roof and side walls, and release through safety valves due to excess pressure in the digester); and (d) CH_4 emissions from flaring of biogas.	CH_4 project emissions from digesters (c) and from flaring of biogas (d) are considered in the project activity.
2	The following sources of leakage emissions are accounted for in this tool: (a) CH_4 and N_2O emission from composting of digestate; (b) CH_4 emissions from the anaerobic decay of digestate disposed in a SWDS or subjected to anaerobic storage, such as in a stabilization pond	CH_4 leakage emissions from anaerobic decay of digestate subjected to anaerobic storage (b) are considered in the project activity.
3	Emission sources associated with N_2O emissions from physical leakages from the digester, transportation of feed material and digestate or any other on-site transportation, piped distribution of the biogas, aerobic treatment of liquid digestate and land application of the digestate are neglected because these are minor emission sources or because they are accounted in the methodologies referring to this tool.	Applicable.

Table 6: Table 6: Applicability conditions for Tool 11, Version 03.0.1

Applicability Criteria Tool 11		Justification
1	This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period, as required by paragraph 49 (a) of the modalities and procedures of the clean development mechanism. The tool consists of two steps. The first step provides an approach to evaluate whether the current baseline is still valid for the next crediting period. The second step provides an approach to update the baseline in case that the current baseline is not valid anymore for the next crediting period.	The current PD is made in the frame of the renewal of the crediting period of the project activity. The continued validity of the baseline has to be assessed and updated according to the procedures of tool 11.

3.3 Project Boundary

Compared to the original PD, the project boundaries with regard to the source of emissions have not changed. As noted, methodologies applied to the project activity are AMS-III.D. “Methane recovery in animal manure management systems”, Version 21.0, and AMS-I.C. “Thermal energy production with or without electricity”, Version 21.0.

AMS-III.D component, according to paragraph 14

The project boundary includes the physical, geographical site(s) of:

- The livestock;
- Animal manure management systems (including centralized manure treatment plant where applicable);
- Facilities which recover and flare/combust or use methane.

AMS-I.C component according to paragraph 11

The project component encompasses the spatial extent of the project boundary and “(a) all plants generating electricity and/or thermal energy located at the project site, whether fired with biomass, fossil fuels or a combination of both”, shown in the diagram below.

AMS-III.AO component according to paragraph 11

The project boundary is the physical, geographical site, "(a) where the solid waste (including animal manure, where applicable) would have been disposed and the methane emission occurs in absence of the proposed project activity".

Hence, the boundary of project Houbensteyn includes the physical and geographical sites of the livestock farms, the centralized animal manure management system and the thermal energy consumers.

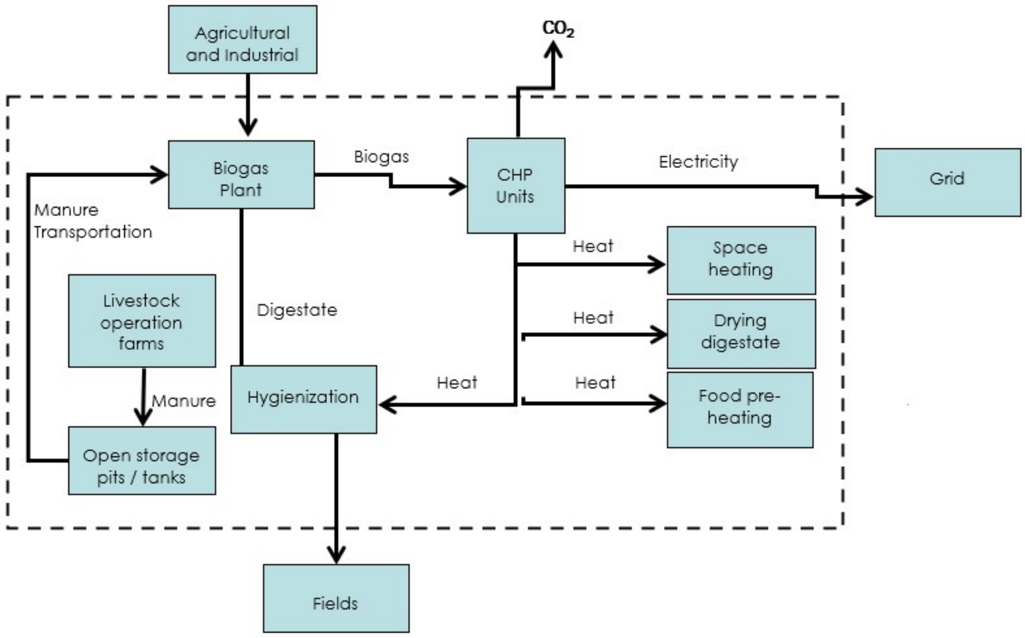

Figure 4: Project boundary of the project activity

The relevant GHG sources included in or excluded from the project boundary are shown in the table below:

Source		Gas	Included?	Justification/Explanation
Baseline	Direct emissions from manure treatment processes	CO_2	No	Excluded for simplification.
		CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	Excluded for simplification.
		Other	-	N/A
		CO_2	Yes	The major source of emissions in the baseline.

Source		Gas	Included?	Justification/Explanation
	Emissions from thermal energy consumption and generation	CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
		Other	-	N/A
Project	Physical leakage of biogas	CO_2	No	Excluded for simplification.
		CH_4	Yes	Main emission source. Physical leakage of biogas has been considered.
		N_2O	No	Excluded for simplification.
		Other	-	N/A
	Emissions from flaring or combustion of the gas stream	CO_2	No	Excluded for simplification.
		CH_4	No	Excluded for simplification. There is no flare installed. Hence, no emissions are considered.
		N_2O	No	Excluded for simplification.
		Other	-	N/A
	Emissions from incremental transportation distances	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
		Other	-	N/A
	Emissions from storage of manure	CO_2	No	Excluded for simplification.
		CH_4	No	The storage time of the manure after removal from the animal barns, including transportation, is within 24 hours before being fed into the anaerobic digester. Hence, emissions from the storage of manure are not accounted for.
		N_2O	No	Excluded for simplification.
		Other	-	N/A

Source		Gas	Included?	Justification/Explanation
	Emissions from on-site electricity or fossil fuel use for plant operation	CO_2	No	The project activity does not make use of fossil fuels for heating. The thermal energy for the digestion process comes from the heat in the CHPs, that is won by burning of the biogas. The electrical energy used in the project activity for the operation of the plant is taken from the own power production process. Therefore, project emissions from this source have been excluded from further consideration.
		CH_4	No	N/A
		N_2O	No	N/A
		Other	-	N/A

Table 7: Emission sources included in or excluded from the project boundary

3.4 Baseline Scenario

The current PD is an update of the first PD in the frame of the renewal of the crediting period of Project Houbensteyn. Section 3.8.9 of VCS Standard, version 4.1 states that "the validity of the original baseline scenario shall be demonstrated". The assessment of the project's baseline validity as per VCS Standard is presented in the Table below.

The project activity consists of 3 components based on 3 methodologies:

- Component 1: The first component of the project activity is the recovery and gainful use of methane through the improvement of animal manure management systems (AMS-III.D.).
- Component 2: The second component of the project activity is the displacement of fossil fuels through the recovery and use of biogas for thermal energy production (AMS-I.C.).
- Component 3: The third component of the project activity is the recovery and gainful use of methane through digestion of agricultural and industrial waste (AMS-III.AO).

Each of the 3 components will be assessed regarding the baseline validity.

Assessment as per VCS standard		Justification
a)	The validity of the original baseline scenario shall be assessed. Such assessment shall include an evaluation of the impact of new relevant national and/or sectoral policies and circumstances on the validity of the baseline scenario.	Regarding Components 1 and 2, the project is in line with all laws and regulation in the Netherlands. As at the time of the original PD, no regulation exists in the Netherlands requiring the collection and/or destruction of methane from livestock manure (Component 1). Also, there is no regulation in place in the Netherlands that prescribes the replacement of fossil fuels for the process heating livestock stalls or pre-heating piglet's food

Assessment as per VCS standard		Justification
		(Component 2). Regarding Component 3, however, it cannot be assessed that the landfilling of agricultural and industrial waste is compliant with mandatory national and/or sectoral policies in the Netherlands. Therefore, the validity of the current baseline of Component 3 cannot be demonstrated. As a result, this component is excluded from further assessments and calculations in relation to GHG emissions reductions.
b)	Where it is determined that the original baseline scenario is still valid, the GHG emissions associated with the original baseline scenario shall be reassessed using the latest version of the CDM Tool to assess the validity of the original/current baseline and to update the baseline at the renewal of a crediting period.	The reassessment of the original baseline scenario for Components 1 and 2 is provided under this table by means of the mentioned Tool 11.
c)	Where it is determined that the original baseline scenario is no longer valid, the current baseline scenario shall be established in accordance with the VCS Program rules.	According to the demonstration regarding the validity of the baseline, the original baseline scenario of Components 1 and 2 are still valid and Component 3 has been excluded. Hence, this section is not applicable.
d)	The project description, containing updated information with respect to the baseline, the estimated GHG emission reductions or removals and the monitoring plan, shall be submitted for validation. Such updates shall be based upon the latest approved version of the methodology or its replacement. Where the project does not meet the requirements of the latest approved version of the methodology or its replacement, the project proponent shall select another applicable approved methodology (which may be a new methodology or methodology revision it has had approved via the methodology approval process) or shall apply a methodology deviation (where a methodology deviation is appropriate). Failing this, the project shall not be eligible for renewal of its project crediting period.	The project description is updated and revised according to the latest approved version of AMS-III.D, AMS-I.C and AMS-III.AO, including the relevant tools to the applied methodologies. For more details, please refer to the paragraphs following the assessment of the validity of the baseline.

VCS Standard states under section 3.8.9 2) b) that "where it is determined that the original baseline scenario is still valid, the GHG emissions associated with the original baseline scenario shall be reassessed using the latest version of the CDM Tool 11 ("Assessment of the validity of the original/current baseline and update of the baseline at the renewal of a crediting period", Version 3.0.1),

Tool 11 consists of two steps: the first one is an evaluation whether the current baseline is still valid and the second one is an update of the baseline in case that the current baseline is not valid anymore for the next crediting period.

Step 1: Assess the validity of the current baseline for the next crediting period

The "Procedure for the renewal of the crediting period of a registered CDM project activity" approved by the CDM Executive Board requires assessing the impact of new relevant national and/or sectoral poli-cies and circumstances on the baseline. The validity of the current baseline is assessed using the fol-lowing Sub-steps:

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

Component 1: Improved manure management systems and methane recovery

According to paragraph 17 AMS-III.D, "the baseline scenario is the situation where, in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and me-thane is emitted to the atmosphere".

The current baseline of the project activity is the storage of pig manure in open pits beneath animal stables or in non gas tight storage tanks outside the barns before being used as fertilizer for farmlands. This mode of manure storage where animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere is common practice since decades in the Netherlands[11]. There is no regulation to store manure in any other way that leads to lower GHG emissions. The storage of manure as described above is the most economic, viable and reasonable option for farm owners and thus, common practice in the Netherlands.

Therefore, it is assessed that the original manure storage system is compliant with mandatory national and sectoral policies in the Netherlands and it is not mandatory to use specific technologies.

Component 2: Thermal energy production

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[11] National Inventory Report 2021, Annex 7, Methodology for estimating emissions from agriculture in the Netherlands, p. 51

In accordance with relevant mandatory national and/or sectoral policies in the Netherlands, there is no regulation that prescribes the replacement of fossil fuel with i.e. renewable energy for the process of heating livestock stalls and pre-heating piglet's food or hygienization of manure/digestate. In the absence of the project activity, the thermal energy would have been based on fossil fuel like natural gas.

Therefore, it is assessed that the current baseline for the heat generation component is in compliance with the regulations in place.

Component 3: Methane recovery from agricultural and industrial digestion

In the previous PD, the baseline scenario is described as the situation where waste from agricultural production processes and industrial food wastes are commonly disposed on landfill sites. The open rotting of this organic matter is causing uncontrolled and uncaptured methane emissions on these dump sites. Using these co-ferments from wastes in the biogas plant not only secures the utilization of this bioenergy but also the capture of the generated methane and avoidance of emissions to the atmosphere.

In the Netherlands, the mandatory national and/or sectoral policies for waste aim at reducing the amount of waste sent to landfill sites[12]. This requires enhanced prevention of waste production and increased recycling of waste, followed by incineration. As stated from the Ministry of Infrastructure and Water Management (Rijkswaterstaat), "The future challenge is to achieve a circular economy. Resources are becoming scarcer and more expensive and need to be used less, and more efficiently. Rijkswaterstaat therefore promotes sustainable consumption and production inside and outside the Netherlands" [13].

Even if there is still a quantity of mixed municipal waste landfilled[14], it cannot be assessed that the landfilling of agricultural and industrial waste is compliant with mandatory national and/or sectoral policies in the Netherlands. Therefore, the validity of the current baseline of Component 3 cannot be demonstrated.

As a result, this component is excluded from further assessments and calculations in relation to GHG emissions reductions.

Step 1.2: Assess the impact of circumstances

As required in Step 1.2 of Tool 11, it is assessed that there are no circumstances existing at the time of requesting renewal of the crediting period which would impact the current baselines of the project activities:

[12] National Inventory Report 2021, section 7.1

[13] From waste to resources, Ministry of Infrastructure and Water Management (Rijkswaterstaat) https://rwsenvironment.eu/subjects/from-waste-resources/

[14] National Inventory Report 2021, section 7.1

- Component 1: continuation of animal manure storage in open pits beneath the animal confinements and tanks outside, which means the release of uncontrolled methane emissions in the atmosphere

- Component 2: continuation of natural gas consumption for heating the livestock stalls, pre-heating piglet food and hygienization of manure, which means the release of CO_2 emissions in the atmosphere.

Not the type but the amount of baseline emissions is impacted from new circumstances like the application of the latest version of the methodologies or the capacity change of the project activity, as described below in the assessment of Step 2 of Tool 11. In fact, the treatment of additional manure in the project boundary does not impact the baseline of Component 1 but only the amount of baseline emissions. Likewise, because more manure was treated in the last decade, additional CHPs were installed to digest the supplementary substrates, which increased the annual electricity and heat production. Just as for Component 1, the use of additional thermal energy does not impact the baseline of Component 2 but only the amount of baseline emissions.

Therefore, the conditions used to determine the baseline emissions in the previous crediting period and the current baseline are still valid. Only data and parameter have to be updated according to Step 2 of the Tool 11.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is request-ed.

Component 1 Improved manure management systems and methane recovery

The baseline equipment used in Component 1 are the pits under the animal barns or outside tanks where manure is stored. The lifetime of manure storage pits and tanks is longer than 20 years, which means technical lifetime of the equipment exceeds the end of the second crediting period (2026). Hence, no investment is planned for this technical equipment and the continuation of use of current baseline equipment is the most likely scenario.

Component 2: Thermal energy production

The baseline equipment used in Component 2 is based on natural. The farms are located next to villages and are connected to the national gas grid.

Without the implementation of the project activity, the livestock barns and the hygienization unit would have been heated with natural gas units. This baseline equipment corresponds to the technical equipment usually used by farmers located next to cities or villages where a connection to the grid exists. The use of natural gas in the Netherlands for heating is common practice, as described in the National Inventory Report 2021 “Natural gas represents a very large share of national energy consumption in all non-transport subsectors: Power generation, Industrial processes and Other (mainly for space heating)"[15] and "Most of the energy in this source sub-category [Agriculture, forestry and fisheries] is used for space heating and water heating, although some is used for cooling. The major fuel used in the sub-category is natural gas"[16]. or by the International Energy Agency "Natural gas is the largest source of domestic energy production and a key fuel for industry and for building heating"[17].

In case farmers are not connected to the gas grid, they usually use propane gas or oil-based firing systems for heating purposes. Only an insignificant part of farmers uses biomass fired plants because they have higher investment costs and require large storage spaces. The main problem, however, is the scarcity of biomass as it competes with large industrial power plants that require large amounts of biomass to generate biomass. Therefore, without the project activity, it can be assumed that the thermal energy production still be based on natural gas. Therefore, the continuation of use of current baseline equipment is the most likely scenario.

Step 1.4: Assessment of the validity of the data and parameters

As described in Step 1.4 of Tool 11, it is to assess whether "data and parameters that were only determined at the start of the crediting period and not monitored during the crediting period are still valid or whether they should be updated". The data and parameter for Component 1 and Component 2 have to be updated according to the VCS Standard requirements and the latest versions of the methodologies and Tools used to calculate the GHG emissions. All the updated data and parameters are described in Sections 4 and 5 of the current PD.

According to the assessment of the validity of the current baseline scenario for the next crediting period as per Step 1 of Tool 11, the current baseline is still valid. Only data and parameters need to be updated. Thus, the application of Step 2 is required.

Step 2 Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The current baseline emissions for the second crediting period are updated based on the latest approved version of the methodologies applicable to the project activity, including the capacity changes of the project. The determination of the baseline emissions is detailed in Sections 4 and 5 of the current PD.

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[15] National Inventory Report 2021, Section 3.1.2, https://unfccc.int/documents/273459, p. 70

[16] National Inventory Report 2021, Section 3.2.7.1, https://unfccc.int/documents/273459, p. 114

[17] The Netherlands 2020, International Energy Agency, https://www.iea.org/reports/the-netherlands-2020

Step 2.2: Update the data and parameters

All applicable data and parameters for the second crediting period are updated based on the latest version of the methodologies applied in the project activity. Please refer to section 5.1 and 5.2 for the updated data and parameters for the second crediting period.

Conclusion: Assessment of baseline validity according to Tool 11

The current baseline for the next crediting period is valid and data and parameter are updated according to the latest relevant methodologies for the project activity. Hence, the VCS requirements described in point b) of the table above are satisfied.

According to point d) of the table above, the project description shall be updated reading information with respect to the baseline, the estimated GHG emission reductions or removals and the monitoring plan. Such updates shall be based upon the latest approved version of the methodology or its replacement.

The project activity involves capacity increase compared to the baseline scenario, since more pig stables have been built and more manure is stored in the project boundary. The increase of manure available led to the implementation of more CHPs units, digesters and storage tanks in order to use the methane production for power and heat generation. The capacity increase is also due to the crisis in the biogas co-digestion sector where economies of scale with higher energy production and sale help to face the difficult economic situation of this type of biogas plants.

As per paragraph 7 AMS-III.D (and per. 6. AMS-I.C), "project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the "General guidelines for SSC CDM methodologies", Version 23.1. Section 4.13 of these Guidelines states, that "Type II and III project activities and PoAs involving capacity increase may use a Type II and Type III small-scale methodology provided that they can demonstrate that the most plausible baseline scenario for the additional (incremental) capacity is the baseline provided in the respective Type II and III small-scale methodologies".

Since the validity of the current baseline scenario including the capacity increases from Component 1 (Type III Project) has just been proved above using the Tool 11, it can be stated that the most plausible scenario baseline scenario for the additional capacity is also the storage of manure in pits under animal confinements or outside tanks. In addition, the capacity increase has no impact on the eligibility of the project as a small-scale project since the installed capacity of the project activity is less than 15 MW (Typ I) and the emission reductions every year are less than 60 ktCO2e (Typ III). The project is even a micro-scale project since the installed capacity of the project activity is less than 5 MW (Typ I) and the emission reductions every year are less than 20 ktCO2e (Typ III).

In conclusion, the baseline scenarios for the different project Components have been assessed and determined as valid and the data and parameters are updated according to the latest versions of the methodologies.

3.5 Additionality

According to the VCS Standard Section 3.8.9 1) "a full reassessment of additionality is not required when renewing the project crediting period. However, regulatory surplus shall be demonstrated in accordance with the requirements set out in the VCS Program rules and the project description shall be updated accordingly".

As at the time of the original PDD, still no regulation exists in the Netherlands requiring the collection and/or destruction of methane from livestock manure. It is common practice to store livestock manure in pits, tanks or lagoons without capturing the methane generated during the storage period, as described in Annex 7 of the National Inventory Report 2021 of the Netherlands[18]. The storage of manure as described above is the most economic, viable and reasonable option for farm owners.

The regulations for the storage of manure are laid down in § 3.4.6 of the already mentioned Activities Decree (Activiteitenbesluit milieubeheer)[19]. Two essential contents are determined there: First, that minimum distances to odour-sensitive facilities must be maintained (Art. 3.51) and second, that leakage into the soil is prevented by appropriate construction measures (Art. 3.52). This is particularly related to the EU Nitrates Directive (91/676/EEC), whose primary objective is to protect the groundwater.

Further laws relevant in this context do not exist so that it is common practice to store manure in pits, tanks, or lagoons without capturing the leaking methane. This statement is supported by the wording in the National Climate Agreement of the Netherlands where "options"[20] are presented which famers might implement to reduce GHG emissions from storing manure. However, these are neither mandatory, required by law nor incentivized through other mechanisms.

Therefore, the project fulfils the requirements and meets the regulatory surplus set out in 3.8.9 of the VCS Standard v4.1.

The Netherlands has set ambitious targets for reducing its GHG. As the government document shows[21], the reductions are also foreseen for GHG emissions from agriculture, intended measures to reduce GHG emissions in the sector of dairy and pig farming are described in the

[18] National Inventory Report 2021, Annex 7, Methodology for estimating emissions from agriculture in the Netherlands, p. 51

[19] Activiteitenbesluit milieubeheer: https://wetten.overheid.nl/jci1.3:c:BWBR0022762&hoofdstuk=3&afdeling=3.4&paragraaf=3.4.6&z=2021-07-01&g=2021-07-01

[20] Dutch Climate Agreement (2019): https://www.klimaatakkoord.nl/binaries/klimaatakkoord/documenten/publicaties/2019/06/28/national-climate-agreement-the-netherlands/20190628+National+Climate+Agreement+The+Netherlands.pdf p. 136, paragraph g.

[21] Measures to reduce GHG emission in the Nehterlands, Government of the Netherlands, https://www.government.nl/topics/climate-change/national-measures

National Climate Agreement of the Netherlands under Section C4.4[22]. Regarding manure processing, the focus is laid on measures which will reduce the use of chemical fertilizers, resulting in a reduction of the use of fossil energy and the emission of nitrous oxide, and on potential sites for the development of high-quality manure processing techniques, where manure processing is focused on integral processing and creating value out of fresh pig manure in regional clusters. The objective is also to explore the difficulties regarding the permit procedure for large-scale low-emission manure processing in regional clusters[23].

These are measures the government is currently working on and not measures that have already been implemented. The reason is partly that the country is confronted with two competing goals: On the one hand, a large and profitable part of agriculture consists of livestock and the sale of the resulting products. On the other hand, the flip side is that the Netherlands has one of the highest per capita GHG emission levels in Europe and the country has been stuck in the so-called "nitrogen crisis" for years because of the high amounts of manure. This situation is also referred to by some as the "Dutch dilemma"[24].

In their recent study „Aligning agricultural production and environmental regulation: An integrated assessment of the Netherlands”, Gonzalez-Martinez et al. (2021) directly pointed out the lack of instruments to address the situation:

„The first one is about the choice of the proper policy objectives, which should take into account the multiple commitments that The Netherlands has made with respect greenhouse gas emission reductions and nutrient emissions, e.g. N, ammonia, P, etc. As the current policy debate in The Netherlands shows, this is not yet clear and a politically contested issue. Then the next policy challenge is to think of designing a set of policy measures that could help to achieve the fixed policy targets. From our study it appears that there are two important policy dimensions which should be distinguished. Firstly, there is the design and selection of policy measures that contribute to making new emission reducing innovations available and which subsequently help farmers to adopt such measures or make investments in new technologies, e.g. the building of low-emission stables. The second dimension relates to policy measures facilitating the structural adjustments in the animal sectors, e.g. reduction of livestock numbers. Aside from direct regulation, e.g. via a restrictive licensing of agricultural activities, there are several other ways to facilitate this “[25].

[22] Dutch Climate Agreement (2019): https://www.klimaatakkoord.nl/binaries/klimaatakkoord/documenten/publicaties/2019/06/28/national-climate-agreement-the-netherlands/20190628+National+Climate+Agreement+The+Netherlands.pdf p. 133.

[23] Dutch Climate Agreement (2019): https://www.klimaatakkoord.nl/binaries/klimaatakkoord/documenten/publicaties/2019/06/28/national-climate-agreement-the-netherlands/20190628+National+Climate+Agreement+The+Netherlands.pdf p. 141.

[24] Gassy grazers: The Dutch Dilemma (12.11.2021): https://www.france24.com/en/tv-shows/down-to-earth/20211112-gassy-grazers-the-dutch-dilemma

[25] Aligning agricultural production and environmental regulation: An integrated assessment of the Netherlands, Gonzalez-Martinez et al. (2021), https://www.sciencedirect.com/science/article/pii/S0264837721001113 , Section 5.2

Therefore, the project goes beyond compliance and is deemed as additional.

3.6 Methodology Deviations

Methodology deviations under AMS-III.D

Quantity of animal manure ($Q_{manure,j,LT,y}$)

Deviant from the Methodology AMS-III.D, the manure input is not measured on a dry basis but on the amount of fresh manure, as it is the practice in the Netherlands. The fresh manure produced on the farms is transported directly to the biogas plant, where it is first weighed and then treated in the plant.

The reason for measurements on fresh basis is that fresh manure is the main data on which are based the subsidies for the power generation. It is mandatory for co-digestion projects in the Netherlands to treat at least 50% of feedstock with manure. This is verified by CertiQ, the Dutch issuing body for guarantees of origin and certificates of origin for heat and electricity generated from sustainable sources[26]. CertiQ is part of TenneT TSO B.V., the national electricity grid operator in the Netherlands and has been commissioned by the Dutch government (Minister of Economic Affairs and Climate Policy) as issuing body.

Mass balance of feedstock based on fresh manure and co-products have to be submitted monthly to CertiQ in order to get the certification for the subsidies. Hence, both biogas farmers as well as authorities operate with fresh manure.

In order to have the equivalent value of the manure on a dry basis as required in the methodology, the measured amount of fresh manure has to be multiplied by the values for dry matter content of animal manure (dm_{LT}), depending on the livestock type and the animal manure management system:

$$Q_{manure,j,LT,y} = Q_{fm,j,LT,y} \cdot dm_{j,LT}$$

Where :

$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type LT and animal manure management system j (t/y, dry basis)
$Q_{fm,j,LT,y}$	Measured quantity of fresh manure treated from livestock type LT and animal manure management system j (t/y, fresh basis)
$dm_{j,LT}$	Average dry matter content from manure of livestock type LT and animal manure management system j (t dry matter/ t fresh matter)

[26] https://www.certiq.nl/about-us/profile/about-certiq/

The average dry matter content from manure will be measured by accredited laboratories specialized in that field, as is already carried out on farms to analyse the composition of the manure. Since the project is a co-digestion project with many manure suppliers, samples for analysing the dry matter content of manure will only be taken at the 4 of the 6 different farms from Houbensteyn Ysselsteyn BV in order to obtain an average dry matter content value for each animal category, but not for each of the 15 supplier farms. The efforts and costs to carry out manure analyses from 15 different suppliers is out of all proportion to the project size (micro-scale project as defined under Tool 19[27]) and the achieved amount of emission reductions from manure digestion. Also, the manure suppliers are changing from time to time, depending on their own manure availability and use. Therefore, the annual average value for $dm_{j,LT}$ from the 4 Houbensteyn farms will be used as the basis for the value for $dm_{j,LT}$ for the other farms. In order to follow the principle of conservativeness as required in Section 2.2.1 of the VCS Standard, only 90% of the measured $dm_{j,LT}$ value will be used for dry matter content of manure coming from external farms.

The methodology deviation for obtaining manure values based on dry matter content have no negative impact on the quantification of GHG emission reductions as all derived values are based on measured project specific data. Accuracy can thus be ensured, and an overestimation of emission reductions can be excluded, since a conservative approach is used to calculate the manure dry matter content from external farms.

Furthermore, in the project activity, manure delivered to the biogas plant ($Q_{fm,I,LT,y}$) is either from the company's own farms or external farms. Manure coming from external farms is measured by truck weighing scale on the biogas site. Manure coming from the own farms is calculated based on animal numbers, since this is the base for mandatory registration for the farm's production (livestock, manure and crop) under the responsible agency RVO (Netherlands Enterprise Agency), the governmental agency which operates under the auspices of the Ministry of Economic Affairs and Climate Policy[28]. Registration is mandatory in order to control the Dutch application standards for manure and fertilizers and to regulate the nutrients surplus of the country[29].

This methodology deviation also has no negative impact on the quantification of GHG emission reductions since the calculated number of animals and manure amounts are based on registrations required by the government and subject to very strict controls and can thus be considered as accurate.

Methodology deviations under AMS-I.C

[27] Tool 19: Demonstration of additionality of microscale project activities, https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-19-v9.pdf, p.3

[28] Manure, a valuable resource, https://edepot.wur.nl/498084 , p. 17

[29] Livestock identification and registration, RVO, https://business.gov.nl/regulation/livestock-identification-registration/

Baseline emissions from heat production are calculated according to paragraph 34 of the AMS-I.C with the following equation:

$$BE_{thermal,CO2,y} = \left(\frac{EG_{thermal,y}}{\eta_{BL,thermal}} \right) \cdot EF_{FF,CO2}$$

Where:

$BE_{thermal,CO2,y}$	Baseline emissions from thermal energy displaced by the project activity during the year y (t CO_2)
$EG_{thermal,y}$	Net quantity of thermal energy supplied by the project activity during the year y (TJ)
$EF_{FF,CO2}$	CO_2emission factor of the fossil fuel that would have been used in the baseline plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (t CO_2/TJ)
$\eta_{BL,thermal}$	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity determined as per paragraph 40 or 40 below

In the project activity, the waste thermal energy going to the 3 external heat consumers (space heating, pre-heating piglet food and hygienization unit) is measured with only 1 heat meter, so that a calculative approach has to be used to determine the heat use for the space and piglet food as well as for the hygienization unit.

The total baseline emissions from external heat use will be calculated as follows:

$$BE_{thermal,CO2,y} = BE_{thermal,CO2,SH,PF,y} + BE_{thermal,CO2,HYG,y}$$

Where

$BE_{thermal,CO2,y}$	total baseline emissions from waste thermal energy use during the year y (Tj)
$BE_{thermal,CO2,SH,PF,y}$	baseline emissions from heating space and pre-heating piglet food during the year y (Tj)
$BE_{thermal,CO2,HYG,y}$	baseline emissions from hygienization of digesate during the year y (Tj)

Since the total thermal energy consumption is directly measured and since the heat used from hygienization can be calculated according to the verified equation already used for the previous crediting period and approved in the previous PD, the thermal energy consumption from heating space and pre-heating piglet food will be calculated as follows:

$$EG_{thermal,CO2,SH,PF,y} = Heat_{tot,y} - Heat_{HYG,y}$$

Where:

$EG_{thermal,CO2,SH,PF,y}$ the net quantity of heat supplied by the project activity to the livestock space (SH) and to the piglet food heating system (PF) during the year y (TJ)

$Heat_{tot,y}$ total quantity of external heat use by the project activity during the year y (Gj), measured

$Heat_{HYG,y}$ net quantity of heat supplied by the project activity to the hygienization unit (HYG) during the year y (Tj), calculated

As for the first crediting period, a calculative approach will be used to calculate the thermal energy used for hygienization ($Heat_{HYG,y}$) based, this time, on the quantity of digestate. The energy demand for heating up a liquid from a given temperature can easily be calculated by means of physical equations. Only the heat capacity of the liquid and the inlet and outlet temperatures need to be known. The heat capacity of manure is set to the one for water. The inlet temperature is fixed to the average digestate temperature in the fermenter and the outlet temperature is fixed to the minimum temperature required for pasteurization process:

$$Heat_{HYG,y} = Digestate \cdot Cap_{heat,PR} \cdot \left(T_{HYG,PR} - T_{inlet,PR}\right) \cdot 1/Eff_{ex,PR}$$

Where:

Digestate quantity of digestate produced by the biogas plant in the year y (kg)

$Cap_{heat,PR}$ heat capacity of the digestate to be heated, set to the capacity of water 1,16 kWh/t

T_{Hyg} needed hygienization temperature, set to 75 °C

$T_{Inlet,PR}$ digestate inlet temperature to the hygienization system in the project scenario, set to the 37 °C

Eff_{Hex} heat exchanger efficiency, set to 87 %

The fixed values for hygienization and digestate temperatures are conservative since the required temperature of hygienization is at 70°C for 1 hour and the temperature range for operating the biogas fermenters is about 37°C to 41°C. These values ensure that the heat quantity calculated with the above equation correspond to the lowest thermal energy use for hygienization. Hence, the quantity of GHG emission is not overestimated, as it is calculated according to conservative assumptions. Moreover, according to AMS-I.C, Appendix 1, a default value for the heat exchanger efficiency of 87% was set, which corresponds to the efficiency of an old natural gas fired boiler and can be considered as conservative. Therefore, the calculation approach described has no negative impact on the quantification of the emission reductions and can be evaluated as accurate and conservative.

Moreover, deviant from the methodology AMS-I.C, the amount of biogas, which has to be monitored for cross check reasons, is not measured but calculated by the amount of electricity produced. Reason is that no flow meter is installed to measure the biogas volume that is utilized in the CHP. Practice shows that biogas flow meters are usually unable to deliver reliable measurements due to contaminations like moisture (condensation) or Sulfur (H_2S).

$$BGP = \frac{EEP}{(ETA_{CHP-el}) * HV_{Biogas}}$$

Where:

BGP	Biogas produced [m³]
EEP	Electrical energy produced [MWh]
ETA_{CHP-el}	Electric efficiency of the CHP engines
HV_{Biogas}	Calorific value of biogas [kWh/m³]

With

$$HV_{Biogas} = 0,01 \frac{MWh}{m^3} \cdot x_{CH4}$$

Where:

0.01	Stoichiometric combustion calculation of CH4 [MWh/m³]:
	802.6 kJ/mol /0.02241 m³/mol = 35,814,37 kJ/m³ = 0.01 MWh/m³
x_{CH4}	CH4 volume content of biogas flow [%]

This calculation, based on a reference method described by the CCX Agricultural Methane Gas Project Guidelines, has already been assessed in the last crediting period and estimated as a conservative way to calculate the amount of biogas produced. This calculation is also used in similar climate protection projects with biogas technology. The electricity measurement can be considered as very accurate because it is also the basis for the accounting with the utility. No negative influence on the amount of emission reductions can be expected as the calculated value is expected to be very close to the actual value.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

1. Baseline Emissions from Manure Management

According to the VCS Standard v4.1, the renewal of the crediting period requires an update of the project description which “shall be based upon the latest approved version of the methodology or its replacement”. The latest approved methodology for the co-digestion of animal manure with other organic matters is the AMS-III.AO “Methane recovery through controlled anaerobic digestion”.

According to the AMS-III.AO, the baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter and are calculated according to following formula:

$$BE_y = BE_{SWDS,y} + BE_{ww,y} + BE_{manure,y} - MD_{reg,y} \cdot GWP_{CH_4}$$

Where:

$BE_{SWD,y}$	Where applicable, yearly methane generation potential of the solid waste digested by the project activity during the year x from the beginning of the project activity (x=1) up to the year y estimated as per the latest version of the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” (tCO_2e). The tool may be used with the factor “f=0.0” assuming that no biogas is captured, flared or used. With the definition of year x as the base year since the project activity started diverting wastes from the SWDS/landfill site. x runs from the first year of the crediting period (x=1) to the year for which emissions are calculated (x=y). Where applicable, baseline emission determination of digested waste that would otherwise have been disposed in stockpiles shall follow relevant procedures in AMS-III.E
$BE_{manure,y}$	Where applicable, baseline emissions from the manure co-digested by the project activities, calculated as per the relevant procedures of AMS-III.D

$BE_{ww,y}$	Where applicable, baseline emissions from the wastewater co-digested, calculated as per the procedures of AMS-III.H
$MD_{reg,y}$	Amount of methane that would have to be captured and combusted in the year *y* to comply with the prevailing regulations (tonne)
GWP_{CH4}	GWP for CH_4 (value of 28[30] is used)

The baseline emissions for the methane component of the project are limited to the animal manure component ($BE_{manure,y}$). The other types of baseline emissions mentioned above are not considered in the calculation as:

- the project activity leads partly to methane emission reductions from waste treatment ($BE_{SWD,y}$) but those emission reductions are not claimed by the project proponent, as described in section 3.4, and hence are considered to be zero
- the project activity do not treats wastewater ($BE_{ww,y}$)
- there are no regulations in the Netherlands that make the collection and destruction of methane emissions from manure storage mandatory ($MD_{reg,y}$).

Hence, the only baseline emissions relevant for this project are $BE_{manure,y}$ and $BE_y = BE_{manure,y}$.

According to paragraph 12. of the AMS-III.AO, baseline emissions $BE_{manure,y}$ has to be calculated as per the relevant procedures of AMS-III.D ("Methane recovery in animal manure management systems"), which provides the choice to estimate the baseline emissions based on the number of animals (option A in section 17 (a)) or based on the quantity of manure and its specific volatile solids content (option B in paragraph 17(b)).

Option B has been chosen for the project activity because the manure treated in the biogas plant comes from many different farms and is directly measured on site using a calibrated weighing scale.

Accordingly, the formula used to calculate the baseline emissions is as follows:

$$BE_y = GWP_{CH4} \cdot D_{CH4} \cdot UF_b \cdot \sum_{j,LT} MCF_j \cdot B_{0,LT} \cdot Q_{manure,j,LT,y} \cdot SVS_{j,LT,y}$$

Where:

BE_y	Baseline emissions in year y (t CO_2e)

[30] According to AMS-III.AO Version 01 from 26/11/2011, a value of 21 should be used for GWPCH4. However, paragraph 3.14.4 of VCS Standard Version 4.1, states that "for GHG emission reductions occurring on or before 31 December 2020, all ex-ante estimates and ex-post calculations may be converted to CO2e using either the GWP values from the IPCC Fourth Assessment Report (AR4) or those from AR5". Thus, the defined value to be utilized in the present project activity according to IPCC AR5 for the GWPCH4 is the value of 28.

GWP_{CH4}	Global Warming Potential of CH_4 applicable to the crediting period (t CO_2e/t CH_4)
D_{CH4}	CH_4 Density (0.00067 t/m³ at room temperature (20 °C) and 1 atm pressure)
UF_b	Correction factor to account for model uncertainties (0.94)
j	Index for animal manure management system
LT	Index for all types of livestock
MCF_j	Annual methane conversion factor (MCF) for the baseline animal manure management system j
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type LT (m^3 CH_4 / kg dm)
$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type LT and animal manure management system j (t/y, dry basis)
$SVS_{j,LT,y}$	Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y (t/t, dry basis)

Global Warming Potential (GWP_{CH4})

According to the VCS Standard v4.1, section 3.14.4, all ex-ante estimates and ex-post calculations may be converted to CO_2e using either the GWP values from the IPCC Fourth Assessment Report (AR4) or those from AR5. For the project activity, the GWP value for methane of 28 established in AR5 has been chosen.

Methane Conversion Factor (MCF_j)

The MCF represents the percentage of manure's maximum methane-producing capacity that is actually achieved during manure management, i.e. part of organic matter actually converted into methane. In the Netherlands, liquid animal manure is stored in pits underneath the slatted floors of animal housing facilities[31]. Against this practice background and as part of the preparation of the National Inventory Report (NIR), country specific MCF values were calculated for liquid manure since the manure management systems are different from the circumstances on which the IPCC default is based[32].

Maximum methane producing potential of volatile solid ($B_{0,LT}$)

[31] "Greenhouse gas emissions in the Netherlands 1990-2019, National Inventory Report 2021", Section 5.3.2, p. 174.

[32] "Methodology for estimating emissions from agriculture in the Netherlands, Calculation from CH4, NH3, N2O, NOx, NMVOC, PM2.5 and CO2 using the National Emission Model Agriculture (NEMA) – Update 2021", Section 4.2.3, p. 54.

The value of B_0 depends on the degradability of the organic components in the manure. As for the MCF values, country specific B_0 values were calculated for liquid pig, cattle and poultry manure and are used for the ex-ante and ex-post emission calculation from manure management[33].

Quantity of animal manure ($Q_{manure,j,LT,y}$)

In order to have the equivalent value of the manure on a dry basis as required in the methodology, the measured amount of fresh manure has to be multiplied by the values for dry matter content of animal manure (dm_{LT}), depending on the livestock type and the animal manure management system:

$$Q_{manure,j,LT,y} = Q_{fm,j,LT,y} \cdot dm_{j,LT}$$

Where :

$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type LT and animal manure management system j (t/y, dry basis)
$Q_{fm,j,LT,y}$	Measured quantity of fresh manure treated from livestock type LT and animal manure management system j (t/y, fresh basis)
$dm_{j,LT}$	Average dry matter content from manure of livestock type LT and animal manure management system j (t dry matter/ t fresh matter)

Specific volatile solids content ($SVS_{j,LT,y}$)

Specific volatile solids content of animal manure is the organic dry matter in livestock manure consisting of biodegradable and nonbiodegradable fractions., $SVS_{j,LT,y}$ will be measured by accredited laboratories specialized in that field, together with parameter $dm_{j,LT}$ described above, conform to the requirements under section 5.1. of the AMS-III.D. The same conditions as for $dm_{j,LT}$ are applied for parameter $SVS_{j,LT,y}$ and are aligned with the requirements for $SVS_{j,LT,y}$ measurements specified in section 5.1. of the AMS-III.D.

The application of the above formula with the above-mentioned deviations leads to the following average annual baseline emissions:

$BE_{pig,own,y}$	= 28 x 0.00067 x 0.94 x 36% x 0.31 m^3 CH_4/kg-dm x 50,000 t/y x 0.115 dm/fm x 0.821 svs/dm
	= 9,291 t CO_2e/a

[33] "Methodology for estimating emissions from agriculture in the Netherlands, Calculation from CH4, NH3, N2O, NOx, NMVOC, PM2.5 and CO2 using the National Emission Model Agriculture (NEMA) – Update 2021", Section 4.2.3, p. 54.

$BE_{pig,ext,y}$ = 28 x 0.00067 x 0.94 x 36% x 0.31 m³ CH_4/kg-dm x 15,000 t/y x (0.115 dm/fm x 90%) x (0.821 svs/dm x 90%)

= 2,258 t CO_2e/a

BE_y = 9,291 + 2,258

= 11,549 t CO_2e/a

2. Baseline Emissions from external heat use

For the PD update, the latest version of the AMS-I.C methodology "Thermal energy production with or without electricity" Version 21.0 is used for calculating the baseline emissions from fossil thermal energy production.

Before the project activity, the livestock stalls of the farm and the piglet food were heated up with natural gas. During the first crediting period of the project, historical values of fossil gas consumption were used to calculate the corresponding baseline emissions for heating stalls, as no measurements of external heat use could be provided properly.

For the second crediting period, the required measurements are available and will be used for the ex-ante and ex-post emission calculations. As described under section 3.4, thermal energy is provided space heating and for pre-heating piglet food. Furthermore, an hygienization unit for digestate pasteurization was put into operation during the first crediting period and is still running now.

Baseline emissions from heat production are calculated according to paragraph 34 of the AMS-I.C with the following equation:

$$BE_{thermal,CO2,y} = \left(\frac{EG_{thermal,y}}{\eta_{BL,thermal}}\right) \cdot EF_{FF,CO2}$$

Where:

$BE_{thermal,CO2,y}$ Baseline emissions from thermal energy displaced by the project activity during the year y (t CO_2)

$EG_{thermal,y}$ Net quantity of thermal energy supplied by the project activity during the year y (TJ)

$EF_{FF,CO2}$ — CO_2emission factor of the fossil fuel that would have been used in the baseline plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (t CO_2/TJ)

$\eta_{BL,thermal}$ — Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity determined as per paragraph 40 or 40 below

According to paragraph 42. c) of the AMS-I.C, a default value of 100% of efficiency of the baseline unit has been chosen.

As described under section 3.6,the external heat going to the 3 external heat consumers is measured with only 1 heat meter, so that a calculative approach has to be used to determine the heat use for the pig stalls and food heating as well as for the hygienization unit.

Therefore, the total baseline emissions from external heat use will be:

$$BE_{thermal,CO2,y} = BE_{thermal,CO2,PF,y} + BE_{thermal,CO2,PS,DP,y} + BE_{thermal,CO2,HYG,y}$$

Where

$BE_{thermal,CO2,PF,y}$ — baseline emissions from heating the poultry farm during the year y (Tj)

$BE_{thermal,CO2,PS,DP,y}$ — baseline emissions from heating the pig stalls and drying potatoes during the year y (Tj)

$BE_{thermal,CO2,HYG,y}$ — baseline emissions from hygienization of digesate during the year y (Tj)

a) Heating pig stalls and pre-heating piglet food ($BE_{thermal,CO2,PS,DP,y}$)

As described in section 3.6, a calculative approach is needed to determine the thermal energy required for space heating (SH) and pre-heating piglet food (PF) and following equation is used:

$$EG_{thermal,CO2,SH,PF,y} = Heat_{tot,y} - Heat_{HYG,y}$$

Where:

$EG_{thermal,CO2,SH,PF,y}$ — the net quantity of heat supplied by the project activity for space heating (SH) and for pre-heating piglet food (PF) during the year y (TJ)

$Heat_{tot,y}$ — total quantity of external heat use by the project activity during the year y (Gj), measured

$Heat_{HYG,y}$ net quantity of heat supplied by the project activity to the hygienisation unit (HYG) during the year y (Tj), calculated

With:

$$Heat_{HYG,y} = Digestate \cdot Cap_{heat,PR} \cdot (T_{HYG,PR} - T_{inlet,PR}) \cdot 1/Eff_{ex,PR}$$

Where:

Digestate quantity of digestate produced by the biogas plant in the year y (kg)

$Cap_{heat,PR}$ heat capacity of the digestate to be heated, set to the capacity of water 1,16 kWh/t

$T_{Hyg,PR}$ needed hygienization temperature, set to 75 °C

$T_{Inlet,PR}$ digestate inlet temperature to the hygienization system in the project scenario, set to the 37 °C

Eff_{Hex} heat exchanger efficiency, set to 87 %

The application of the formula above to calculate the baseline emissions from space heating and pre-heating piglet food according to AMS-I.C gives following results:

$Heat_{HYG,y}$ = 65,000,000 kg x 1.16 kWh/t x (75°C – 37°C) x 1 / 87%

= 3,293,333 kWh

$EG_{thermal,CO2,SH,PF,y}$ = 37,000 Gj / 1,000 Gj/Tj – (3,293,333 kWh x 0.0000036 kWh/Tj)

= 37 Tj – 12 Tj

= 25 Tj

$BE_{thermal,CO2,SH,PF,y}$= (25 Tj / 100%) x 56.40 t CO_2/Tj

= 1,418 t CO_2e

b) Heat use for hygienization unit ($BE_{thermal,CO2,HYG,y}$)

Since the amount of heat required in the project activity does not correspond to that used in the baseline scenario, direct measurements of $EG_{thermal,CO2,HYG,y}$ cannot be used for the calculation. This can be explained as follows: while the baseline scenario does require only the manure to be heated up from storage (10.8°C = ambient temperature) to 70 °C, the actual installed apparatus does heat up the complete digestate from fermenter exit temperature of about 37°C.

As for the first crediting period, a calculative approach will be used. The energy demand for heating up a liquid from a given temperature can easily be calculated by means of physical equations. Only the heat capacity of the liquid and the inlet temperature need to be known. The heat capacity of manure was set to the one for water. The inlet temperature was fixed to the average annual ambient temperature. According to paragraph 42. c) of the AMS-I.C and for conservativity reasons, a default value of 100% of efficiency of the baseline unit has been chosen.

$$Heat_{HYG,y} = Q_{fm,i,LT,y} \cdot Cap_{heat,BE} \cdot (T_{HYG} - T_{inlet,BE}) \cdot 1/Eff_{ex}$$

Where:

$EG_{thermal,y}$	Net quantity of thermal energy supplied by the project activity during the year y (TJ)
$Q_{fm,j,LT,y}$	annual manure excreted from the animals in kg during the year y
$Cap_{Heat,BE}$	heat capacity of the manure to be pre-heated, set to the capacity of water 4,18 kJ/kg K
T_{Hyg}	needed hygienization temperature, set to 70 °C
$T_{Inlet,BE}$	manure inlet temperature to the hygienization system in the baseline scenario, set to the average ambient temperature 10.8 °C
Eff_{Hex}	heat exchanger efficiency, set to 100 %

Thus, the amount of heat supplied to the hygienization units will be calculated based on the amount of manure that have been fed into the digester according to the above formula:

$EG_{thermal,CO2,HYG,y}$ = 65,000,000 kg * 4.18 KJ/kg K * (70°C – 10.8°C) * 1 /100%

= 16 TJ

$BE_{thermal,CO2,HYG,y}$ = (16 TJ / 100%) * 56.40 t CO_2/TJ

= 907 t CO_2

Therefore, the estimated total amount of baseline emissions from external heat used is:

$BE_{thermal,CO2,y}$ = 1,418 t CO_2 + 907 t CO_2

= 2,325 t CO_2

4.2 Project Emissions

1. Project emissions – Manure management

According to AMS-III.D, project activity emissions consist of:

(a) Physical leakage of biogas in the manure management systems which includes production, collection and transport of biogas to the point of flaring/combustion or gainful use ($PE_{PL,y}$);

(b) Emissions from flaring or combustion of the gas stream ($PE_{flare,y}$);

(c) CO_2 emissions from use of fossil fuels or electricity for the operation of all the installed facilities ($PE_{power,y}$);

(d) CO_2 emissions from incremental transportation distances;

(e) Emissions from the storage of manure before being fed into the anaerobic digester ($PE_{storage,y}$).

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y}$$

Where:

PE_y	Project emissions in year y (t CO_2e)
$PE_{PL,y}$	Emissions due to physical leakage of biogas in year y (t CO_2e)
$PE_{flare,y}$	Emissions from flaring or combustion of the biogas stream in the year y (t CO_2e)
$PE_{power,y}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y (t CO_2e)
$PE_{transp,y}$	Emissions from incremental transportation in the year y (t CO_2e), as per relevant paragraph in AMS-III.AO
$PE_{storage,y}$	Emissions from the storage of manure (t CO_2e)

a) $PE_{PL,y}$ - Emissions from physical leakage of biogas

According to paragraph 21 (a) (ii) of AMS-III.D, project emissions due to physical leakage of biogas from the animal manure management systems used to produce, collect and transport the biogas to the point of flaring or gainful use are estimated as:

$$PE_{PL,y} = 0.10 \cdot GWP_{CH4} \cdot D_{CH4} \cdot \sum_{i,LT} B_{0,LT} \cdot Q_{manure,LT,y} \cdot SVS_{LT,y} \cdot MS_{i,y}$$

Where

$MS\%_{i,y}$ Fraction of manure handled in system i in year y

If the project activity involves sequential manure management systems, the procedure specified in paragraph 18(e) shall be used to estimate the project emissions due to physical leakage of biogas in each stage

The project does not involve sequential manure management systems (MS% = 100%). Therefore, the project emissions from physical leakage are calculated as the baseline emissions from manure management (BE_y) multiplied by factor 0,1:

$PE_{PL,y}$ = 0.10 x BE_y

= 0.10 x 11,549 t CO_2e

= 1,155 t CO_2e

b) $PE_{flare,y}$ - Emissions from flaring or combustion of the biogas stream

The methodology AMS-III.D refers to the Tool “Project emissions from flaring” to estimate the project emissions in case of flaring of the recovered biogas. According to paragraph 38. Of this Tool, project emissions from flaring are calculated as the sum of emissions for each minute m in year y, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare,y} = GWP_{CH4} \cdot \sum_{m=1}^{525600} F_{CH4,RG,m} \cdot (1 - \eta_{flare,m}) \cdot 10^{-3}$$

$PE_{flare,y}$ Project emissions from flaring of the residual gas in year y (tCO_2e)

GWP_{CH4} Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)

$F_{CH4,RG,m}$ Mass flow of methane in the residual gas in the minute m (kg)

$\eta_{flare,m}$ Flare efficiency in minute m

A flaring system is not included in the project activity. The project operator has an official license to operate the biogas plant without a flare since there is a total of 4 CHPs installed on site. In case of failure of 1 CHP (because of maintenance or other technical problems) where the biogas produced cannot be processed, the biogas is first stored in the biogas membrane and then, once the gas storage is full, fed to another on-site CHP. Therefore, technical measures used ensure that all biogas capture from the digester is combusted. The value of biogas produced for the project owner is too high to be flared. Hence project activity emissions from flaring are expected to be zero.

c) $PE_{power,y}$ - Emissions from use of fossil fuel or electricity for plant operation

The project activity does not make use of fossil fuels for heating. The thermal energy for the digestion process comes from the heat in the CHPs, that is won by burning of the biogas. The electrical energy used in the project activity for the operation of the plant is taken from the own power production process. Therefore, project emissions from this source have been excluded from further consideration

d) $PE_{transp,y}$ - Emissions from incremental transportation of manure

In Paragraph 20., the methodology AMS-III.D refers the AMS-III.AO to estimate the project emissions from incremental transportation. The calculation is based on the incremental distances between:

(i) The collection points of biomass and/or manure and the digestion site as compared to the baseline solid waste disposal site or manure treatment site;

(ii) When applicable, the collection points of wastewater and treatment site as compared to baseline wastewater treatment site;

(iii) Treatment sites and the sites for soil application, landfilling and further treatment of the residual waste.

$$PE_{transp,y} = (Q_y / CT_y) \cdot DAF_w \cdot EF_{co2,transport} + (Q_{res-waste,y} / CT_{res-waste,y}) \cdot DAF_{res-waste} \cdot EF_{CO2,transport}$$

Where:

Q_y	Quantity of raw waste/manure treated and/or wastewater co-digested in the year y (tonnes)
CT_y	Average truck capacity for transportation (tonnes/truck)
DAF_w	Average incremental distance for raw solid waste/manure and/or wastewater transportation (km/truck)

$EF_{CO2,transport}$ — CO_2 emission factor from fuel use due to transportation (kgCO$_2$/km, IPCC default values or local values may be used)

$Q_{res\cdot waste,y}$ — Quantity of residual waste produced in year y (tonnes)

$CT_{res\cdot waste,y}$ — Average truck capacity for residual waste transportation (tonnes/truck)

$DAF_{res\cdot waste}$ — Average distance for residual waste transportation (km/truck)

Transport of biomass to the biogas plant causes emissions from the combustion of fossil fuels. In the project activity, only emissions from manure transported from the farms to the biogas plant will be taken into account and calculated according to the equation above. Since the transportation of manure and agricultural goods is part of agricultural activity and also takes place in absence of the project activity, emissions from digestate transportation away from the biogas plant are not considered.

Furthermore, a country-specific value for the CO_2 emission factor from fuel use is available and will be used for the project emission calculation from manure transport.

The manure transport from the company's own and from external farms to the biogas plant is operated by an external company.

Manure supplied to the project by Houbensteyn Milieur BV is delivered by farms located within an average radius of 2 km from the biogas site. Manure supplied to the project by external farms is delivered by farms located within an average radius of approx. 20 km from the biogas site:

$PE_{transp,y}$ = (50,000 t / 36 t/truck) x 2 km/truck x 1.028 g CO_2/km +

(15,000 t / 36 t/truck) x 20 km/truck x 1.028 g CO_2/km

= 3 t CO_2 + 9 t CO_2

= 11 t CO_2

e) $PE_{storage,y}$ - Emissions from the storage of manure

According to paragraph 23. of the AMS-III.D, project emissions on account of storage of manure before being fed into the anaerobic digester shall be accounted for if both condition (a) and condition (b) below are satisfied:

(a) The storage time of the manure after removal from the animal barns, including transportation, exceeds 24 hours before being fed into the anaerobic digester;

(b) The dry matter content of the manure when removed from the animal barns is less than 20%.

The storage time of the manure after removal from the animal barns, including transportation, is usually within 24 hours before being fed into the anaerobic digester. Hence, emissions from the storage of manure is not accounted for, $PE_{storage,y}$ = 0 t CO_2e.

2. Project emissions – Using thermal energy

According to AMS-I.C, project activity emissions are calculated using the following equation:

$$PE_y = PE_{FF,y} + PE_{EC,y} + PE_{Geo,y} + PE_{ref,y} + PE_{cultivation,y}$$

Where:

PE_y	Project emissions from the project activity during the year y (t CO_2)
$PE_{FF,y}$	Project emissions from fossil fuel consumption during the year y (t CO_2)
$PE_{EC,y}$	Project emissions from electricity consumption during the year y (t CO_2)
$PE_{Geo,y}$	Project emissions from a geothermal project activity in year y (t CO_2)
$PE_{ref,y}$	Project emissions from use of refrigerant in project activity in year y (t CO_2)
$PE_{cultivation,y}$	Project emissions from cultivation of biomass in a dedicated plantation in year y (t CO_2e)

The project emissions from fossil fuel consumption ($PE_{FF,y}$) and from electricity consumption ($PE_{EC,y}$) correspond to the project emissions from use of fossil fuel or electricity for the operation of the installed facilities ($PE_{power,y}$) from AMS-III.D (please refer to section 4.2.,1. c).

There is no geothermal project included in the project activity. Hence $PE_{Geo,y}$ are not considered.

The cultivation of biomass in a dedicated plantation is not included in the project activity. Hence, $PE_{cultivation}$,y are not considered.

3. Project emissions – Using organic waste (AMS-III.AO)

According to paragraph 13. of the AMS-III.AO, project activity emissions are calculated as follows:

$$PE_y = \{PE_{transp,y} + PE_{power,y} + PE_{reswaste,y} + PE_{phyleakage,y} + PE_{flaring,y}\}$$

Where:

PE_y	Project activity emissions in the year y (tCO_2e)
$PE_{transp,y}$	Emissions from incremental transportation in the year y (tCO_2e)

$PE_{power,y}$	Emissions from electricity or fossil fuel consumption in the year y (tCO_2e)
$PE_{res\ waste,y}$	In case residual wastes are subjected to anaerobic storage, or disposed in a landfill: methane emissions from storage/disposal/treatment of waste (tCO_2e)
$PE_{phy\ leakage,y}$	Methane emissions from physical leakages of the anaerobic digester in year (tCO_2e)
$PE_{flaring,y}$	Methane emissions due to incomplete flaring in year determine project emissions from flaring gases containing methane"(tCO y as per the "Tool to determine project emissions from flaring gases containing methane" (tCO_2e)

Project emissions from incremental transportation of manure to the biogas plant ($PE_{transp,y}$) are already calculated above according to the requirements set in AMS-III.D (please refer to 4.2.,1. **Fehler! Verweisquelle konnte nicht gefunden werden.**. As yet described in the previous PD and handled in the first crediting period, transportation of agricultural and industrial waste products also takes place in absence of the project activity. Therefore, emissions from co-products transportation are not considered.

Project emissions from use of fossil fuel or electricity for the operation of the installed facilities ($PE_{power,y}$) have been excluded from further consideration, as explained in section 4.2.,1. c) of this PD.

Residual waste from the digestion process ($PE_{res\ waste,y}$) is stored in gas tight final storage tanks. Since these tanks are connected to the biogas grid on site, no methane emissions from storage of digestate occurs. Hence, project emissions from digestate storage are excluded from further consideration.

Project emissions from physical leakages of the anaerobic digester ($PE_{phy\ leakage,y}$) have already been calculated (please refer to section 4.2.,1.**Fehler! Verweisquelle konnte nicht gefunden werden.**).

Project activity emissions from flaring ($PE_{flaring,y}$) are expected to be zero, as described in section 4.2.,1. **Fehler! Verweisquelle konnte nicht gefunden werden.** of this PD.

4.3 Leakage

Paragraph 26. of the AMS-III.D refers to the Tool "Project and leakage emissions from anaerobic digesters" to determine leakage emissions. According to paragraph 25. of this Tool, the leakage emissions associated with the anaerobic digester depend on how the digestate is managed and included:

(a) CH_4 and N_2O emissions from composting of digestate:

(b) CH_4 emissions from the anaerobic decay of digestate disposed in a SWDS or subjected to anaerobic storage, such as in a stabilization pond.

The project does not involve composting of digestate. Digestate is also not stored in open anaerobic storages, but in gas-tight storage tanks and lagoons. In case biogas is still produced, it is conducted to the CHP units for power generation. Therefore, leakage emissions of the project associated with the anaerobic digester as per AMS-III.D are not accounted for.

All the equipment used in the project activity for power and heat generation is either brought for purpose of project activity and no shifting of old equipment takes place. No energy equipment currently being utilised is transferred from outside the boundary to the project activity. Therefore, there is no leakage as per AMS-I.C.

4.4 Net GHG Emission Reductions and Removals

The project activity reduces GHG emissions due to methane recovery through controlled anaerobic digestion and to the displacement of fossil fuel by using the produced renewable thermal energy.

Overall emission reductions are calculated as the sum of the 2 project components under the methodologies AMS-III.D and AMS-I.C as described below.

AMS-III.D

As per paragraph 27. of the AMS-III.D, the emission reductions achieved any year are the lowest value of the following:

$$ER_{y,ex-post} = min\left[\left(BE_{y,expost} - PE_{y,expost}\right), \left(MD_y - PE_{power,y,expost}\right)\right]$$

Where:

$ER_{y,ex\ post}$	Emission reductions achieved by the project activity based on monitored values for year y (t CO_2e)
$BE_{y,ex\ post}$	Baseline emissions calculated using equation 1 (for projects using option in paragraph 17(a)) using ex post monitored values of $NL_{T,y}$ and if applicable $VS_{LT,y}$. For projects using option in paragraph 17(b), the ex post monitored values for $Q_{manure,j,LT,y}$ and $SVS_{j,LT,y}$ are used
$PE_{y,ex\ post}$	Project emissions calculated using equation 6 using ex post monitored values of $NL_{T,y}$, $MS\%_{i,y}$, $MS\%_{l}$, AI_l, $Q_{res\ waste,y}$ and if applicable $VS_{LT,y}$
MD_y	Methane captured and destroyed or used gainfully by the project activity in year y (t CO_2e)
$PE_{power,y,ex\ post}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year y (t CO2e)

The calculations of the baseline and project and leakage emission in section 4.1, 4.2 and 4.3 are based on project data and are also used for the calculation of the net GHG emission reductions.

AMS-I.C

As per paragraph 81. of the AMS-I.C, the emissions reductions achieved any year are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y	Emission reductions in year y (t CO_2e)
BE_y	Baseline emissions in year y (t CO_2e)
PE_y	Project emissions in year y (t CO_2)
LE_y	Leakage emissions in year y (t CO_2)

The calculations of the baseline, project and leakage emission in section 4.1, 4.2 and 4.3 are based on project data and are also used for the calculation of the net GHG emission reductions.

The emissions reductions achieved by the project activity are presented in the table below. Since the 2nd crediting period started on May 1st, 2016 and ends on April 30th, 2026, the emissions reductions in the year 2016 and 2026 are converted into an 8 and an 4 month period, respectively.

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
01.05.2016 - 31.12.2016	9,250	778	0	8,472
01.01.2017 - 31.12.2017	13,874	1,166	0	12,708
01.01.2018 - 31.12.2018	13,874	1,166	0	12,708
01.01.2019 - 31.12.2019	13,874	1,166	0	12,708

01.01.2020 - 31.12.2020	13,874	1,166	0	12,708
01.01.2021 - 31.12.2021	13,874	1,166	0	12,708
01.01.2022 - 31.12.2022	13,874	1,166	0	12,708
01.01.2023 - 31.12.2023	13,874	1,166	0	12,708
01.01.2024 - 31.12.2024	13,874	1,166	0	12,708
01.01.2025 - 31.12.2025	13,874	1,166	0	12,708
01.01.2026 - 30.04.2026	4,625	389	0	4,236
Total	138,743	11,663	0	127,080

5 MONITORING

5.1 Data and Parameters Available at Validation

Data and parameter from the AMS-III.D

Data / Parameter	GWP_{CH4}
Data unit	t CO_2e / t CH_4
Description	Global warming potential of methane applicable to the crediting period
Source of data	IPCC Fifth Assessment Report (AR5)
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	As per VCS Standard, Version 4.1, paragraph 3.14.4
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	D_{CH4}
Data unit	t CH_4/m^3

Description	Density of Methane
Source of data	UNFCCC
Value applied	0.00067
Justification of choice of data or description of measurement methods and procedures applied	Density of methane at room temperature (20°C) and at 1 atm pressure
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	U_{fb}
Data unit	-
Description	Model correction factor to account for model uncertainties
Source of data	AMS-III.D, Version 21.0; Reference: FCCC/SBSTA/2003/10/Add.2, page 25.
Value applied	0.94
Justification of choice of data or description of measurement methods and procedures applied	As per AMS-III.D, Version 21.0
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	MCF_j
Data unit	%
Description	Annual methane conversion factor (MCF) for the baseline animal manure management system j
Source of data	National Inventory Report 2021- Annex 7 Van der Zee (2021) – Methodology for estimating emission from agriculture in the Netherlands – Section 4.2.3, p. 54
Values applied	<table><tr><td>Manure type</td><td>MCF_j</td></tr><tr><td>Liquid cattle manure:</td><td>17%</td></tr><tr><td>Liquid pig manure:</td><td>36%</td></tr></table>
Justification of choice of data or description of	Country specific values are available for cattle and pig manure. Those values are used in the NIR for the emissions calculations of the Netherlands.

measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	$B_{0,LT}$
Data unit	m^3 CH_4/kg dm
Description	Maximum methane producing potential of the volatile solid generated for animal type LT
Source of data	National Inventory Report 2021- Annex 7 Van der Zee (2021) – Methodology for estimating emission from agriculture in the Netherlands – Section 4.2.3, p. 54 (for liquid pig and cattle manure).
Values applied	<table><tr><td>Manure type</td><td>Bo_{LT}</td></tr><tr><td>Liquid cattle manure</td><td>0.22</td></tr><tr><td>Liquid pig manure</td><td>0.31</td></tr></table>
Justification of choice of data or description of measurement methods and procedures applied	Country specific values are available for cattle and pig manure. Those values are used in the NIR for the emissions calculations of the Netherlands.
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	$MS\%_{i,y}$
Data unit	-
Description	Fraction of manure handled in system I in year y
Source of data	AMS-III.D
Values applied	100%
Justification of choice of data or description of measurement methods and procedures applied	The project activity does not involve sequential manure management systems. Hence, all manure will be handled in system I and a value of 100% is applied.
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	CT_y
Data unit	Tonnes/truck
Description	Average truck capacity for transportation
Source of data	Standard specifications, D-TEC, Manure tank trailer FV-2006-R360
Values applied	36
Justification of choice of data or description of measurement methods and procedures applied	The load capacity of this model of manure tank trailers is described in the specifications
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$EF_{CO2,transport}$
Data unit	g CO_2/km
Description	CO_2 emissions factor from fuel use due to manure transportation
Source of data	TNO Report, Dutch CO_2 emission factor for road vehicl”", 2016, p. 3
Values applied	1.028
Justification of choice of data or description of measurement methods and procedures applied	Country specific CO_2 emission factor from fuel use for heavy duty vehicles on rural roads.
Purpose of Data	Calculation of project emissions
Comments	-

Data and parameter from AMS-I.C

Data / Parameter	$EF_{FF,CO2}$
Data unit	t CO_2/TJ
Description	CO_2 emission factor for propane gas
Source of data	The Netherlands: list of fuels and standard CO2 emission factors version of January 2020, Netherlands Enterprise Agency, p. 3, https://english.rvo.nl/sites/default/files/2020/03/The-Netherlands-list-of-fuels-version-January-2020.pdf
Value applied	56.4

Justification of choice of data or description of measurement methods and procedures applied	Country specific values for natural gas are available and published on the governmental website from RVO (Netherlands Enterprise Agency)
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$\eta_{BL,thermal}$
Data unit	%
Description	Efficiency of the plants using natural gas
Source of data	As per AMS-I.C, paragraph 42. c)
Value applied	100
Justification of choice of data or description of measurement methods and procedures applied	No data concerning the operational efficiency of the baseline units are available. Hence, a default efficiency value is used as per AMS-I.C
Purpose of Data	Calculation of baseline emissions
Comments	-

CapHeat	$Cap_{Heat,PR}$
Data unit	kWh/tonne
Description	Specific heat capacity of digestate
Source of data	"Biogashandbuch Bayern, 17.05.2007 (Trad: *Biogas manual Bavaria*), Section 1.7.8, p. 22.
Value applied	1.16
Justification of choice of data or description of measurement methods and procedures applied	The heat capacity of digest ate to be heated up is set to the capacity of water. As described in the biogas manual, the specific heat capacity of water is set for biogas substrate.
Purpose of Data	Calculation of baseline emissions
Comments	-

CapHeat	$Cap_{Heat,BE}$
Data unit	KJ / kg K
Description	Specific heat capacity of manure
Source of data	Wikipedia

Value applied	4.18
Justification of choice of data or description of measurement methods and procedures applied	The heat capacity of the manure to be pre-heated is set to the capacity of water 4,18 kJ/kg K
Purpose of Data	Calculation of baseline emissions
Comments	-

CapHeat	$T_{Hyg,PR}$
Data unit	°C
Description	Outlet temperature of digestate
Source of data	-
Value applied	75
Justification of choice of data or description of measurement methods and procedures applied	The special treatment process to sanitize manure/digestate for export needs for 1 hour a temperature above 70°C
Purpose of Data	Calculation of baseline emissions
Comments	For conservativity reasons, a temperature of 75°C was set as the sanitization process is set to 73°C and it does not exceed 75°C.

CapHeat	$T_{Hyg,BE}$
Data unit	°C
Description	Outlet temperature of digestate
Source of data	-
Value applied	70
Justification of choice of data or description of measurement methods and procedures applied	The special treatment process to sanitize manure/digestate for export needs for 1 hour a temperature above 70°C
Purpose of Data	Calculation of baseline emissions
Comments	For conservativity reasons, a temperature of 70°C was set as 70°C represents the lowest temperature required for the sanitization process.

CapHeat	$T_{Inlet,PR}$

Data unit	°C
Description	Inlet temperature of digestate to the hygienization system
Source of data	-
Value applied	37
Justification of choice of data or description of measurement methods and procedures applied	The temperature in the digesters varies between 37°C – 41°C to guarantee the survival of the bacterial cultures. For conservativity reasons, the digestate temperature is set to 37°C.
Purpose of Data	Calculation of baseline emissions
Comments	For conservativity reasons, a temperature of 37°C was set as this represents the lowest temperature for digestate, since the usual temperature in the fermenter fluctuates between 37°C - 41°C.

CapHeat	$T_{Inlet,BE}$
Data unit	°C
Description	Inlet temperature of manure to the hygienization system
Source of data	World Weather Online, https://www.worldweatheronline.com/lang/es/wanroij-weather-averages/north-brabant/nl.aspx
Value applied	10.8
Justification of choice of data or description of measurement methods and procedures applied	Value set to the average annual ambient temperature in the region of Wanroij, North Brabant
Purpose of Data	Calculation of baseline emissions
Comments	-

CapHeat	$Eff_{ex,PR}$
Data unit	%
Description	Heat exchanger efficiency of the hygienization unit
Source of data	As per AMS-I.C, Appendix 1
Value applied	87
Justification of choice of data or description of measurement methods and procedures applied	No data concerning the operational efficiency of the baseline units are available. Hence, a default efficiency value is used as per AMS-I.C

Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$ETA_{CHP\text{-}el}$
Data unit	%
Description	CHP electrical efficiency
Source of data	Technical specification of the CHP
Value applied	**CHP Units** / **Electric efficiency (%)**: CHP 1 - MAN LE 312: 37.8 CHP 2 - MAN LE 312: 37.8 CHP 3 - MAN LE 312: 37.5 CHP 4 - MAN LE 312: 37.5
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	To cross-check the biogas produced and destroyed by the CHP engines
Comments	-

Value applied:

CHP Units	Electric efficiency
	%
CHP 1 - MAN LE 312	37.8
CHP 2 - MAN LE 312	37.8
CHP 3 - MAN LE 312	37.5
CHP 4 - MAN LE 312	37.5

5.2 Data and Parameters Monitored

Data / Parameter	$Q_{fm,j,LT,y}$
Data unit	kg/y, fresh basis
Description	Quantity of fresh manure treated from livestock type LT at animal manure management system j
Source of data	Manure quantities from external farms are measured by truck weighing scale and recorded in the electronic data base. Manure quantities from own farms are calculated as the difference between the amount of digestate sold and the amount of co-ferment inputs.

Description of measurement methods and procedures to be applied	Quantity of manure supplied by external farms is weighed when delivered by a truck weighing scale. Quantity of manure supplied by Houbensteyn Ysselsteyn are calculated as the difference between the amount of digestate sold and the amount of co-ferment inputs. The amounts of digestate and co-ferment inputs are measured by weighing scale and recorded daily in operation manual and in electronic databases.
Frequency of monitoring/recording	Annually, based in daily measurements
Value applied	Manure from Houbensteyn farms — Quantity [kg]/y] Liquid pig manure — 50.000 Manure from ext. farms — Quantity [kg]/y] Liquid pig manure — 15.000
Monitoring equipment	Specifications of the weighing scale on the installation: **KEURINGS / CONTROLE RAPPORT** Serienummer(s): 3550 Type: sca1c1 Fabrikaat BWT Klasse: III Ordernummer 10910 Tnr. : T2992 cem-cy 01/0025-5.2 Max: 70000 kg min: 400 kg e= 20 kg d= 20 kg
QA/QC procedures to be applied	Weighing scales are precise and belong to the accuracy class III. Calibration occurs when the devices need service or repair.
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	Manure from own farms [t/y] = Digestate sold [t/y] - Co-ferment inputs [t/y]
Comments	Manure amounts can vary from year to year, depending on the manure availability in the region. The calculation method for manure quantities supplied by Houbensteyn Ysselsteyn is the same as that in the first crediting period and is considered to be very conservative, as it does not take into account the weight loss due to dissolved biogas.

Data / Parameter	$dm_{j,LT,y}$
Data unit	Kg dm/kg fresh manure

Description	Dry matter content of animal manure from livestock type LT and animal manure management system j in year y
Source of data	Dry matter content analyses from specialized accredited laboratories as Eurofins or TLR international laboratories
Description of measurement methods and procedures to be applied	For manure supplied by the Houbensteyn farms: Manure samples from all Houbensteyn farms for each animal category are sent to laboratories to measure the respective dry matter content, as is already common practice in the agricultural sector. For manure coming from external farms: The average dry matter content of the annually aggregated average measured values from the Houbensteyn farms is multiplied by 90% to obtain the value used for dry matter content (conservative approach)
Frequency of monitoring/recording	Annually
Value applied	Manure from Houbensteyn farms: Liquid cattle manure 0.128; Liquid pig manure 0.115 (Dry matter content [kg/kg]) Manure from ext. farms: Liquid cattle manure 0.115; Liquid pig manure 0.104 (Dry matter content [kg/kg])
Monitoring equipment	Laboratories analyses
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	For manure coming from external farms: average annually dm value of Houbensteyn farms x 90%
Comments	1 sample will be taken once a year for each animal category on each Houbensteyn farm (= annually 6 samples for each animal category). Since the 2nd crediting period already started in May 1st, 2016, the values for $dm_{j,LT,y}$ will be taken from actual measured values. The feeding of animals is the same since 2016. Therefore, the composition of manure has not changed since then and the current average value for $dm_{j,LT,y}$ applies for the monitoring years 2016 – 2021.

Value applied:

Manure from Houbensteyn farms	Dry matter content [kg/kg]
Liquid cattle manure	0.128
Liquid pig manure	0.115

Manure from ext. farms	Dry matter content [kg/kg]
Liquid cattle manure	0.115
Liquid pig manure	0.104

Data / Parameter	$SVS_{j,LT,y}$
Data unit	Kg svs/kg dm
Description	Organic dry matter content (=specific volatile solids content) of animal manure from livestock type LT and animal manure management system j in year y
Source of data	Organic dry matter content analyses from specialized accredited laboratories as Eurofins or TLR international laboratories
Description of measurement methods and procedures to be applied	For manure supplied by the Houbensteyn farms: Manure samples from all Houbensteyn farms for each animal category are sent to laboratories to measure the respective organic dry matter content, as is already common practice in the agricultural sector. For manure supplied by external farms: The average organic dry matter content of the annually aggregated average measured values from the Houbensteyn farms is multiplied by 90% to obtain the value used for organic dry matter content (conservative approach) The SVS measurements in accredited laboratories are compliant with the requirements of the guideline in annex 2 of AM0073, as required by AMS-III.D.
Frequency of monitoring/recording	Annually
Value applied	Manure from Houbensteyn farms / Organic dry matter content [kg/kg]: Liquid cattle manure 0.557; Liquid pig manure 0.821 Manure from ext. farms / Organic dry matter content [kg/kg]: Liquid cattle manure 0.502; Liquid pig manure 0.739
Monitoring equipment	Laboratories analyses
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	For manure coming from external farms: average annually odm value of Houbensteyn farms x 90%

Value applied (tables):

Manure from Houbensteyn farms	Organic dry matter content [kg/kg]
Liquid cattle manure	0.557
Liquid pig manure	0.821

Manure from ext. farms	Organic dry matter content [kg/kg]
Liquid cattle manure	0.502
Liquid pig manure	0.739

Comments	1 sample will be taken once a year for each animal category on each Houbensteyn farm (= annually 6 samples for each animal category). Since the 2nd crediting period already started in May 1st, 2016, the values for $SVS_{j,LT,y}$ will be taken from actual measured values. The feeding of animals is the same since 2016. Therefore, the composition of manure has not changed since then and the current average value for $SVS_{j,LT,y}$ applies for the monitoring years 2016 – 2021.

Data / Parameter	$Heat_{tot,y}$
Data unit	Gj
Description	Quantity of thermal energy consumption for total external heat use during the year y
Source of data	Heat meter
Description of measurement methods and procedures to be applied	The heat use is measured by a heat meter and recorded digitally. The daily measurements are recorded and send both monthly and annually to CertiQ for certification.
Frequency of monitoring/recording	Annually, based on monthly reports
Value applied	37,000
Monitoring equipment	Heat meter
QA/QC procedures to be applied	The electric and heat meters are supplied, installed, and operated by a recognized measuring company Fudura B.V. Fudura reads, collects and validates the necessary measurement data and send the data to the grid operator. Fudura also takes care of the control and maintenance of the meter. The meters are operated, maintained and calibrated according to the manufacturer's instructions.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	The operator has not the possibility to access or manipulate the meters as they are sealed by officials (Fudura B.V.).

Data / Parameter	Digestate
Data unit	kg
Description	Quantity of digestate (output substrate from the biogas plant) during the year y
Source of data	Measurements reports (Meetrapport) certified by CertiQ, the Dutch issuing body for guarantees of origin and certificates of origin for heat and electricity generated from sustainable sources, and required for grant payment
Description of measurement methods and procedures to be applied	Measured by truck weighing scale after digestion process
Frequency of monitoring/recording	At collection
Value applied	65,000,000
Monitoring equipment	Specifications of the truck weighing scale on the installation: KEURINGS / CONTROLE RAPPORT Serienummer(s): 3550 Type: sca1c1 Fabrikaat BWT Klasse: III Ordernummer 10910 Tnr. : T2992 cem-cy 01/0025-5.2 Max: 70000 kg min: 400 kg e= 20 kg d= 20 kg
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	DAF_w
Data unit	km/truck
Description	Average incremental distance for manure transportation
Source of data	Farm’s location of manure suppliers
Values applied	2 and 80

Justification of choice of data or description of measurement methods and procedures applied	Farms delivering manure from the Princepeel group are located within an average radius of 2 km around the biogas plant. External farms delivering manure to the project are located up to 80 km from the biogas site. The weighted average distance will be calculated ex-ante based on the location of the manure suppliers and the respective manure amounts brought to the plant.
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	DAF_w
Data unit	km/truck
Description	Average incremental distance for manure transportation
Source of data	Farm's location of manure suppliers
Description of measurement methods and procedures to be applied	The distance between the manure suppliers and the biogas plant will be calculated based on the addresses of the manure suppliers. Together with the respective manure amounts from each supplier, the weighted average incremental distance for manure transportation can be calculated.
Frequency of monitoring/recording	Annually
Value applied	2 and 20
Monitoring equipment	Farms delivering manure from Houbensteyn Ysselsetyn are located within an average radius of 2 km from the biogas plant. External farms delivering manure to the project are located within an average radius of 20 km from the biogas site. The addresses of manure suppliers and the respective manure quantities are recorded internally at BV Landgoed de Princepeel.
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	BGP
Data unit	Nm^3
Description	Biogas produced
Source of data	Calculated
Description of measurement methods and procedures to be applied	Calculated by the amount of electricity produced (EEP), the methane content of the biogas and the efficiency of the CHP engines
Frequency of monitoring/recording	See parameter EEP
Value monitored	5,000,000
Monitoring equipment	N/A
QA/QC procedures to be applied	See Parameter EEP
Purpose of the data	To cross-check the biogas produced and destroyed by the CHP engines
Calculation method	$BGP = \frac{EEP}{(ETA_{CHP-el}) * HV_{Biogas}}$ Where: BGP Biogas produced [m^3] EEP Electrical energy produced [MWh] ETA_{CHP-el} Electric efficiency of the CHP engines HV_{Biogas} Calorific value of biogas [kWh/m^3] With $HV_{Biogas} = 0,01 \frac{MWh}{m^3} \cdot x_{CH4}$ Where: 0,01 Stoichiometric combustion calculation of CH_4 [MWh/m^3]: 802,6 kJ/mol /0,02241 m^3/mol = 35.814,37 kJ/m^3 = 0,01 MWh/m^3 x_{CH4} CH_4 volume content of biogas flow [%]
Comments	-

<table>
<tr><td>Data / Parameter</td><td>EEP</td></tr>
<tr><td>Data unit</td><td>kWh</td></tr>
<tr><td>Description</td><td>Electrical energy produced</td></tr>
<tr><td>Source of data</td><td>Power meter</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Electric power meter at each CHP measures the produced electric energy.</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Continuously</td></tr>
<tr><td>Value monitored</td><td>11,000,000</td></tr>
<tr><td>Monitoring equipment</td><td>Technical specifications of the power meter at CHP units:
<table>
<tr><th>EAN Code</th><th>Serial nr</th><th>Brand</th><th>Type</th><th>Description</th><th>Unit</th><th>Accuracy class</th></tr>
<tr><td>EAN 33436</td><td>37 578 524</td><td>ZDM410.CT44.0457</td><td>kWh1</td><td>Gross production meter WKK1</td><td>kWh</td><td>Class 1</td></tr>
<tr><td>EAN 23595</td><td>51 286 505</td><td>ZDM410.CT44.0457</td><td>kWh3</td><td>Gross production meter WKK2</td><td>kWh</td><td>Class 1</td></tr>
<tr><td>EAN 23595</td><td>37 435 494</td><td>ZDM410.CT44.0457</td><td>kWh4</td><td>Gross production meter WKK3</td><td>kWh</td><td>Class 1</td></tr>
<tr><td>EAN 23595</td><td>95 215 481</td><td>ZDM410.CT44.0457</td><td>kWh5</td><td>Gross production meter WKK4</td><td>kWh</td><td>Class 1</td></tr>
</table></td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Precision is very high (uncertainty < 0,5%). The electric meters are sealed and maintained by the grid operator. Calibration is done by authorized service providers.</td></tr>
<tr><td>Purpose of the data</td><td>To cross-check the biogas produced and destroyed by the CHP engines</td></tr>
<tr><td>Calculation method</td><td>N/A</td></tr>
<tr><td>Comments</td><td>-</td></tr>
</table>

Data / Parameter	MC
Data unit	Vol-%
Description	Methane content of the biogas
Source of data	Calculated or gas analyzer, if available
Description of measurement methods and procedures to be applied	The methane content is calculated based on literature values for all the substrate inputs (annually weighed average content) or the gas analyzer is used to measure daily the amount of

	methane in the biogas. The measured values are recorded by the operations staff and logged electronically.
Frequency of monitoring/recording	Continuous measurement
Value monitored	59
Monitoring equipment	Gas analyzer
QA/QC procedures to be applied	The devices are calibrated annually according to manufacturer's instructions.
Purpose of the data	To cross-check the biogas produced and destroyed by the CHP engines
Calculation method	The weighted average methane content is calculated based on the amount and methane content of each substrate entering the biogas installation.
Comments	-

	$B_{Biomass,y}$
Data unit	t
Description	Net quantity of co-ferments i fed into the digester
Source of data	Scale recording
Description of measurement methods and procedures to be applied	Each co-ferment is weighed at delivery. The mass of the co-ferment is noted on the delivery receipt and recorded in the electronic database
Frequency of monitoring/recording	At delivery
Value monitored	16,000
Monitoring equipment	Specifications of the weighing scale on the installation: **KEURINGS / CONTROLE RAPPORT** Serienummer(s): 3550 Type: sca1c1 Fabrikaat BWT Klasse: III Ordernummer 10910 Tnr. : T2992 cem-cy 01/0025-5.2 Max: 70000 kg min: 400 kg e= 20 kg d= 20 kg
QA/QC procedures to be applied	Weighing scales are precise and belong to the accuracy class III. Calibration occurs when the devices need service or repair.
Purpose of the data	To cross check the biogas produced and destroyed by the engines
Calculation method	N/A

Comments	-

5.3 Monitoring Plan

The monitoring plan presented in this PD assures that real, measurable, long-term GHG emission reductions can be monitored, recorded and reported. This monitoring plan will be implemented by the project owner during the project operation. The details of the monitoring plan are specified as follows:

1 Data and parameter to be monitored

The monitoring procedures will be followed as mentioned in section 5.2. The data will be recorded on a continuous basis or as indicated in section 5.2 and fed into the logbooks.

The calibration of monitoring equipment is done on regular intervals as per manufacturer's specification. However, calibration of energy meters for the measurement of export/import is under the responsibility of Fudura. Fudura reads, collects and validates the necessary measurement data and send the data to the grid operator. Fudura also takes care of the control and maintenance of the meter.

2 Management structure

The project owner Martin Houben is the person responsible for collecting all data relevant for the monitoring of GHG emission reductions. The operation and maintenance of the biogas plant is being done by the operation personnel of the company. Generally, all the relevant data needed for the calculation and monitoring of emission reductions are also requested by the government for usual business operation and must be collected and recorded. Data is needed for controlling and accountancy, but also to meet the requirements for the feed-in tariff for energy production. All data are also logged electronically.

Further, everi GmbH provides necessary support and advice to monitor the data as per the requirement. The carbon manager at everi GmbH was already responsible for the monitoring in the previous crediting period and has sufficient experience in monitoring such project type. It is not expected that there will be major issues in future.

3 Quality assurance and Quality control

Quality control and quality assurance procedures will guarantee the quality of monitored data. All metering equipment for monitoring are in accordance with VCS requirements and will be calibrated regularly for accuracy by qualified party according to the national regulations. All data will be archived electronically and backed up regularly.

4 Data storage and filling

All monitoring data will be stored in the logbooks and in electronic format. The monitoring records shall be archived for a period of the crediting period plus 2 years.

APPENDIX A - DOUBLE COUNTING

Verified Carbon Standard

Supporting Documentation:

The following email evidence was provided to Verra by the project proponent to demonstrate that emissions reductions associated with methane emissions from manure digesters are not included within the national inventory.

The original email record is provided at the end of this document.

Email of Nov 21, 2017, from Jos Cozijnsen, on behalf of John Horrevorts in the framework of the Dutch Green Deal to establish a domestic CO2 market [not official translation]:	
Original (Dutch):	Translated (English):
Hallo Peter, "In vervolg op onze eerdere gesprekken wil ik je namens John Horrevorts, die aangesloten is bij onze green deal en met mestvergistingsprojecten bezig is in Brabant vragen om een mededeling dat bevestigt dat de methaanreducties van mestvergisting totnogtoe niet zijn meegenomen in de NIR. Dat kan wellicht via email, of over brief, met verwijzing naar de plek in de NIR. Graag horen we of je daar nog informatie voor nodig hebt of dat je dat zo kunt sturen."	"Hello Peter As a follow-up to our earlier discussions, I would like to ask you on behalf of John Horrevorts, who is involved in our green deal and with manure fermentation projects in Brabant, to submit a statement confirming that the methane reductions of manure digesters have not yet been included in the NIR. This may be possible via email, or letter, with reference to the place in the NIR. We would like to hear if you need information or that you can send it that way."
Email of Nov 27, 2017, from Peter , Dutch official, responsible for drafting the National Inventory Report:	
Original (Dutch):	Translated (English):
"Beste Jos en John Door middel van deze mail bevestig ik dat er in Nederland nog geen sprake van het meerekenen van emissiereducties als gevolg van mestvergisting. Hierbij verwijs ik naar de NIR2017 (http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/nld-2017-nir-14apr17.zip) waar in paragraaf 5.3.6 de volgende tekst staat vermeld: *A technical measure to prevent methane emissions caused by manure management is manure treatment in an anaerobic digester. In 2014, 2% of the total amount of manure in animal housing was treated in an anaerobic digester. The Netherlands is examining future needs and possibilities in this area to include anaerobic treatment in the methodology and to extend calculations. Results of initial research (Hoeksma et al., 2012) make it clear that further investigation is needed.* Op dit moment is het RIVM samen met de WUR een methode te ontwikkelen, waarmee de effecten van mestvergisting kunnen worden verrekend in de emissies. Het blijkt een complex onderwerp (met plussen en minnen), dat waarschijnlijk in de NIR 2019 zal worden doorgevoerd."	"Dear Jos and John, By means of this e-mail I confirm that there is no inclusion in the Netherlands of the emission reductions as a result of manure digesters. I refer to the NIR2017 (http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/nld-2017-nir-14apr17.zip where the following text is mentioned in section 5.3.6: A technical measure to prevent methane emissions caused by manure management is manure treatment in an anaerobic digester. In 2014, 2% of the total amount of manure in animal housing was treated in an anaerobic digester. The Netherlands is examining future needs and possibilities in this area to include anaerobic treatment in the methodology and to extend calculations. Results of initial research (Hoeksma et al., 2012) make it clear that further investigation is needed. At the moment, the RIVM, together with the WUR, is developing a method with which the effects of manure fermentation can be calculated in the emissions. It turns out to be a complex topic (with pluses and minuses) that will probably be implemented in the NIR 2019."

The email evidence above proves that emissions reductions from manure digested in agricultural biogas power plants (ER) were not accounted in the NIR for the period defined in the NIR 2017. An assessment of the further NIRs shows that the ER have not yet been taken into account in the National Inventory Report of the Netherlands:

NIR	Rel. Years	Section	Page	Abstract from the NIR
NIR 2017	1990-2015	5.3.6	173	A technical measure to prevent methane emissions caused by manure management is manure treatment in an anaerobic digester. In 2014, 2% of the total amount of manure in animal housing was treated in an anaerobic digester. The Netherlands is examining future needs and possibilities in this area to include anaerobic treatment in the methodology and to extend calculations. Results of initial research (Hoeksma et al., 2012) make it clear that further investigation is needed.
		Major changes	157	-
NIR 2018	1990-2016	5.3.6	173	A technical measure to prevent methane emissions caused by manure management is manure treatment in an anaerobic digester. In 2014, 2% of the total amount of manure in animal housing was treated in an anaerobic digester. The Netherlands is examining future needs and possibilities in this area to include anaerobic treatment in the methodology and to extend calculations. Results of initial research (Hoeksma et al., 2012) make it clear that further investigation is needed.
		Major changes	175	*Parameters used for the calculation of CH4 from Manure management (MCF and B0) have been updated*
NIR 2019	1990-2017	5.3.6	171	No improvements are planned
		Major changes	153	The emissions of manure treatment are now included in the calculations...These emissions are reported under category 3, with the exception of CH4 from manure digestion; these emissions are reported in category 5B2 Biological treatment of waste – anaerobic digestion at biogas facilities.
		7.3.2	231	The amount of animal manure used in digesters is based on the registered manure transports (data from the Netherlands Enterprise Agency; RVO). The emissions are calculated using the National Emissions Model Agriculture (NEMA), as described in chapter 5 and the methodology report for agricultural emissions (Lagerwerf et al. 2019).
NIR 2020	1990-2018	5.3.6	189	It will be investigated whether enough information is available to include the emissions from more manure treatment techniques, namely manure hygienisation and the composting of manure.
		Major changes		-
NIR 2021	1990-2019	5.3.6	177	It will be investigated whether enough information is available to include the emissions from more manure treatment techniques, namely manure hygienisation and the composting of manure.
		Major changes	161	-

The NIR 2019 states in Chapter 7.3.2 “The amount of animal manure used in digesters is based on the registered manure transports (data from the Netherlands Enterprise Agency; RVO). The emissions are calculated using the National Emissions Model Agriculture (NEMA), as described in chapter 5 and the methodology report for agricultural emissions (Lagerwerf et al. 2019)”. It means that only the emissions from manure, which are treated in large scale (industrial) waste plants generating biogas are accounted in the NIR, but not manure treated in agricultural biogas plants. This is the reason why these emissions are included in Chapter 7 (Waste sector - CRF sector 5) and not in Chapter 5 (Agriculture – CRF sector 3).

This is also confirmed by Jos Coszijnsen, dutch carbon specialist working at Climate Neutral Group, in close contact and collaboration with the RVO (Netherlands Enterprise Agency), which delivers the data concerning the registered manure transport for emission calculations in the NIR:

Re: Future credits - Netherlands Biogas VCS

JC Jos Cozijnsen <jos.cozijnsen@climateneutralgroup.com>
An Kalathas, Pauline
Cc John Horrevorts; Lene Keerberg; John Leppers; Silvana Claassen

Antworten | Allen antworten | Weiterleiten | ...

Di 05.01.2021 17:12

Sie haben am 06.01.2021 09:50 auf diese Nachricht geantwortet.

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Thanks for follow-up, Pauline,

1. Manure digesters of farms are NOT included. The RVO does not even have numbers of individual farms and what type of manure is digested. RVO is still figuring out how to do this.

Since project Houbensteyn is an agricultural biogas plant, as it can be shown in the figure below (industrial plants are not allowed in agricultural zones), emissions from manure treatment in agricultural biogas plants like Houbensteyn Milieu BV are not accounted in the NIR.

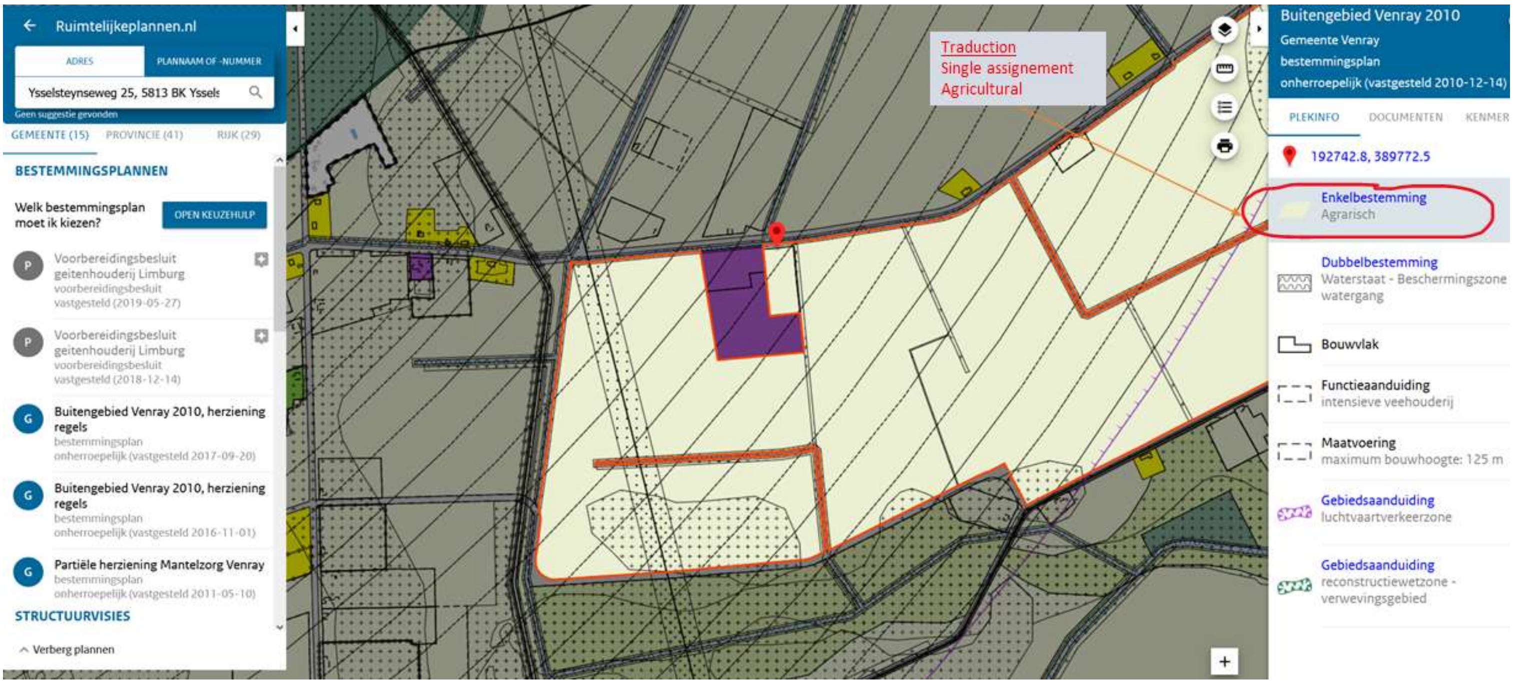

Figure 5: Houbensteyn biogas site is built in the agricultural zone