METHANE RECOVERY PROJECT PRAKTIJKCENTRUM STERKSEL, NORTH BRABANT, THE NETHERLANDS

Document Prepared by GES Energie GmbH

Project Title	Methane Recovery Project Praktijkcentrum Sterksel, North Brabant, the Netherlands
Version	02
Report ID	N/A
Date of Issue	23-February-2021
Project ID	338
Monitoring Period	01-January-2008 to 30-April-2016
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CONTENT

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The Methane Recovery Project Praktijkcentrum Sterksel 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. Technically, the project is an agricultural biogas plant that produces renewable energy (electricity and heat) from different organic input materials. The GHG emission reduction approaches were demonstrated in the PDD by the mitigation of uncontrolled methane emission out of manure and organic wastes as well as the generation of renewable thermal energy decentrally used to substitute fossil fuels. The project activity was put into operation in spring 2006. The Methane Recovery Project Praktijkcentrum Sterksel has been verified for its first operation period from May 1st, 2006 to December 31st, 2007 in order to certify the correspondingly reduced GHG emissions by this project activity within this period.

The present Report monitors emission reductions that have occurred from the first monitoring period until the end of the project's crediting period (01/01/2008 - 30/04/2016), with a quantitative monitoring of emission reductions for only the last 6 years of the project's crediting period (01/05/2010 - 30/04/2016). The years between 01/01/2008 and 30/04/2010 are subject to a verification by the Verification Body concerning the evidence, that the project have reduced and not emitted GHG emissions in that period of time (see in Appendix E the "Request for exemption from quantitative monitoring for the crediting period from 01/01/2008 to 30/04/2010"). Consequently, no emission reductions are claimed in those years.

The current Monitoring Report refers to the monitoring concept of the PDD submitted in its version 04 by ARA Carbon Finance GmbH on June 28th, 2007 to the TÜV Rheinland Group.

The project activity involves power generation using Combined Heat and Power engines (CHP) to produce electricity and heat: 2 CHPs with a total electric capacity of 690 kW has been put into continuous operation till March 2020. A third CHP with 70kW_{el} was in operation from 2008 untill 2009 for research reasons. Today, the biogas plant is not in operation anymore. The plant owner decided to stop the energy production in March 2020 because the operation of the biogas installation is no longer viable under the current legislation. The plant has now been dismantled.

The heat produced by the biogas plant is used for the own process of the biogas plant, but also substitutes fossil fuels with heating the swine stall, the administrative buildings of the plant and with hygienization of the digestate.

The total GHG emission reductions generated under the current quantitative monitoring period starting from 01/05/2010 to 30/04/2016 are 36.031 t CO_2e.

1.2 Sectoral Scope and Project Type

The VCS sectoral scopes applicable to the project activity is 13 “Waste handling and disposal”. The project is not a debundled component of a larger project activity.

1.3 Project Proponent

Organization name	Wageningen Livestock Research (former name Praktijkcentrum Sterksel)
Contact person	John Horrevorts
Title	Plant Manager
Address	Vlaamseweg 17 6029 PK Sterksel North Brabant - The Netherlands
Telephone	+31 6 30 99 19 19
Email	jh@re-n.nl

1.4 Other Entities Involved in the Project

Organization name	GES Energie GmbH
Role in the Project	Carbon Consultant
Contact person	Pauline Kalathas
Title	Project Manager
Address	Domstrasse 11, 20095 Hamburg
Telephone	+49 (0)40 80 90 63 220
Email	p.kalathas@ges-energie.de

1.5 Project Start Date

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

1.6 Project Crediting Period

The starting date of the crediting period and the first monitoring period is set to the 01st of May 2006. The project uses a fixed crediting period of 10 years which ends on 30th of April 2016.

1.7 Project Location

The project activity takes place on the estate of the project owner Wageningen Livestock Research in Sterksel, North Brabant, southeastern part of the Netherlands. The geographical coordinates are N51°22'21" E5°37'30".

1.8 Title and Reference of Methodology

Referring to the PDD, 2 small-scale methodologies according to the CDM standards of the UNFCCC are used in the project:

Type III, other project activities, 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, Category 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).

1.9 Participation under other GHG Programs

The project is not registered under any other GHG program.

Methane Recovery Project Sterksel 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.

1.10 Other Forms of Credit

The project has been planned for the generation of voluntary emission reductions (VER) in Sterksel, North Brabant, The Netherlands, 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. Even if the project activity investigated being currently treated as a VER-project, approved CDM baseline methodologies as well as the *Tool for the demonstration and assessment of additionality* of the UNFCCC were applied in order to allow a conversion 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.

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.

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, *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.

1.11 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"[1].

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.

2 SAFEGUARDS

2.1 No Net Harm

The Sterksel 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 Sterksel 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.

[1] 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)

2.2 Local Stakeholder Consultation

The Project is already registered with VCS (VCS ID 338). 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 responsible at Wageningen Livestock Research in case they feel directly or indirectly disturbed by the project activity.

The public stakeholders are united behind local representative persons. Those persons are responsible for the communication with Wageningen Livestock Research in the name of the stakeholders. No complain or litigation has taken place during the entire crediting period of the project. The discussions have always resulted in a commitment of full support for the project.

2.3 AFOLU-Specific Safeguards

Not applicable to the project activity.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity was put into operation in 2006. At this stage and during the first monitoring period, 1 CHP with a capacity of 330 kW_{el} was installed on the project site, running with high energy production rates. As a research institute, Wageningen Livestock Research put a 70 kW_{el} CHP into operation as a test unit in 2008, which was put out of operation in 2009. The grid connection has been kept in order to make other tests possible, but the CHP unit were not used anymore till 2020. Another CHP with a capacity of 360 kW_{el} was installed in 2008 and was in operation during the remaining crediting period of the project, corresponding to the extension of the plant's capacity mentioned in the PDD on page 9. During the present monitoring period, a total of 690 kW_{el} were in operation on the plant's site.

CHP Units		Electric capacity installed	Thermal capacity installed	Electric efficiency [FT]	Start of operation date
		kWel	kWth	%	
WKK1	Jenbacher	330	405	38,7	2006
WKK4	MAN	360	421	40,2	2008

Table 1: Data of installed CHP units from Wageningen Livestock Research (source: App D - 9 - Meetprotocol biogas installatie VIC Sterksel, p. 5/6)

The biogas plant is treating manure from the own farm as well as manure from farmers in the neighbourhood around the biogas plant (minimum of 50% of the total biomass fed). Co-ferments from agricultural and food industries are also delivered and fed to the biogas plant.

The heat produced by the biogas plant is used for the own process as well as for heating the pig stalls, the office buildings and since 2014, for hygienization of the digestate. To measure the heat used externally, a first heat meter has been installed in 2013.

During this monitoring period, the biogas plant has been running without any significant event that would have affected the GHG emission reductions and monitoring.

Today, the biogas plant is not anymore in operation and has stopped producing renewable energy in March 2020 (see Appendix D "Beeindiging contract Jenbacher" and Beeindiging contract MAN").

3.2 Deviations

3.2.1 Methodology Deviations

1. Biogas production

Deviant from the Methodology described in the PDD, the amount of biogas 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. This calculation, based on a reference method described by the CCX Agricultural Methane Gas Project Guidelines, has already been assessed in the last monitoring 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.

This deviation has already been assessed and verified by the Verification Body TÜV Rheinland as well as by Verra under VCS for the last monitoring period in 2006/2007 as well as recently by the Verification Body Aenor and Verra under VCS for the monitoring of Methane Recovery Project Aben (which is the same project type and category as the present project) for the period 2010 to 2016.

2. Conservativity factor

Another deviation from the methodology is the application of an overall deduction factor of 0,5 on the emission reductions due to methane recovery. This conservativity factor covers the uncertainties due to the fact, that the project owner has to deal with a lot of organic waste streams of different type and only default values are used instead of local values for waste

specific parameter. Furthermore, the project was developed at a time when the methodological approaches and guidelines were not yet mature. Following the conservativeness principle prescribed by the VCS methodology as well as ISO 14064, the application of an additional security factor of 0.5 (conservativity factor) is appropriated to highly compensate the risk of an over-estimation of the emission reductions.

This factor has already been assessed and verified by the Verification Body TÜV Rheinland as well as by Verra under VCS for the last monitoring period in 2006/2007. Furthermore, this deviation has also been evaluated during the last monitoring in 2012 of the Methane Recovery Project Princepeel Wilbertoord, that is the same project type and category as the present project (see in Appendix B the *Project Review Report* of Project Princepeel, pages 5-7).

Through the selection of conservative values for the biogas production of input substrates and the application of an overall deduction factor of 0,5, it is absolutely secured that, in general, no over-estimation of the emission reductions can occur.

3.2.2 Project Description Deviations

1. Increase of manure quantities

Deviation in the implementation of the project has been the increase in the manure quantities over the crediting period of the project. Higher amounts of manure generally and of manure with a dry matter content have been treated than initially planned. This development is attributed to the higher manure surpluses that the Netherlands have been experiencing in the last decade and that could not have been anticipated. To address these issues on a national level, dutch policies have been developed to reduce the amounts of manure surplus again. Hence, the biogas plants in the Netherlands had to adapt their plant concepts to the changed biomass market. For the project activity, this has resulted in an increase in emission reductions, even if the plant capacity has stayed the same as described in the initial project documentation.

This deviation has already been worked out, assessed and verified by the Verfication Body TÜV Rheinland as well as by Verra under VCS during the last monitoring for the Methane Recovery Project Princepeel Wilbertoord, that is the same project type and category as the present project (see in Appendix B the *Project Review Report* of Project Princepeel, page 7).

2. Amount of emission reductions

The amount of emission reductions is higher than the estimated amounts in the PDD. This is partly due to the larger amounts of manure that are processed in the biogas plant, as described above. But it is also due to the fact, that only the baseline methane emissions released from stored manure are calculated in the PDD and not the one from waste management. Hence, the

yearly estimated methane emissions reductions written down in the PDD do not correspond to the entire methane emissions that are reduced through the project activity. Furthermore, the Global Warming Potential of CH_4 has been adapted from 21 to 25 according to the Fourth Assessment Report and VCS Requirements, which also leads to higher emission reductions.

3. Carbon Consultant

Deviant from the last Monitoring in 2006/2007, the company of the Carbon Manager has changed from ARA Carbon Finance GmbH to GES Energie GmbH, but this company and its employees belong to the same company group as the ARA Carbon Finance GmbH. This has no impact on the quality of the Monitoring Report and the resulting emission reductions, since the actual Carbon Consultant has been working in the carbon sector for almost 15 years.

4. Project Proponent

The person responsible for collecting all data relevant for the monitoring of GHG emission reductions was Mart Smolder till 2011, managing director of Wageningen Livestock Research (former name Praktijkcentrum Sterksel) with John Horrevorts as head of technical staff. Between 2011 and 2014, the managing directors and heads of technical staff has changed several times. Since 2014, the company RE-N Technology B.V. is the project operator with John Horrevorts as plant manager. John Horrevorts has taken over the responsibility for monitoring and recording all data with Bas de Kort supporting him as head of technical staff. This presents a deviation from the PDD information from 2011 on. Since the data collected for this Monitoring has also to be collected by Wageningen Livestock Research as basis for accountancy and feed-in tariffs, and is verified by external authorities, negative impacts because of the changes on the quality of the documentation provided for the calculation of emission reductions is excluded.

The name of the research institute that owns the biogas plant has been changed from Praktijkcentrum Sterksel to Wageningen Livestock Research. This research institute from the Wageningen University & Research operates the biogas plant under the research facility Varkens Innovatie Centrum (VIC) Sterksel. This deviation has no impact on the emission reductions.

5. Heat meter

Deviant from the initial PDD, no heat meter was installed to measure the use of external heat from the start of the project but only in 2013 (installation of first heat meter; second one in 2014). Hence, during the last monitoring (2006/2007), no heat meter was installed but emission reductions were claimed for the substitution of natural gas by biogas with a calculation based on historic fossil fuel consumption, according to the PDD. The project proponent has decided not to claim any emission reductions for the substitution of fossil fuel for the current monitoring period, as the work efforts to calculate the emission reductions and collect the necessary documents and evidence are economically not viable.

This deviation has a conservative impact on the emission reductions since these are not claimed for the substitution of fossil fuel.

6. Biogas flow meter

Deviant from the description in the PDD, no flow meter has been running during the present monitoring period. In the first years of operation of the biogas plant, a flow meter has been installed, as required in the monitoring plan in the PDD. Practice during this period has shown that the flow meter was unable to deliver reliable measurements, due to contaminations like moisture (condensation) or Sulfur (H_2S). Therefore, the measurements could not be used as accurate values for calculation the emission reductions.

Hence, the biogas flow has been calculated following a reference method described by the CCX Agricultural Methane Gas Project Guideline, based on the electric energy produced, the efficiency of the CHPs and the calorific value of biogas (please refer to section 5.1.1 of the present Monitoring Report). The calculation of the biogas amount bases on the electricity production measured by an electric meter with an accuracy <1%. Since the accuracy of the electric meter is highly precise and the method described by CCX is considered to be conservative, using the CCX method will have a conservative effect on the quantity of emission reductions.

7. Methane content

The methane content has been measured daily with a mobile gas analyzer, which has been calibrated annually. Since the accuracy of the methane content measurements is not secured during the monitored years between 2010 and 2016, because the daily records are only handwritten (see Appendix D “Daily rapport 2015” as example) but not recorded electronically (only estimation of average annual methane content possible) and the calibration reports could not be provided for each year (see Appendix D “Calibration rapport gas analyzer - 2013), the methane content has been calculated based on the literature values, as it has been done for the biogas production and methane content from non-waste co-ferments” (please refer to section 5.1.1. of this Monitoring Report). The calculated average value of methane content in the biogas over the monitored years is 57,45% and correspond to the estimated average value for methane content of the biogas plant in Sterksel with 58% (see Appendix D “20201028_VCS_Data Inquiry_Sterksel”). Since the biogas production is calculated based on the electricity production and the methane content in the biogas, the biogas production will decrease proportionally with a higher methane content. Hence, the level of methane content in the biogas has no direct impact on the amount of emission reductions.

8. Emergency boiler

The emergency boiler has only been used in 2006 to heat the digester to launch the biogas process. After the successful warming up of the installation, the plant has used the own heat produced to keep the digesters warm. The boiler was disconnected after the launching phase of

the project and, according to this, could not be used during the current monitoring period, deviant from the description in the PDD on page 19. Since the emergency boiler has been disconnected, no fuel use and consequently, no project emission can occur during the current monitoring period.

9. Manure from own farm

The amount of liquid manure coming from the own farm is calculated based on the animal number instead of being measured, as required in the PDD. As practice has shown in other biogas projects, flow meters are never installed on a biogas plant just to measure the amounts of manure coming from their own farm. Since biogas projects are usually hardly economically viable, investments in technologies that are of no use or not prescribed by law are avoided. The law requires to calculate the amount of manure from own farm based in the animal number. The accuracy of the manure amounts from the company's own farm can be stated as very precise, as the number of animals is annually calculated, listed and approved by the government.

However, the emission reductions are calculated based on the total amount of CH4 minus the amount of CH4 from non-waste co-substrates. Therefore, the amount of manure has no significant impact on the amount of emission reductions. Hence, this deviation does not impact the accuracy and quantity of emission reductions.

3.3 Grouped Projects

Project activity is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	D_{CH4}
Data unit	t CH_4/m^3
Description	Density of Methane
Source of data	UNFCCC
Value applied	0,0007168
Justification of choice of data or description of measurement methods and procedures applied	Density of methane at standard temperature and pressure. “Methane Recovery Project Praktijkcentrum Sterksel”, PDD p. 22

Purpose of Data	Calculation of emissions from manure management systems and agricultural/ food wastes
Comments	None

Data / Parameter	GWP_{CH4}
Data unit	t CO_2e / t CH_4
Description	Global warming potential of methane
Source of data	UNFCCC
Value applied	25
Justification of choice of data or description of measurement methods and procedures applied	Global Warming Potential value for methane for the second commitment period is 25 t CO_2e/t CH_4
Purpose of Data	Calculation of emissions from manure management systems and agricultural/ food wastes
Comments	The GWP value set in the PDD has been adapted to the second commitment period with value from the fourth assessment report according to UNFCCC and VCS Requirements

4.2 Data and Parameters Monitored

This Monitoring Report comprises a total of 6 years of monitored data. In order to keep the Monitoring Report clear, only the values for the year 2014 are given below for each parameter when displaying the values of all monitored years is not possible. The values of the other monitored years are stated in the annexed spreadsheet with the details of all the calculation steps for every year (see Appendix C).

Since the quantitative monitoring period of this Report includes the last 6 years of the crediting period of the project activity (01/05/2010 - 30/04/2016), the annual values monitored in 2010 and 2016 are converted into the monitoring periods of 8 month and 4 month, respectively.

Data / Parameter	BGP
Data unit	Nm^3
Description	Biogas produced
Source of data	Calculated
Description of measurement methods and	Calculated by the amount of electricity produced (EEP), the methane content of the biogas and the efficiency of the CHP engines

<table>
<tr><td>procedures to be applied</td><td></td></tr>
<tr><td>Frequency of monitoring/recording</td><td>See parameter EEP</td></tr>
<tr><td>Value monitored</td><td>
<table>
<tr><th>Year</th><th>Biogas produced [m³]</th></tr>
<tr><td>2010</td><td>1.597.021</td></tr>
<tr><td>2011</td><td>2.164.253</td></tr>
<tr><td>2012</td><td>1.665.429</td></tr>
<tr><td>2013</td><td>2.154.193</td></tr>
<tr><td>2014</td><td>1.905.686</td></tr>
<tr><td>2015</td><td>2.184.967</td></tr>
<tr><td>2016</td><td>695.444</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>N/A</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>See Parameter EEP</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Calculation method</td><td>$$BGP = \frac{EEP}{(ETA_{CHP-el}) * HV_{Biogas}}$$

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 CH_4 [MWh/m³]:
802,6 kJ/mol /0,02241 m³/mol = 35.814,37 kJ/m³ = 0,01 MWh/m³
x_{CH4} — CH_4 volume content of biogas flow [%]</td></tr>
</table>

Comments	None

Data / Parameter	MC
Data unit	Vol-%
Description	Methane content of the biogas
Source of data	Calculated
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)
Frequency of monitoring/recording	N/A
Value monitored	
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	For calculation of the amount of biogas produced and for controlling reasons
Calculation method	The weighted average methane content is calculated based on the amount and methane content of each substrate entering the biogas installation.
Comments	None

Year	Weighted average methane content [%]
2010	56,31
2011	57,42
2012	58,56
2013	57,34
2014	57,44
2015	56,65
2016	56,77

Data / Parameter	Fraction of time
Data unit	h

Description	Runtime of the CHP
Source of data	Runtime counter in CHP
Description of measurement methods and procedures to be applied	Runtime counters automatically record the number of hours that a CHP operates. The value increases continuously during lifetime.
Frequency of monitoring/recording	Monthly
Value monitored	<table><tr><th>2014</th><th>Electricity produced [EEP]</th><th>Hours of operation [FT]</th></tr><tr><th>CHP Unit</th><th>kWh</th><th>h</th></tr><tr><td>Jenbacher</td><td>1.707.625</td><td>8.202</td></tr><tr><td>MAN</td><td>2.614.225</td><td>8.408</td></tr></table>
Monitoring equipment	Runtime meter
QA/QC procedures to be applied	Runtime meters have an inaccuracy of < 1% (see Appendix D “Runtime counter - Accuracy - Jenbacher”)
Purpose of the data	Plausibility of electricity production
Calculation method	N/A
Comments	None

Data / Parameter	ETP
Data unit	kWh
Description	Thermal energy production for external utilization
Source of data	Heat counter
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Continuously
Value monitored	0
Monitoring equipment	N/A

QA/QC procedures to be applied	N/A
Purpose of the data	To determine the displaced fossil fuels of the baseline scenario
Calculation method	N/A
Comments	Heat counter has first been installed in 2013 but the thermal energy production is not monitored because no emission reductions are claimed

Data / Parameter	EEP
Data unit	kWh
Description	Electrical energy produced
Source of data	Power meter
Description of measurement methods and procedures to be applied	Electric power meter at each CHP measures the produced electric energy.
Frequency of monitoring/recording	Continuously
Value monitored	

Year	Electricity produced [kWh]
2010	3.550.349
2011	4.906.766
2012	3.850.823
2013	4.877.331
2014	4.321.850
2015	4.886.926
2016	1.558.884

Monitoring equipment: Technical specifications of the power meter at CHP units (source: App D - 9 - Meetprotocol biogas installatie VIC Sterksel, page 9):

EAN Code	Serial nr.	Brand	Meter Type	Description	Unit	Inaccuracy
EAN 70554	85011459	Landis+Gyr	ZDM410CT	Gross production meter WKK1	kWh	< ± 1%
EAN 05946	50584982	Landis+Gyr	ZDM410CT	Gross production meter WKK4	kWh	< ± 1%

QA/QC procedures to be applied	Precision is very high (inaccuracy < 1 %). The electric meters are sealed and maintained by the grid operator. Calibration is done by authorized service providers in compliance with the European CE-Directive (MIT = Measurement Instrument Directive).
Purpose of the data	Calculation of baseline emissions, of biogas produced by the plant and cross-checking the biogas produced and destroyed by the CHP engines
Calculation method	N/A
Comments	None

Data / Parameter	EEI
Data unit	kWh
Description	Electric energy imported
Source of data	Power meter
Description of measurement methods and procedures to be applied	The own electricity consumption for running the biogas plant is not directly measured. The gross and net electricity productions are directly measured, so that the own electricity consumption can be calculate.
Frequency of monitoring/recording	Continuously
Value monitored	

Year	Electricity consumed for own process [kWh]
2010	934.616
2011	822.877
2012	798.276
2013	770.785
2014	895.000
2015	1.049.380
2016	1.099.588

Monitoring equipment: Technical specification of power meter for gross measurements (please refer to Parameter EEP) and for net measurements in following table (source: App D - 9 - Meetprotocol biogas installatie VIC Sterksel, page 9):

EAN Code	ID	Brand	Meter Type	Description	Unit	Inaccuracy
EAN 70554	44.4207	Landis+Gyr	ZDM410CT	Net production meter WKK1	kWh	< ± 1%
EAN 05946	44.0007	Landis+Gyr	ZDM410CT	Net production meter WKK4	kWh	< ± 1%

QA/QC procedures to be applied	Precision is very high (inaccuracy < 1 %). The electric meters are sealed and maintained by the grid operator. Calibration is done by authorized service providers in compliance with the European CE-Directive (MIT = Measurement Instrument Directive).
Purpose of the data	To demonstrate that the net impact of electricity production and consumption is positive.
Calculation method	The project's own electricity consumption can be calculated as gross electricity production minus net electricity production = own consumption.
Comments	None

Data / Parameter	MCOFi
Data unit	t
Description	Mass of each co-ferment i fed into the digester
Source of data	Delivery receipts
Description of measurement methods and procedures to be applied	Each co-ferment is weighed by the supplier company. The mass of each co-ferment is noted on the delivery receipt, which is stored as hard copy in folder on the plant's site. The amounts are also electronically recorded in excel files by the operation personal.
Frequency of monitoring/recording	At delivery
Value monitored	
Monitoring equipment	Weighing scales at the location of the supplier companies.

Substrates in 2014	**Amount [t]**
Corn silage	500
Grain	867
Potato starch	151
Cocoa products	579
Food waste	2.674
Glycerin	1.115
Plant fat	1.234
Vegetable waste	59
Whey waste	992
Total	**8.171**

QA/QC procedures to be applied	Weighing scales used by the supplier companies are calibrated[2] and certified according to the legal metrology. The weights are verified and approved by Fudura as external recognized organization (please refer to chapter 4.3)
Purpose of the data	Calculation of baseline emissions
Calculation method	N/A
Comments	None

Data / Parameter	MANURE
Data unit	t
Description	Volume of manure fed into digester
Source of data	Delivery receipts for external manure
Description of measurement methods and procedures to be applied	External manure is weighed like co-ferments with calibrated weighing scales at the supplier companies[3]. The delivery receipts are stored on the operation site. The manure amounts are logged in the official software of the government under minj.rvo.nl. Manure from the own farm is estimated based on the current animal number. The daily amounts of manure are recorded in the electronic database.
Frequency of monitoring/recording	At delivering to the plant
Value monitored	**Manure in 2014** / **Amount [t]** Liquid - pig: 10.043 Liquid - cattle: 470 Solid - pig: 145 Solid - cattle: 3.613 **Total**: **14.271**
Monitoring equipment	Weighing scales at the location of the supplier companies

[2] Example from supplier AgriBioSource: Terms of delivery https://www.agribiosource.com/nl/contact/juridisch/leveringsvoorwaarden/ under 3.5 "*weighing will take place on a calibrated weighbridge designated by ABS Europe*"

[3] Official rules regarding the weighing of animal manure https://www.rvo.nl/onderwerpen/agrarisch-ondernemen/mest/mest-vervoeren-nederland/dierlijke-mest-vervoeren under "Hoe wegen": "*The weighing installation meets the requirements of the Measuring Instruments and Market Participants Decree for non-automatic weighing instruments*"

QA/QC procedures to be applied	Weighing scales used by the supplier companies are calibrated and certified according to the legal metrology. The weights are verified and approved by Fudura as external recognized organization (please refer to chapter 4.3)
Purpose of the data	Calculation of baseline emissions
Calculation method	N/A
Comments	None

Data / Parameter	OIL
Data unit	m^3
Description	Oil consumed in emergency boiler
Source of data	Volume scale and/or delivery receipt
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	At delivery
Value monitored	0
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	Emergency boiler has been disconnected in 2006 after the successful launching of the biogas plant and hence, has not been used during the monitoring years 2010-2016.

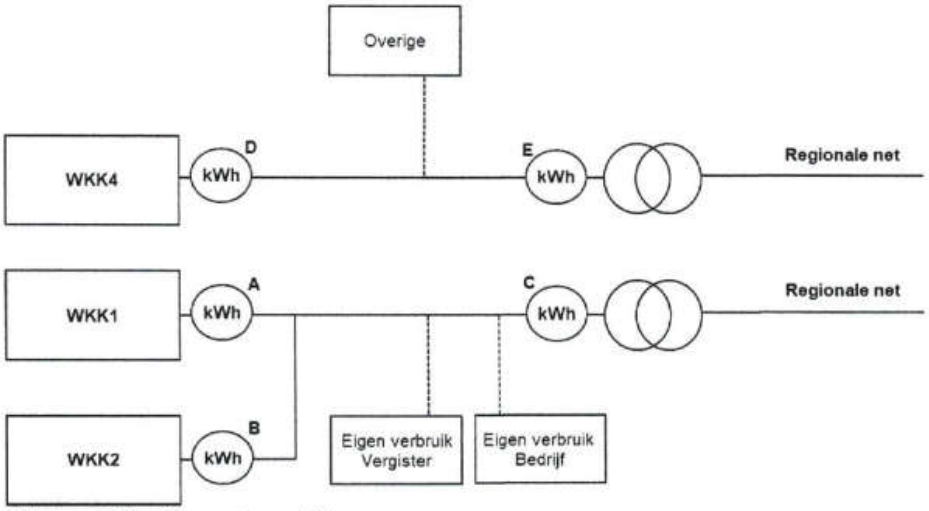
4.3 Monitoring Plan

The person responsible for collecting all data relevant for the monitoring of GHG emission reductions was Mart Smolder till 2011, managing director of Wageningen Livestock Research (former name Praktijkcentrum Sterksel) with John Horrevorts as head of technical staff. Between 2011 and 2014, the managing directors and heads of technical staff has changed several times.

Since 2014, John Horrevorts, plant manager at Wageningen Livestock Research, has taken over the responsibility for monitoring and recording all data with Bas de Kort supporting him as head of technical staff. 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. The daily recorded data of substrate inputs, electricity production, runtime hour and thermal energy consumption are logged in the operation manual stored on the plant's site.

The electricity production is continuously recorded at the processing unit of the CHP (measurements every 15 minutes). The daily production is recorded by a data logger. The records of the monthly production rates for the year 2010 till 2012 are provided by Agentschlap NL (from the Ministry of Economic Affairs) or CertiQ as certification body designated by the Dutch government to control the electricity production before part of the subsidies can be paid out (see Appendix D "Production data Jenbacher [year]" and "Production data MAN [year]" as well as "Production data 2011 Sterksel_CertiQ"). For the years 2013 - 2016, an overview of the monthly production rates can be found in the obligatory measurements reports certified by the recognized measuring company Fudura B.V. (see Appendix D "Meetrapport [year] VIC Sterksel"). The electric meters are supplied, installed, and operated by this 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. According to Fudura, the electricity measurements fully comply with the European CE-Directive Measuring Instrument Directive (MID). That means, that the meters are operated, maintained and calibrated according to the manufacturer's instructions (see E-Mail from a Fudura adviser in Appendix D "Fudura_Electric meters"). The installation and operation of the electrical meter is regulated by law. The operator has not the possibility access or manipulate the meters as they are sealed by officials (Fudura B.V.). This is a common fact in EU countries. Authorities require meters to be initially qualified (DU: "Eichung") which is similar to a calibration but can only be conducted by a competent authority. Accuracy is provided and safeguarded by law through the competent authority (see Appendix B "Project Review Report" of the Methane Recovery Project Princepeel Wilbertoord from VCS, Finding 1, p. 3).

The accuracy class of the CHPs' power meters is given in a report named "Meetprotocol biogasinstallatie VIC Sterksel", p. 9 (see Appendix D). This report contents also the data regarding electricity (and heat) production, their technical description and the monitoring methods. This report has to be submitted to the government and serves as basis for the subsidies.



Figuur 2 Situatie meters elektra

	Meter	EAN-Code	EAN Groen code
A	Brutoproductiemeter wkk1	871687910000070554	871837800000006246
B	Brutoproductiemeter wkk2	871687910000070554	871837800000006246
C	Netmeting	871687910000070554	871837800000006246
D	Brutoproductiemeter wkk4	871687910000305946	871837800000000343
E	Netmeting	871687910000305946	871837800000000343

Figure 1: Schematic representations of electricity flow, including system boundary and meters [4]

As can be seen from the schema above, all CHP installations are equipped with their own gross production counter (A for WKK1 and D for WKK4 for the current monitoring period). The own electricity consumption (for digesters, self-consumption of the CHPs and external heat consumers) is directly taken from the electricity produced by the biogas plant. Since the net production is also measured with electricity meters (C for WKK1 and E for WKK4 for the current monitoring period), the project's own electricity consumption can be calculated (gross production - net production = own production).

The runtime counters automatically record the number of hours that a CHP operates (see Appendix C in the calculation spreadsheet under "CHP"). The runtime hours can be read directly on the CHP engine. For the monitoring period 2010 till 2016, the runtime hours of each CHP are recorded annually on the invoices for maintenance of the CHP manufacturer (see Appendix D "MAN [year] - Runtime hour" or "Jenbacher [year] - Runtime hour") as well as daily in the operation manual (see Appendix D "MAN and Jenbacher [year] - Runtime hour"). An overview of the

[4] „Meetprotocol biogasinstallatie VIC Sterksel", p. 7.

operating hours for both CHPs is also recorded under the name “Operating hours CHP’s 2010 - 2016” (see Appendix D).

The methane content has been measured daily with a mobile gas analyzer, which has been calibrated annually. Since the accuracy of the methane content measurements is not secured during the monitored years between 2010 and 2016, because the daily records are only handwritten (see Appendix D “Daily rapport 2015”) but not recorded electronically (only estimation of average annual methane content feasible) and the calibration reports could not be provided for each year (see Appendix D “Calibration rapport gas analyzer - 2013), the methane content has been calculated based on the literature values, as it has been done for the biogas production and methane content from non-waste co-ferments” (please refer to section 5.1.1. of this Monitoring Report). The calculated average value of methane content in the biogas over the monitored years is 57,41% and correspond to the average value for methane content of the biogas plant in Sterksel (58%, see Appendix D “20201028_VCS_Data Inquiry_Sterksel”). Since the biogas production is calculated based on the electricity production and the methane content in the biogas, the biogas production will decrease proportionally with a higher methane content. Hence, the level of methane content in the biogas has no direct impact on the amount of emission reductions.

The heat produced by the biogas plant is used for the own process as well as for heating the pig stalls, the office buildings and since 2014, for hygienization of digestate. To measure the heat used externally, a heat meter has first been installed in 2013 and a second one in 2014. In the last monitoring (2006/2007), no heat meter was installed so that emission reductions were claimed for the substitution of natural gas by biogas with a calculation based on historic fossil fuel consumption. The project proponent has decided not to claim any emission reduction for the substitution of fossil fuel for the current monitoring period, as the work efforts to calculate the emission reductions and collet the necessary documents and evidence are economically not viable.

The co-ferment substrates entering the biogas plant are weighed at the suppliers’ site with calibrated weighing scales according to the legal metrology in the Netherlands. The delivery receipts of each substrate delivered are stored in folders on the plant’s site. The amounts of co-ferments are electronically logged in excel files named “Aanvoer co-producten [year]” (see Appendix D) and as overview for the monitoring years (see Appendix D “Overview co-products for 2010-2016”). Since 2012, the amounts of co-products are also recorded in the annual measurement reports, which are verified and certified by Fudura BV (see Appendix D “Meetrapport [year] VIC Sterksel”).

The amounts of manure coming from external farms entering the biogas plant are weighed at the suppliers’ site with calibrated weighing scales according to the legal metrology in the Netherlands. Those amounts of manure are recorded online via the official program from the Dutch National Service for Enterprise (Rijksdienst voor Ondernement RVO), that records all the nutrients shifts and flows between farms under minj.rvo.nl (see Appendix D “Supply manure

2010-2011_rvo"). Since 2012, the amounts of external manure are also recorded in the annual measurement reports, which are verified and certified by Fudura BV (see Appendix D "Meetrapport [year] VIC Sterksel"). The manure coming from the project's owner farm is calculated based on the number of animals at the time the biogas plant is fed.

The emergency boiler has only been used in 2006 to heat the digester to launch the biogas process. After the successful warming up of the installation, the plant has used the own heat produced to keep the digesters warm. The boiler was disconnected after the launching phase of the project. Hence, the emergency boiler has not been used during the current monitoring period, as attested by the heating company Heesmans Installatie Techniek B.V. (see Appendix D "Attestation_boiler not used_Heesmans").

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

5.1.1 Manure management systems and agricultural/ food wastes

The methane emission reduction through the project activity is calculated according to the small-scale Methodology AMS III D, as per the registered PDD Section D with the following equation:

$$GHG_{red,\,IIID} = AF \bullet (BGP \bullet MC - \Sigma\, BGCO_i \bullet MCCO_i) \bullet D \bullet GWP_{CH4}$$

With:

$$AF = 1 - dm_{nw,\,i} \,/\, (dm_{manure} + \Sigma\, dm_{nw,\,l} + \Sigma\, dm_{w,\,j}) \bullet 0{,}1$$

Where:

$GHG_{red,IIID}$	is the annual emission reduction through methane recovery, in t CO_{2e}
BGP	is the total annual biogas produced by the project activity BGP, in Nm^3
AF	is an adjustment factor, which ensures a conservative estimation of the realized emission
$dm_{nw,l}$	is the dry matter of the proceeded quantity of non-waste co-ferment i

dm_{manure}	is the dry matter of the proceeded quantity of manure
$dm_{w,j}$	is the dry matter of the proceeded quantity of waste co-ferment j
$BGCO_i$	is the annual biogas portion of the total biogas amount produced, caused by a digested non-waste co-ferment i if applied, to be determined by the appropriate input amount (MCOFi) and the specific gas productivity of the non-waste co-ferment i, in m^3
MC	is the average annual methane content in the biogas, in Nm^3 methane / Nm^3 biogas
$MCCO_i$	is the average methane content arising in the biogas through digesting a non-waste co-ferment i, in Nm^3 methane / Nm^3 biogas
D	is the density of methane, set to 0,7168 kg CH_4 / Nm^3 CH_4 according to ACM0001
GWP_{CH4}	is the Global Warming Potential of methane, set to 25 t CO_{2e} / t CH_4 according to UNFCCC

The calculation of the methane emission reductions bases on the total amount of methane produced in the biogas plant, from which the amount of methane produced out of non-waste is deducted, because only the emission reductions caused by manure and waste, that would have otherwise been left to decay, are taken into account.

The co-ferments intended to be fed into the biogas installation are separated into waste and non-waste co-ferments:

- the waste co-ferments have been left to decay on landfills in the baseline scenario
- the non-waste co-ferments are substrates that would not have been landfilled in the baseline scenario since these substrates could be used as animal feed.

Biogas flow (BGP) and Methane content (MC)

Since the biogas flow BGP could not be directly recorded, BGP is calculated following a reference method described by the CCX Agricultural Methane Gas Project Guidelines and used in different similar climate protection projects. The produced electricity and methane content of the biogas are used to calculate the biogas flow as follows:

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

with:

- BGP: Biogas produced [m³]
- EEP: Electricity energy produced [MWh]
- ETACHP-el Electric efficiency of the CHP engines [%] (Ref.: engine data sheet)
- HVBiogas Caloric value biogas [kWh/m³]:

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

with:
x_{CH4}: = CH_4 volume content of biogas flow [%]

Methane is the component that determines the calorific value of biogas. The net calorific value of methane has been derived from common stoichiometric combustion calculation of methane under normal conditions: 802,6 kJ/mol / 0.02241 m³/mol = 50,01 MJ/kg = 0,01 MWh/m³ [5]. Hence, the calorific value of biogas is given by the multiplication of 0,01. As described under *4.3. Monitoring Plan* of this Report, the methane content has been calculated based on literature values.

To calculate the biogas production, the electricity production and the electric efficiency of the CHP is needed. The electricity production of the biogas is measured by an electric power meter at the CHP. The electric meters are sealed and maintained by an independent and qualified company, Fudura B.V. As the measurements for the amounts of electricity produced are the base for the feed-in tariff, the value measured can be stated as very accurate.

The efficiency of the CHP engines is taken from the data sheet of the CHPs (see Appendix D "Technical data CHP Jenbacher" and "Technical data CHP MAN"). An average weighted efficiency has been calculated for each year. The efficiency value of a CHP in the technical data sheet of the CHP manufacturers is the highest the CHP engine will have in practice. Consequently, this value has a conservative impact on the emission reductions because a higher efficiency value leads to less emission reductions.

Using the formula above, the biogas flow in the monitoring years 2010-2016 is represented in the following table and detailed below for the year 2014:

BGP = 4.321.850 kWh / (0,395 * 5,74 kWh/m²)

= 1.905.686 m³

[5] Source: HAHNE: Technische Thermodynamik, (ISBN 348659231-9), page 406

Year	Electricity produced [kWh]	Weighted average Methane content [%]	Calorific value [kWh/m³]	Efficiency	Biogas Flow [m³]
	EEP	x_{CH4}	HV_{Biogas}	ETA_{CHP-el}	BGP
2010	3.550.349	56,31	5,63	0,395	1.597.021
2011	4.906.766	57,42	5,74	0,395	2.164.253
2012	3.850.823	58,56	5,86	0,395	1.665.429
2013	4.877.331	57,34	5,73	0,395	2.154.193
2014	4.321.850	57,44	5,74	0,395	1.905.686
2015	4.886.926	56,65	5,66	0,395	2.184.967
2016	1.558.884	56,77	5,68	0,395	695.444

Table 2: Calculated biogas flow (BGP) from electricity production per year

Biogas flow (BGCO) and Methane content (MCCO) from non-waste substrates

The biogas flow and methane content from non-waste substrates are calculated based on the data provided by literature mainly from the "Bayerische Landesanstalt für Landwirtschaft (Lfl)"[6]. Lfl data and calculation methods are recognized and commonly used as reference values in practice in the biogas field. Two other sources have been used, where the biogas production or methane content of specific substrates could not be found in the Lfl: "Gaserträge und Nährstoffgehalte - Abfall (Archea)"[7] and "Ökostrom Schweiz". Both references base also on officially recognized sources and are also used for GHG emission reduction projects on both the voluntary and the mandatory markets.

To calculate the biogas potential and methane content of the biogas, the values for dry matter, organic matter, biogas production from dry matter and methane content from the non-waste co-ferments (as well as from waste and manure for cross-check reasons) are needed and taken from the described sources above. Where no precise data for specific substrates were available, the co-ferment has been analyzed and the highest values from a substrate with similar specifications has been taken to calculate the biogas potential and the methane content of the biogas, in order to maintain the principle of conservativeness.

The values for BGCO and MCCO from non-waste co-ferments of the year 2014 are presented in the table below (the values for the remaining years of the present Monitoring are presented under Appendix C in the attached calculation spreadsheet):

[6] https://www.lfl.bayern.de/iba/energie/049711/

[7] https://www.archea-biogas.de/_mediafiles/9-substrate.pdf

	Substrate	Amount	Dry matter (dm)	Organic dm (odm)	Total dry matter	Biogas production from odm	Biogas production from fresh mass	Methane content	Biogas potential from substrate "i"	Methane potential from substrate [x]
		[t]	[%]	[%]	[t]	[m³/ t odm]	[m³/ t fresh mass]	[%]	[m³]	[m³]
NON-WAS	Corn silage	500	33,00	95,80	165,00	586,10	185,29	52,20	92.645	48.361
	Grain	867	40,00	93,90	346,80	518,70	194,82	52,30	168.912	88.341
	Potato starch	151	83,60	99,50	126,24	728,10	605,65	50,00	91.453	45.726
WASTE	Cocoa products	579	90,40	92,00	523,42	412,90	343,40	55,30	198.829	109.952
	Food waste	2.674	15,60	86,60	417,14	681,40	92,05	60,20	246.154	148.184
	Glycerine	1.115	100,00	99,50	1.115,00	850,00	845,75	50,00	943.011	471.506
	Plant fat	1.234	95,00	92,00	1.172,30	500,00	437,00	56,00	539.258	301.984
	Vegetable waste	59	15,00	76,00	8,85	500,00	57,00	56,00	3.363	1.883
	Whey waste	992	5,60	88,80	55,55	742,30	36,91	53,50	36.618	19.591
MANURE	Liquid - pig	10.043	6,00	85,00	602,58	400,00	20,40	60,00	204.877	122.926
	Liquid - cattle	470	10,00	85,00	47,00	400,00	34,00	55,00	15.980	8.789
	Solid - pig	145	22,50	82,50	32,63	400,00	74,25	60,00	10.766	6.460
	Solid - cattle	3.613	25,00	80,00	903,25	450,00	90,00	55,00	325.170	178.844
	Total	**22.442**			**5.516**			**57,44**	**2.877.036**	**1.552.547**

Table 3: Input substrates and their biogas and methane potential in 2014

As described under *3.1.1. Methodology deviation* of this Report, the conservativity factor of 0.5 has been applied on the calculated emission reductions to compensate the risk for an over-estimation of the emission reductions

The application of the formula above and of the factor of conservativity results in emission reductions due to the project activity *Methane Recovery Project Sterksel* in the Monitoring year 2014 of:

$GHG_{red, IIID}$ = 0,9884 * (1.905.686 m³ * 57,44 % - 353.010 m³ * 52,04 %) * 0,0007168 t CH_4/m³ * 25 * 0,5

= 8.067 t CO_2e

2014			
Parameter ID	**Value**	**Unit**	**Description**
AF	0,9884	#	Adjustment factor
$dm_{nw, i}$	638,04	t	Dry matter of the proceeded quantity of non-waste co-ferment i
$dm_{w, j}$	3.292,26	t	Dry matter of the proceeded quantity of waste co-ferment j
dm_{manure}	1.585,46	t	Dry matter of the proceeded quantity of manure
BGP	1.905.686	m³	total annual biogas produced by the project activity
MC	57,44	%	average annual methane content in the biogas
$BGCO_i$	353.010	m³	Portion of biogas from co-ferments
$MCCO_i$	52,04	%	Methane content of co-ferments (weighted average)
D_{CH4}	0,0007168	t CH_4/m³	Density of methane
GWP_{CH4}	25	#	Global Warming Potential of methane
KF	0,5	#	Factor of conservativity
$GHG_{red, IIID}$	**8.067**	**t CO_2e**	Annual emission reduction through methane recovery

Table 4: Emission reductions through methane recovery in 2014

The emission reductions through methane recovery for the remaining years of the Monitoring are presented under Appendix C in the attached calculation spreadsheet ("ER *Year*").

5.2 Project Emissions

The oil-fired emergency boiler has not been used during the actual monitored period from May 1st, 2010 to April 30th, 2016. Hence, no emission by this source of the project activity occurred.

The project emissions from transport of biomass due to the combustion of fossil fuels is not considered, since the emissions from transportation are below 1 % of total emission reductions by the project and do not exceed the criterion for significance. The calculation of the emissions from truck transportation for manure are based on the transport load in tonne kilometre and the respective GHG emissions per tonne kilometre as follows:

MANURE in 2014	Amount	Source	Distance from biogas site	Transport load
Livestock	[t/a]	[own or external]	[km]	[t km/y]
Liquid - pig	2.243	external	30	67.290
Liquid - cattle	470	external	30	14.100
Solid - pig	145	external	30	4.350
Solid - cattle	3.613	external	30	108.390
TOTAL	6.471			194.130

Table 5: Transport load for all manure type in 2014

All the manure is coming from Noord Brabant, approximately 20-30 km radius from the biogas installation. In order to be conservative, a distance of 30 km from the biogas site has been chosen.

Due to the fact that the GHG emissions for a 12-24 t lorry using diesel are 204 g CO_2e/t km[8], the project emissions from truck transportation for manure in 2014 are:

$PE_{Transport,2014}$ = 194.130 t km * 204 g CO_2e/t km / 1.000.000

= 40 t CO2e

Since the baseline emissions of the year 2014 were 8.067 t CO_2e, the transport emissions make up 0,49 % of those. Hence, no emission by this source of the project activity has to be considered.

CH_4 emissions from physical leakage of biogas in the manure management systems, which includes production, collection and transport of biogas to the point of combustion or gainful use of the anaerobic digester, have to be considered. Those project emissions have not been considered during the last monitoring period. This is due to the fact, that the Carbon Consultant in charge of the Monitoring at that time was not aware of the existence of physical leakage from biogas plant. He has correctly followed the Monitoring Plan defined in the PDD. The current Monitoring Report has been established by a different Carbon Consultant, who has worked for years in the field of biogas as project developer as well as Carbon Manager for similar emission reductions projects from methane recovery. The biogas practice as well as corresponding methodologies regarding methane emissions from manure management systems have been considerably developed over the last 15 years. The practice has shown that few emissions from physical leakage of biogas on the plant can potentially occur. The CDM Methodology AMS III.AO

[8] Calculating GHG emissions for freight forwarding and logistic services in accordance with EN 16258, European Association for Forwarding, transport, logistics and customs services, p. 11, https://www.dslv.org/dslv/web.nsf/gfx/1090CAF3225E6AF241257BB70077B20E/$file/DSLV-Leitfaden%20engl.%20Berechnung%20von%20THG-Emissionen%20Stand%2003-2013.pdf

"Methane recovery through controlled anaerobic digestion", Version 01[9], suggests estimating these project emissions using a default factor of 0,05 m^3 biogas leaked/m^3 biogas produced. Considering experience from practice, this value can be addressed as too high. The system of the biogas plant starting at the input of manure is gastight. The operator has an interest to keep the system gastight for security reasons, but also because biogas is the fuel that runs the engine and creates the income. Severe discrepancies between the biogas potential of the substrates and the produced electric energy would become apparent to the operator. Nevertheless, since no measurements of leaked methane on the plant are available, the proposed calculation for Project Emissions from physical leakage of biogas has been taken over, so that the principle of conservativity can be kept.

The calculation of the Project Emissions from physical leakage for the project Sterksel is shown is the table below with following equation (with the year 2014 as example):

$$PE_{phy\ leakage,2014} = 1.905.686\ m^3 * 0,05 * 57,44\% * 0,0007168\ t\ CH_4/m^3 * 25 = 981\ t\ CO_2e$$

Year	Biogas Flow [m^3]	Default factor [m^3 biogas leaked/m^3 biogas produced]	Biogas leaked [m^3]	Methane content of biogas [%]	Density of methane [t CH_4/m^3]	Global Warming potential of CH_4	Project emissions [t CO_2e]
	BGP			MC	D_{CH4}	GWP_{CH4}	$PE_{phy\ leakage}$
2010	1.597.021	0,05	79.851	56,31	0,0007168	25	806
2011	2.164.253	0,05	108.213	57,42	0,0007168	25	1.114
2012	1.665.429	0,05	83.271	58,56	0,0007168	25	874
2013	2.154.193	0,05	107.710	57,34	0,0007168	25	1.107
2014	1.905.686	0,05	95.284	57,44	0,0007168	25	981
2015	2.184.967	0,05	109.248	56,65	0,0007168	25	1.110
2016	695.444	0,05	34.772	56,77	0,0007168	25	354

Table 6: Project Emissions from physical leakage during the monitoring period 2010 - 2016

5.3 Leakage

According to the PDD section E.2., no leakage has to be considered.

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)

[9] https://cdm.unfccc.int/filestorage/C/D/M/CDM_AMSU745LJQM81SDJJOJ2S4G7ID9EIKFGD/EB58_repan16_AMS-III.AO.pdf?t=aWx8cWF6bDdlfDC8bL3Q3JMGdSFxjetuSlEX, Page 6

Year 2008	0	0	0	0
Year 2009	0	0	0	0
Year 2010	4.382	806	0	3.576
Year 2011	8.108	1.114	0	6.994
Year 2012	6.516	874	0	5.642
Year 2013	7.521	1.107	0	6.414
Year 2014	8.067	981	0	7.086
Year 2015	5.344	1.110	0	4.234
Year 2016	2.439	354	0	2.085
Total	42.377	6.346	0	36.031

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	"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
verrekend in de emissies. Het blijkt een complex onderwerp (met plussen en minnen), dat waarschijnlijk in de NIR 2019 zal worden doorgevoerd."	emissions. It turns out to be a complex topic (with pluses and minuses) that will probably be implemented in the NIR 2019."

APPENDIX B: PROJECT REVIEW REPORT

For further information about the increase of manure amounts during the project activity, please refer to the Project Princepeel in the “Project Review Report of the Methane Recovery Project Princepeel Wilbertoord” under Finding 3, page 7.

For further information about the electricity meters and their accuracy, please refer to the Project Princepeel in the “Project Review Report of the Methane Recovery Project Princepeel Wilbertoord” under Finding 1, page 3.

APPENDIX C: SPREADSHEET WITH CALCULATION OF EMISSION REDUCTIONS

APPENDIX D: MONITORING PLAN - DOCUMENTATION

1. Proof of operation stop of the CHPs with the end of maintenance contracts named “Beeindiging contract Jenbacher” and Beeindiging contract MAN”
2. Daily records of the main data process i.e. methane content in “Daily rapport 2015”
3. Calibration reports for gas analyzer named “Calibration rapport gas analyzer - 2013”
4. Filled questionnaire with project data, i.e. average methane content “20201028_VCS_Data Inquiry_Sterksel”
5. Inaccuracy of CHP runtime counters under “Runtime counter - Accuracy - Jenbacher”
6. Records of the monthly production rates for the year 2010 till 2012 provided by Agentschlap NL and CertiQ named “Production data Jenbacher [year]”, “Production data MAN [year]” and “Production data 2011 Sterksel_CertiQ”
7. Records of the monthly production rates for the year 2013 till 2016 certified by Fudura BV named “Meetrapport [year] VIC Sterksel”
8. Email information about operation, maintenance and calibration of electric meters complying with MID according to Fudura adviser named “Fudura_Electric meters”
9. Reports containing information about electricity and heat production, their technical description, the monitoring methods as well as the accuracy class of the CHPs’ power meters named “Meetprotocol biogas installatie VIC Sterksel”
10. Runtime hours recorded annually on the invoices for maintenance of the CHP manufacturer named “MAN [year] - Runtime hour”, “Jenbacher [year] - Runtime hour” as well as recorded daily in the operation manual named “MAN and Jenbacher [year] - Runtime hour”
11. Overview of the operating hours for both CHPs recorded in excel under “Operating hours CHP’s 2010 - 2016”
12. Amounts of co-products logged in annual excel files under “Aanvoer co-producten [year]”
13. Overview of co-products fed into the biogas plant over the current monitoring period named “Overview co-products for 2010-2016”
14. Manure amounts recorded online via the official program that records all the nutrients shifts and flows between farms under minj.rvo.nl “Supply manure 2010-201_rvo”
15. “Attestation_boiler not used_Heesmans”

16. Electric efficiency of project's CHPs named "Technical data CHP Jenbacher" and "Technical data CHP MAN".

APPENDIX E: REQUEST FOR EXEMPTION FROM QUANTITATIVE MONITORING FOR THE CREDITING PERIOD FROM 01/01/2008 TO 30/04/2010