JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE PROJECTS
Version 01.1 - in effect as of: 27 October 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	19.03.2007	Draft version
02	07.05.2007	First Issue to Determination Body
03	22.06.2007	Second Issue to Determination Body
04	28.06.2007	Third Issue to Determination Body

SECTION A. General description of the small-scale project

A.1. Title of the small-scale project:

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Methane Recovery Project Cleanergy Wanroij, North Brabant, The Netherlands,
Also locally known and herein referred to as "Cleanergy Project" or "the Project".

A.2. Description of the small-scale project:

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General Background

Agricultural operations have been shaping the landscape and the way of life in the Dutch Provinces of North Brabant and Limburg for several hundred years. Until today, this is a mostly rural region with relatively little heavy industry, where agro-swine industry still plays the significant role. Indeed, these provinces house the majority of swine farms in Holland. This concentration of livestock has already led to a situation in which the complete manure cannot be disposed off on fields in the region any more due to the reached nitrogen absorption limit of the soil.

While elsewhere agro-industries matured and large scale single operations developed to realize economies of scale, North Brabant still has in its majority only few big farms compared to those in other parts of Europe - not to mention the agricultural structure of North America. Instead, the region around Wanroij is housing numerous medium-sized farms. Concentration in the agricultural sector is rather expressed in the economic and administrative merger of various operations of small to mid-scale which are scattered within a radius of few kilometres. These single stables would then be operated by one company or belong to a group of companies with certain central activities such as food purchase, storage and preparation.

The swine operations are ubiquitous and play a significant role in the local economy of North Brabant. Environmental consequences, such as greenhouse gas emissions, odour, and water/land contamination (including seepage, runoff, and over application), that result from storing and farmland application of animal manure, are eminent in case of the traditional open-air storing of manure and applying it to fields unprocessed. Due to this over supply of manure in the region a large percentage of it cannot be applied to the fields in the region any more and must be transported to regions with soils still having a demand for fertilizers.

Figure 1 - Photo of Typical Settlement Structure in North Brabant and Limburg

Purpose of the Cleanergy Project

The proposed project activity is a Combined Heat and Power Plant that will utilise biogas produced by efficiently managing and upgrading the existing manure system and drastically reducing the open storage dwell time of the manure produced.
Main objective of the project activity is the technical production of biogas using cattle and pig manure that otherwise would emit uncontrolled methane emissions into the atmosphere during their storage. Another objective of the project activity is to mitigate GHG emissions by replacing fossil fuels in the foreseen hygienization system by waste heat. Instead of the fossil fuel waste heat from the biogas fired CHP motor will be used for this thermal application. The waste heat from the CHP motors is also heating the power plant buildings itself, but since the building is project dependant this waste heat utilization for space heating is not considered herein to be GHG reduction relevant. Additionally, renewable energy is produced to be fed in the local power grid.

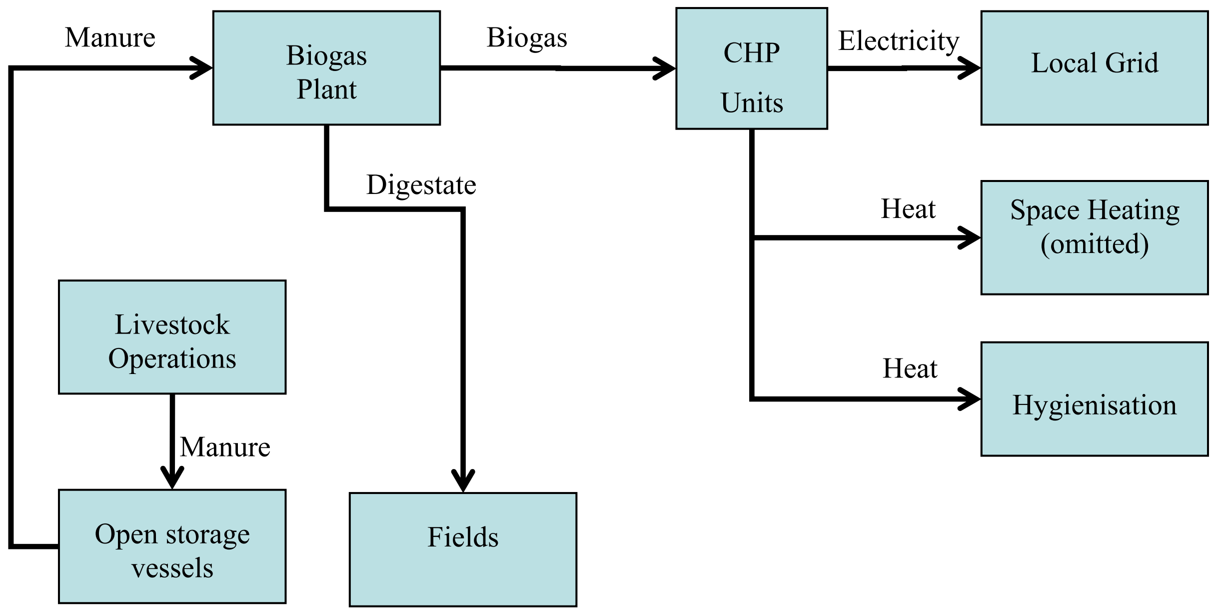

Figure 2 - Layout of Project Activity

The biogas plant receives cattle and pig manure from about 30 separate farm operations located in the near vicinity of the project site. Without this project activity the pig manure would continue to be stored in open storage tanks over roundabout 6-9 months before being used as fertiliser for farm lands. The cattle and pig manure when kept in open-top basins, tanks or lagoons open to the atmosphere will undergo anaerobic fermentation and release greenhouse gases (methane, CO_2 and N_2O) to the atmosphere and also produce bad smell for the neighbourhood. Nitrogen when applied to the fields in excess would contaminate the soil and the ground water.
The substrate or digestate after extracting the biogas can be used as a fertiliser due to the high ammonia content. But, after the fermentation process the ammonia is mineralized and does behave better in the soil with regards to ground water contamination and application to growing plants. Hence, the biogas installation not only reduces the GHG emissions by reducing both uncontrolled methane gas emissions and the use of fossil fuels, but also contributes to an improved ecological sustainability and increased flexibility for fertilizer application to the fields.

The owner / operator of the CHP plant would the Agrokracht company established in the year 2005. The shareholders of the company are the farmers supplying their manure to the biogas power plant. The managing director is Mr. Eric Verbruggen.

Logistics of Fuel and other material
The acquisition or provision of the input substrates will be carried out by the operating company. The details of the different materials required are given below.

Material requirements of biogas plant
During the course of pre-planning of the project, the shareholders of the Agrokracht have carried out a study to identify the liquid manure quantities available for the project activity. It was inferred that a liquid manure potential of approximately 27.000 tonnes per annum would be available from the existing and planned livestock within the boundary of the project. This amount is far more than can be used by the biogas plant in phase 1.
Fig. 2 shows the manure envisaged for the biogas installation in phase 1.

Input material	Amount [t/ a] Phase 1	Percentage [%]
Cattle manure	1.000	4
Pig manure	26.000	96
Total	**27.000**	**100**

Figure 3 - Manure input envisaged for the biogas plant

Additionally, co-ferments like grass, potato shells, grains and special biogas energy mix and so on will be fed into the digester to back the input material requirements and to stabilise the digestion process.
Hence, the project proponents are sure that a sufficient quantity of manure required for the project activity is available and contracts can be executed for the supply of the same. The transportation of the manure is to be carried out by own vehicles and local transporting companies on hire while the co-ordination of the transportation is to be carried out by the operating company. There are no long term agreements/contracts with suitable producers and suppliers for the procurement of the necessary co-ferments, as this market is driven on an opportunity basis.

Economic / Social Sustainability
The project embeds itself regionally into a structure of about approximately 30 farmers as well as companies and natural persons, who are merged in the project segments ownership shareholding, financing, material flow logistics and plant enterprise/support.
The project is going to create business opportunities for local stakeholders such as biomass suppliers, transporters, bankers/consultants, equipment suppliers/manufacturers and contractors, etc. The operation of the plant requires additional skilled labour leading to the preservation and creation of jobs. Today it is expected that around 3 skilled workers are going to operate the Biogas plant. A further employment creation effect arise from the need for external service contractors e.g. for maintenance of the CHP motors. This is as well having the effect of know how dissipation and workforce education in the region as the biogas CHP motor industry is underrepresented in The Netherlands.
Biogas plants enhance the economic growth by expanding the farmers’ areas of work from cultivation and cattle/pig farming to energy production. Hence, sustainable new economic opportunities are created within the farming sector. The use of the manure and crop residues brings additional revenues to farmers. They would otherwise dump the residues or apply the manure to their lands without receiving any commercial value from it. A large portion of the manure even has to be disposed off-site against substantial fee.
Also the biogas plant requires co-ferments which is leading to the cultivation of additional lands. This is improving the economic potential of the region. Besides, it is opening up a more efficient way to utilize the energetic and commercial value of the collected agricultural and food wastes to be disposed.

Environmental Sustainability
The reduction of emissions would improve the local air quality in the entire region of the province of North Brabant which in turn would increase the quality of life of the local population. Also the livestock health is benefiting as the gas emissions in the barns would decrease.
The pig and cattle manure could cause environmental destruction if not treated and applied appropriately. If the habit of storing manure in open tanks would be continued, greenhouse effect gas (carbon dioxide, methane and laughing gas) would be continuously emitted into the atmosphere in huge amounts. They would also contaminate the ground and water when nitrogen – which is part of the manure - is discharged into the ground. Hence, proper treatment of the manure is very important. The digestion of manure in a closed and controlled technical system guarantees a significant reduction of uncontrolled methane and laughing gas emissions. It also eliminates the odorous emissions into the atmosphere occurring during the application of raw manure to the fields. The substrate of the manure after digestion contains ammonium nitrogen. Hence, the residual manure or digestate after extracting gas can be used as a substitute for the industrially produced fertilisers based on ammonium nitrogen. The project activity also avoids new uncontrolled waste and residue disposal in North Brabant.
Some of the co-ferments foreseen to be used, especially the wastes from agricultural production processes and industrial food wastes are currently commonly disposed off on waste dumps. The open rotting of this organic matter is 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.

Political Sustainability
The project enhances diversification of the sources of electricity generation and optimises the use of natural resources and wastes. Since the project activity utilise a renewable energy source, it will positively contribute towards the reduction in use of finite natural resources like coal, gas and oil minimising depletion or else increasing its availability to other important processes. Enhanced production of heat and electricity from renewable energy sources is an official objective of the European energy policy. The increase of distributed CHP generation is directly addressed in this project. It will contribute to reaching the European CO_2 reduction targets defined in the Kyoto protocol as well as the goals defined to meet energy security and environmental protection in the EU.

Technological Sustainability
The project would make use of lean and efficient technologies conserving natural resources. It is encouraging the development of modern and more efficient generation of electricity and thermal energy using biomass fuel through out The Netherlands. It is further enlarging the technical skill level and that of the available CHP technologies in The Netherlands by creating an initial market for such plants. This is fuelling the general technological development and secures the participation of the region's companies to the ongoing improvement process in the biogas power plant industry sector. Since Agrokracht is a cooperation of various farmers, the experience gained in the operation of the plant will be available to a much larger circle of market players than in the case of just a single company or private person operating the plant.

As a whole the proposed project activity significantly reduces GHG emissions and also contributes to a cleaner and safer environment. Hence, project participants consider that the project activity profoundly contribute to a sustainable development.

A.3. Project participants:
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Name of the party involved (Indicate Host party)	Private or Public entity(ies) as project participants (as applicable)	Party involved wishes to be considered as project participant(Yes/No)
The Netherlands (Host)	Agrokracht	No

A.4. Technical description of the small-scale project:

A.4.1. Location of the small-scale project:

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The project activity will take place on the estate of the project owner Agrokracht on an estate especially bought for the project more or less in the geometric centre between the different manure suppliers. This is to ensure shortest possible transport routes for the utilized manure.

A.4.1.1. Host Party(ies):

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The host party for this project activity is **The Netherlands**.

Figure 4 - Map of The Netherlands with marked project location

A.4.1.2. Region/State/Province etc.:

>>
The project will be located in North Brabant - **(Province of The Netherlands).**

A.4.1.3. City/Town/Community etc.:

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The project will be located in Wanroij.
Approximate geographical coordinates are N51°39'6" E5°50'57".

Figure 5 – Area Map with marked project site

A.4.1.4. Detail of physical location, including information allowing the unique identification of the small-scale project:

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The postal address / plant location for the Cleanergy project is :
Straatscheveld 2
5446 Wanroij
North Brabant
The Netherlands

A.4.2. Small-scale project type(s) and category(ies):

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The project activity will capture methane gas from decomposing manure of livestock farms located in the vicinity of the plant. To a much lower content, certain co-ferments from agricultural or food industry wastes are used which also emit methane when decomposing uncontrolled on the normal dump sites. Also this methane is captured and burned. Additionally, GHG's are reduced through substitution of fossil sources by utilizing of the waste heat of the biogas power plant for thermal applications such as hygienization of the digestate.

Therefore, two methodologies according to the CDM standards of the UNFCCC are used in the project. The project activities described in this document are described as

“Type III, other project activities, Category III.D, Methane recovery” (Version 11)
(referring to the capture of methane gases from decomposing manure and agricultural wastes)
“Type I, Renewable Energies, Category I.C, Thermal Energy for the user” (Version 09)
(referring to the utilization of the waste heat to replace fossil energy)

The emissions considered in this analysis include the release of methane from open anaerobic lagoons. The fugitive CO_2 generated from anaerobic digestion does not represent any difference in emission volumes between each scenario, neither the CO_2 emitted due to the combustion of the captured methane.

A.4.3. Technology(ies) to be employed, or measures, operations or actions to be implemented by the small-scale project:

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The project 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 solid food wastes, crop residues and special biogas co-ferment energy mixes. Thus the primary energy generated in the digester is biogas, which is then burned in the CHP .

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 motors. The fermenters will 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 bio-gas.
In case of a breakdown of the CHP, a fossil fired backup motor will keep the substrate on the temperature of 37-40°C to guarantee the survival of the bacterial cultures. The biogas produced during a CHP downtime is completely destroyed using a flare which is installed for that specific purpose.
The bacterial decomposition of the organic material that take 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, CO2, 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.
Several operating conditions affect the amount of the methane produced in this system: 1) the ambient temperature, 2) the lagoon temperature, and 3) residency of manure solids in its system. All theses factors affect the amount of methane emitted because they influence the growth of the bacteria responsible of the methane formation. Methane production generally increases with rising temperature and residency time.
On the other hand, the methane production is proportional to the volume of manure produced that is influenced by the manure colleting and storage system, the hygiene system, the food mix of the livestock, and of course the number, type and size of the animals.

The biogas will be directly used for electricity production (CHP plant) with a capacity of 1.064 kWel. In the current phase the project is anticipated to generate 8,4 GWh of electric power and 8,1 GWh of useable heat per year. The waste heat is used for space heating of the plant buildings and for hygienization of the digestate. The first unit of the hygienization system was commissioned in October 2006 with a capacity of 80t/d, a second unit of same capacity will be put in service in April 2007. Then the complete digestate can be heat treated before disposal.
An extension by about 1 MWel is foreseen for the end of 2008. Then also the amount of manure which can be used will be highly increased.

Associated to the smell of the manure, the piggeries provoke different types of pollution as a result of the evaporation of the volatile compounds that are harmful to human beings and animals. The most common air contaminants of the manure are ammonia, methane, H_2S, N_2O and ethanol. The gas emission can cause injury in the respiratory organs, as well as contribute to the acid rain trough ammonia emission and to the global warming.

The effluent treatment system consists of tanks in which the digestate is stored until the effluent until can be applied to the land or transported for disposal. Digestate application and irrigation will be done in surrounding fields or further away, but out of project boundaries. Here methane and nitrous oxide emissions can be considered negligible small since there are no anaerobic conditions regarding these applications.

The performance data of the entire project in the current phase is given below.

Description	Unit	Amount
Total Substrate input	to/a	45.000
Manure input	to/a	27.000
Biogas production	m^3/a	4.250.000
Combustion Energy	GWh/a	23,7
Electric power output	kW	1.064
Thermal power output	kW	1.025
Full pay load	hours/a	7.884
Electric power generated	GWh/a	8,4
Waste Heat generated	GWh/a	8,1
Useable Heat available	GWh/a	4,0

Figure 6 - Performance data of the Cleanergy Project Phase 1

A.4.4. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed small-scale project, including why the emission reductions would not occur in the absence of the proposed small-scale project, taking into account national and/or sectoral policies and circumstances:

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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 cost, poor environmental performance and high rates of GHG emissions.
Currently, the GHG's generated in the farms are neither collected nor destroyed but instead are emitted uncontrolled into the atmosphere. There are no legal requirements to change the current manure handling system in The Netherlands. And as such measures would cost money while not bringing adequate benefits to the farm there is no motivation to make an investment into a less emitting system. This can be easily seen from the fact that in the whole of The Netherlands only few handfuls of farms do exist which capture and burn the methane.
In addition various agricultural and food industry wastes are usually dumped on open waste sites. There they decompose and emit methane and other gases.

This project proposes to capture and destroy these GHG's by using it as propellant for combustion motors to produce electricity and heat. The resulting waste heat would further reduce GHG's as it would replace fossil fuels so far foreseen to be used for hygienization of the untreated manure.
If the proposed project is not developed, all greenhouse gases from the anaerobic lagoons will be emitted to the atmosphere, and no emission reductions will occur.

A.4.4.1. Estimated amount of emission reductions over the crediting period:

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According to the methodologies described in section B.2, the proposed project activity is expected to reduce 9.643 tonnes of CO_2 equivalents per annum when phase 1 is running on full load. This would result in a total reduction of 93.753 tonnes of CO_2 equivalents over the crediting period, as per the boundary definition given and thus not including e.g. reductions due to renewable energy fed into the public grid system. The emission reductions of phase 2 with the addition of a further 1 MWel generation capacity and the use of more manure is not described in the below table.
The project operation is scheduled to commence in several stages with the fermenters only slowly being loaded to full capacity. Due to this the omitted emissions in the first year of operation do not reach the design point, mostly because the manure amount which can be handled by the plant in the initial phases is lower than the design mass flow after full commissioning. Also the waste heat usage for hygienization was limited due to the late commissioning of the units.

Year of generation	**Emission reductions due to Methane capture [t CO_{2e}]**	**Emission reductions due to Waste heat usage [t CO_{2e}]**	**Total Emission reductions [t CO_{2e}]**
(May 1st) 2006	6.870	150	7.020
2007	9.139	450	9.589
2008	9.139	504	9.643
2009	9.139	504	9.643
2010	9.139	504	9.643
2011	9.139	504	9.643
2012	9.139	504	9.643
2013	9.139	504	9.643
2014	9.139	504	9.643
2015	9.139	504	9.643
2016 (Apr 30th)	3.046	175	3.221
Total estimated reductions	**92.167**	**4.807**	**96.974**
Annual average over crediting period	**9.217**	**481**	**9.697**

Figure 7 - Estimated Emission Reductions per year

A.4.5. Confirmation that the proposed small-scale project is not a debundled component of a larger project:

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The project participant is not participating in any other registered project activity (neither small-scale, nor large-scale) in the same project category or same technology/measure. The project participant is however sharing information with a group of other biogas power plant operations on an informal basis, and some of these projects are situated in the same region. But every project does have its own operator as well as its independent installation with different technology, substrate input mix, and energy and digestate usage concept.
Based on provisions for joint implementation small-scale projects (version 01) of the JISC, section 2./Debundling, Cleanergy is a true stand-alone project. Hence, the project cannot be considered as being “debundled”.

A.5. Project approval by the Parties involved:

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The stakeholder responsible for the formal approval of the biogas power plant is the provincial government of the Province of North Brabant. The initial application was lodged already in 2001, but a revision had to be made in 2003.

The biogas power plant was formally and finally approved by the authority in the year 2005.

Once the draft determination report on the project activities is available, the necessary request to issue a host country Letter of Approval will be made to the relevant Dutch authorities. Received written approvals by the Parties involved, including the necessary acceptance of the project activities as JI project, will be attached to the final PDD. Should such JI approval be denied by the Dutch authorities, the carbon credits generated from the emission reductions verified from the project activity shall be undertaken as domestic GHG offset aiming for the voluntary carbon market.

SECTION B. Baseline

B.1. Description and justification of the baseline chosen:

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According to Decision 10/CMP.1 paragraph 4 (a), the participants in JI projects may apply Baseline and Monitoring methodologies approved by the CDM Executive Board.

Therefore, the following approved CDM baseline methodologies for small-scale project activities shall be used for this project :

- **AMS-III.D Methane Recovery**
- **AMS-I.C Thermal energy for the user**

The arguments for applicability of the AMS-III.D. methodology to this small-scale JI project activity are as follows:

- The Project activity is the installation of a methane recovery and combustion system to an existing agricultural source of methane emissions
- The source of the emissions is manure and agricultural wastes
- The estimated emission reduction is less than 60.000 t CO_{2e}/a

The arguments for applicability of the AMS-I.C. methodology to this small-scale JI project activity are as follows:

- The Project activity is the installation of a renewable energy supply device that supplies individual users with thermal energy that displace fossil fuels.
- The thermal energy is used for space and water heating, food preheating and hygienisation
- The generation capacity / the thermal capacity of the CHP motor is less than 45, and even less than 15 MWth

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the small-scale project:

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Current practise in The Netherlands is the storage of manure in lagoons, basins and tanks open to the environment, so that all methane, laughing gas and other odorous and hazardous gases are emitted to the atmosphere. The Agrokracht shareholders and ferment suppliers use such anaerobic lagoons in all their barns since this concept is compliant with Dutch legislation and it represents the state of the art and least cost scenario for manure systems in The Netherlands. From economic point of view, an anaerobic lagoon is much cheaper than a biogas plant with closed fermenters.

In the present anaerobic lagoon system, the floor of the barns consist of a grid or split floor system. Thus the animal excrements are falling directly through the barns floor into a basin below the floor. The basin is therefore open to the atmosphere. Dependent on the capacity of the basin and the animal production the manure is then stored in these basins as long as possible until the basins are full. It is then intermittently flushed from the basins with the use of water and flows to a collection lagoon (or an open tank). During this storage the manure is partially digested at ambient temperature by naturally occurring anaerobic micro – organisms. This digestion is resulting in atmospheric emissions of methane, carbon dioxide, laughing gas, ammonia and hydrogen sulphide.
The manure management system proposed by the project - anaerobic fermentation - captures a significant amount of the produced a.m. gases. The fermenters consist of tanks with agitators, heat management and impermeable gas domes closed to the atmosphere. Bio gas produced is collected and then burned in CHP motors to produce electricity and heat.

The digestate is pumped in a storage tank from where it is used as liquid fertilizer on agricultural fields.

Some of the co-ferments derived from agricultural or food industry wastes are commonly disposed on open dump sites in The Netherlands. Here they would rot and emit methane to the atmosphere. Using these co-ferments from wastes in the biogas plant not only secures the utilization of this bio-energy but also the capture of the generated methane and avoidance of emissions to the atmosphere.

Within the project boundary 2 heat consumers are present : Hygienization of the Digestate and space heating of the plant buildings. Space heating is eliminated herein as the plant buildings would not have been built without the biogas power plant, so that the space heating demand solely arise from the existence of the plant. It’s consumption can thus not be counted to replace a fossil fuel.
The produced manure respectively the digestate is to be exported to Germany. Before such trans-border disposal is permitted a special heat treatment process or hygienization has to be done. For this the manure from the storage system is to be heated to and kept on 71 °C for one hour.
All these heat consumptions will completely be displaced by waste heat from the CHP motor. Consequently the GHG emissions from this application will completely be offset, as the waste heat is derived from burning greenhouse gas effect neutral biogas.

The additionality of the proposed project activities may be proven with respect to the following prevailing barriers :

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions
The production of biogas is not an economically attractive business in The Netherlands. This can be clearly seen from the fact that there are only about 40 operating biogas plants so far, and about 60 in preparation. This number is specifically much lower than the respective record of e.g. neighbouring Germany.
Other than in Germany there is no feed-in law in place offering state guaranteed long term electricity prices. Thus the operator of a biogas power plant cannot rely on a stable income stream from the sale of electricity generated in the biogas power plant. The operator is selling its power to one of the various electricity distribution companies. He does receive an annually new negotiated price for it which is depending on the market price for grey power as well as certain marketing aspects. Currently the project owner is selling the generated power to an electricity distributor who is selling its products under a green electricity label. The price received is currently around 5,0 c/kWh. Additionally under the Dutch state MEP programme the project is receiving a bonus of 9,7 c/kWhel generated for the production of the first 10 years. This contracted bonus can be reduced by the Dutch minister of economic affairs in special cases. Thereafter no further bonus is available.

In the recent past, the Dutch administration impaired the financial framework for biogas plant operators. It was ruled that plants that had not received MEP subsidies until August 18th 2006 will not be supported by the government using MEP subsidies. Plant operators who already had the needed permissions but had not finished building their plant at that date got the opportunity to participate in a 270 M€ transitional subsidy program. This

program distributed the money in a first-in-first-out principle and because of the much too small amount of distributable money, the program was largely oversubscribed after the first day of registration. Content for this program is that the plant operators receive subsidies for a maximum of 2 years (2006 + 2007) if they prove once a year that they need these subsidies. The Dutch government has not decided yet, if the biogas plants that had not finished building their installation until August 18th 2006 will be financially supported by the government after 2007 but considering the fact that the Dutch administration stopped all subventions for potential new biogas plants, they probably will not be supported any more. The Dutch government has generally not explained what its future renewable energy policy will look like.
Additional restrictioning laws have been enacted. In The Netherlands, MEP subsidies for biogas plants < 10 MW_{el} are reduced to a maximum of 7.000 hours on full load from 2007 on. All business plans for the five biogas plants have been made on the basis of nearly 8.000 hours on full load.

The investment into a biogas power plant is only made if the expected return on investment is adequate to the risk of possibly decreasing prices for the electricity sold and if the payback period is not much longer than the time in which the bonus is available.
As a benchmark for the attractiveness of an investment the following value have been set :
Return on Equity : min. 13 %/a
Further, the NPV (net present value) of the project must be positive.

The economics of the biogas plant under the project activity is as follows :

Description	Unit	Amount
Plant Capacity	kW	1.064
Annual produced electricity	GWhel	8,4
Investment Sum	Mio. €	2,87
Annual cost for co-ferments	Mio. €	0,45
Annual operating cost	Mio. €	0,25
Total Annual cost	Mio. €	0,7
Income from Electricity Sale	Mio. €	0,42
Income from Bonus	Mio. €	0,82
Income from Heat Sale	Mio. €	0
Total Annual Income	Mio. €	1,235
NPV		negative
Return on Equity	%	5

Figure 8 – Project Activity Economics without Income from Certificate sale

It can be seen from the above table that the benchmark of 13 % RoE cannot be reached. The inclusion of income from certificate sales was therefore foreseen by the project sponsors and is mandatory for a commercially acceptable situation of the plant. Also the NPV is negative. Consequently an investment into a biogas power plant is not sensible purely based on the income from electricity generation and heat sale.

Another lead indicator for the high financial risk of investing in biogas installations in The Netherlands is the fact that the Dutch banks approached for financing of the projects did not grant a project financing. The bank loans for the plants have been given to the project company but requesting direct guarantees of the biogas plant project company shareholders. So the owners of the biogas plant are liable for the complete loan with their own lands and property as the banks do not trust the biogas plant installation to be sufficient security for their loan.

(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

Up to date there are only a few handful of biogas power plants in operation in The Netherlands. Although in neighbouring Germany a high number of biogas power plants are installed and in operation, due to the economic unattractiveness nearly no biogas market exists in The Netherlands so far. Core technology, turnkey capability and O&M support are not available in The Netherlands, but have to be imported e.g. from Germany. The results are not only higher prices but also higher operational risks and performance uncertainties.

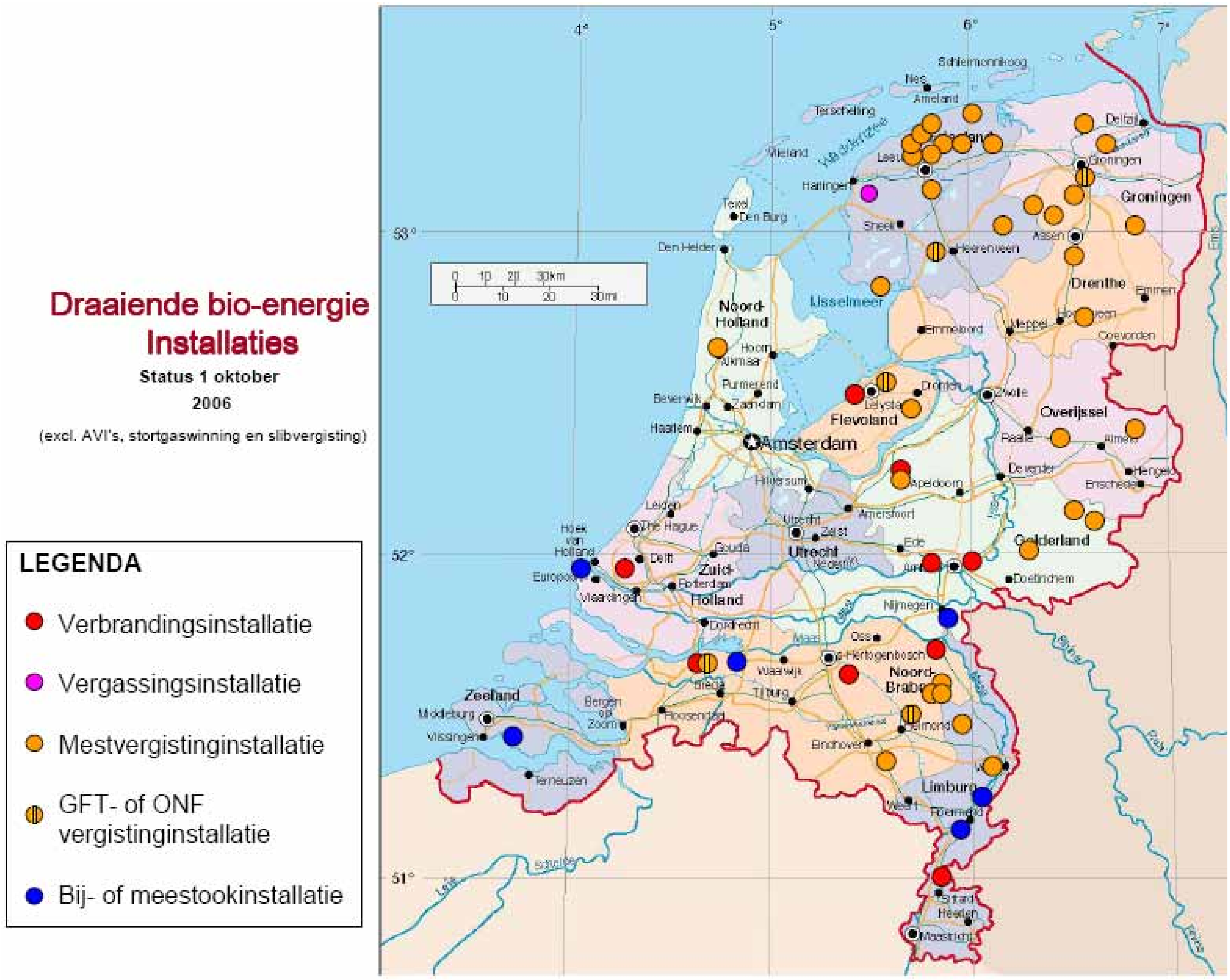

Figure 9 Operational bio-energy plants (Status October 1st 2006) Source: SenterNovem

(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

The treatment of manure is not compulsory in The Netherlands. The baseline system of manure storage in open lagoons and the subsequent disposal on fields is state of the art. Also the disposal of agricultural and food industry wastes on dump sites is common practise in The Netherlands. No political initiatives are known to make a less emitting technology mandatory in the future.

B.3. Description of how the definition of the project boundary is applied to the small-scale project:

>>
The project boundary is the physical-geographical site of the installation including its inherent and surrounding baseline sources supplying manure and co-ferments to the project, as well as grid electricity and the heat sinks provided with waste heat from the CHP engine.

Carbon emissions originating from the combustion of biogas are considered biogenic. This assumption is based on the fact that animal feeding has a renewable (and not fossil) source. The same argument is prevailing for the co-ferments.

The different emissions of the baseline could be described as follows :

- CH_4 emissions during storage of manure in open basins, tanks and lagoons
- CH_4 emissions during the disposal of agricultural and food wastes on dump sites
- CO_2 emissions during the production of thermal energy for heating and hygienization

The following emissions of the project activity have not been considered :

- Excluded : Emissions from the truck transportation of manure :

Annual quantity of manure :	27.000	tons per year,
Average distance to plant :	10	km
Resulting transport load per year :	270.000	ton km
Diesel oil consumption of truck :	0,2	l/ton km
Resulting diesel oil consumption :	54.000	l per year
Emission factor diesel oil :	2,68	kg CO_2/l
Resulting emissions :	144	t CO_2 per year,

  due to insignificant quantity (< 2% of baseline emissions)
- Excluded : Emissions during construction and installation,
  due to insignificant quantity
- Excluded : Emissions from burning biogas in the CHP engines,
  as emissions factor is zero
- Excluded : Emissions from reduced or unnecessary logistics and transport for fossil fuels displaced by waste heat or biogas,
  due to insignificant quantity
- Not occurring : Methane emissions not captured by the project and released to the atmosphere,
  due to treatment of entire manure within the project boundary as defined;
- Not occurring : Methane emissions captured but not burned, this would only happen in case of a severe process failure, monitored if occurring,
  as not part of the standard scenario
- Not existent : Emissions from combustion of non-biogenic methane,
  as no non-biogenic methane present or used
- Neutralized : emissions from displaced fossil sources through electricity produced and fed into the grid,
  as per European double allocation prohibition
- Neutralized : emissions from use of electrical energy to drive plant components, treated as fed into the grid and received back,
  as per European double allocation prohibition

- Neutralized : N_2O emissions of the manure respectively digestate during storage and application on the fields,
  as emission factor assumed to be equal

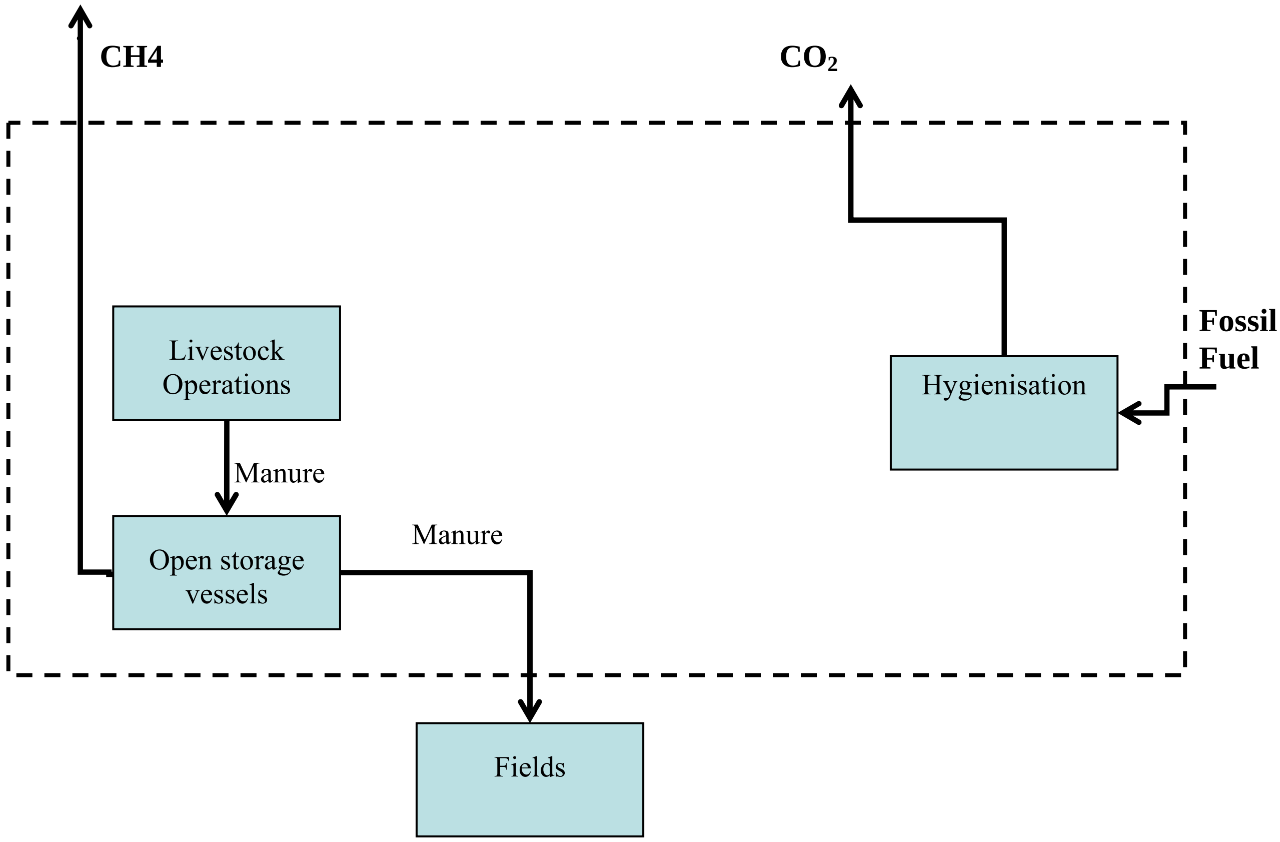

Figure 10 - Baseline Boundary

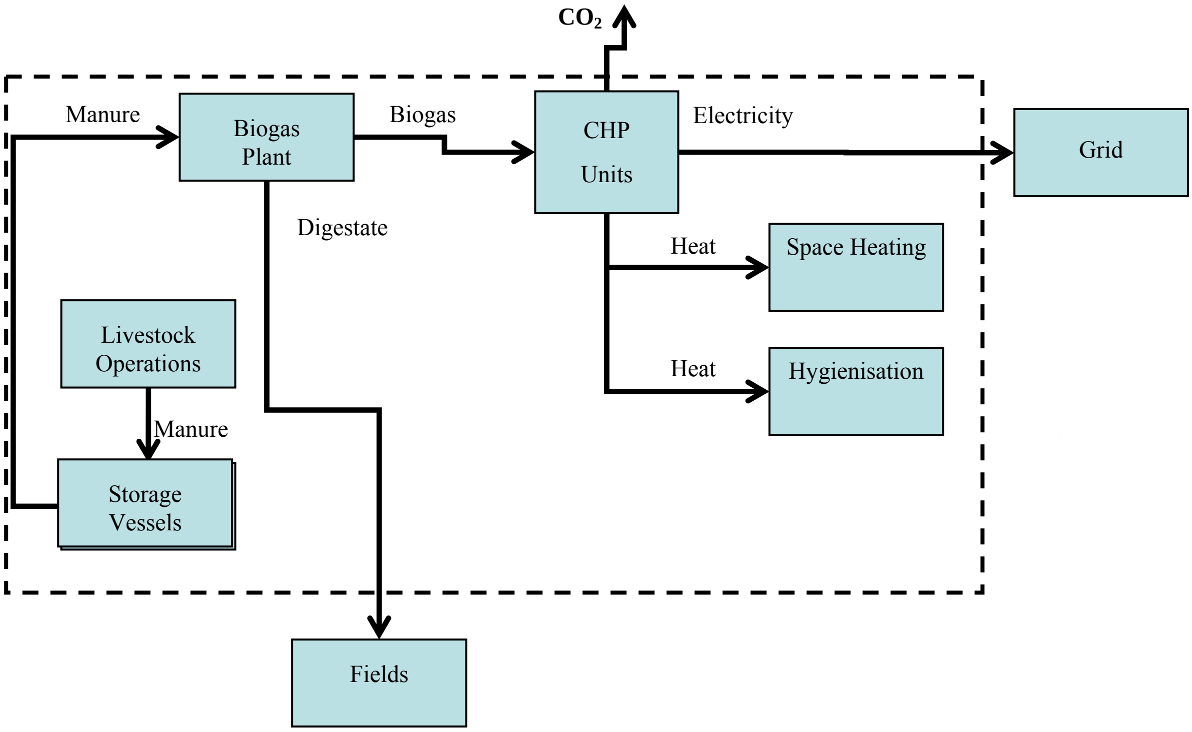

Figure 11 - Project Boundary

B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

>>

Date of completion : 7th of May 2007

Responsible person / entity for setting the baseline :
ARA Carbon Finance GmbH
Mr. Norbert Heidelmann / Mr. Rüdiger Wolf
Großer Burstah 31
20457 Hamburg
Tel. : +49 – 40 -80 90 63 105
heidelmann@ara-co2.de

SECTION C. Duration of the small-scale project / crediting period

C.1. Starting date of the small-scale project:

>>

The start of commissioning of the first phase of the project was April 2006. The project operation did commence in several stages with the fermenters slowly being loaded to full capacity. Further, the hygienization units were only commissioned in stages so that the waste heat use was limited.
Due to this the omitted emissions in the first year of operation do not reach the design point.

The starting date of the crediting period and the first monitoring period is set to 1st of May 2006.

C.2. Expected operational lifetime of the small-scale project:

>>
The expected life of this project is 20 years.

C.3. Length of the crediting period:

>>
The project will use a fixed crediting period of 10 years.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

>>
Dependent on the emission reduction targeted different methodologies and monitoring plans will be applied.

The two monitoring plans are :

AMS-III.D Methane Recovery
The simplified monitoring methodologies are going to be applied to determine and record the methane emissions caused by the manure that will be captured and destroyed by the project activity and otherwise would have been released into the atmosphere.
The amount of methane used as fuel for combustion or flared is going to be monitored, using a flow meter respectively an hour counter and analysing the methane content of the burned gases. Not only the amount of manure, but also the amounts and quality of co-ferments is monitored. The share of methane gas production resulting from fermentation of the manure and from the co-ferments derived from wastes can thus be determined from 2 ways. It is either calculated from the amount of manure and waste co-ferments used, or calculated from the total produced amount of biogas minus the calculated theoretical methane production from the other co-ferments.
In operation year 1 the flow meter is not yet available. Thus for the first year of operation the amount of biogas burned cannot be measured, but will have to be calculated from the CHP motor suppliers data sheet based on the recorded electricity generation and motor efficiency given.
From operation year 2 the co-ferment and manure scales, flow meters and gas analysers are constantly online. Their data will be stored in the plant central database. The instruments will be subject to regular maintenance, testing and calibration to ensure accuracy.

In the rare case of plant dysfunction the produced methane is burned in the flare. For counterchecking the total produced biogas with the electricity generation in the CHP motors the biogas burned in the flare must be known. For this the flare is equipped with a clock counting the operating hours. By multiplication of the operating hours with the flare nominal flow capacity the methane amount burned in the flare can be approximated.
Since this operating mode is very seldom and this value only being used as a second tier probability check the respective formulas and numbers are not presented in the below.

AMS-I.C Thermal energy for the user
The simplified monitoring methodologies are going to be applied to determine and record the thermal energy produced and delivered to the waste heat users replacing GHG emissions of the baseline.
The amount of waste heat supplied to the hygienization units will be measured by heat counters, etc. although the consumption of these units does not correspond to the baseline properties of the manure. While the baseline scenario does require only the manure to be heated up from storage = ambient temperature to 71 °C, the actual installed apparatus does heat up the complete digestate, but from fermenter exit temperature of about 36°C. Thus the monitoring of the actual thermal energy utilized in the hygienization units does not make much sense, but will be executed.
For crosschecking purpose a calculative approach was used. The energy demand for heating up a liquid from a given temperature can relatively 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.

The space heating system for the building is also not equipped with heat counters, as this thermal energy usage is to be neutralized as project this consumption would not occur in absence of the project.

The heating system of the biogas power plant is equipped with blind flanges for a mobile fuel oil fired emergency boiler system. This will ensure the temperatures in the fermenters to be kept stable in case of a CHP downtime. In these periods the fuel oil consumption is metered and recorded manually. The amount must be offset from the fossil energy replaced by the waste heat of the plant.
Since this operating mode is very seldom and this value only being used as a second tier probability check the respective formulas and numbers are not presented below.

D.2. Data to be monitored:

>>

D.2 Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number	**Data variable**	**Source of data**	**Data unit**	**Measured (m), calculated (c), estimated (e),**	**Recording frequency**	**Proportion of data to be monitored**	**How will the data be archived? (electronic/ paper)**	**Comment**
1. BGP	Biogas produced	Flow meter	Nm³	m	Continuously	100 %	Analysis report, electronic or paper	The flow meter measures data cumulative and continuously as the biogas flow is occurring.
2. MC	Methane content	Gas analyser	Vol-%	m	Continuously	100%	Analysis report, electronic or paper	This parameter determines the actual methane content in the biogas
3. FT	Fraction of time	Runtime counter	h	m	Monthly	100%	Analysis report, electronic or paper	This parameter is used to control that the biogas produced (parameter 1. BGP) is destroyed in the CHP engines
4. ETPH	Thermal energy produced for hygienisation	Heat Counter	kWh or MWh	m	Continuously	100%	Analysis report, electronic or paper	To determine the displaced fossil fuels of the baseline scenario (only for phase 2)
5. EEP	Electrical energy produced	Power meter	kWh or MWH	m	Continuously	100%	Analysis report, electronic or paper	To cross-check the biogas produced and destroyed by the CHP engines

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
6. EEI	Electrical energy imported	Power meter	kWh or MWH	m	Continuously	100%	Analysis report, electronic or paper	To ensure that the amount of EEP of the project activity exceeds the demand for its electrical energy
7. MCOFi	Mass of each co-ferment i fed into digester	Scales recording	t	m	when applicable	100 %	Analysis report, electronic or paper	To determine the portion of biogas generated by non-waste co-ferments within the entire biogas amount produced
8. MANURE	Volume of manure fed into digester	Scales recording	t	m	when applicable	100%	Analysis report, electronic or paper	To determine the portion of biogas generated by manure itself within the entire biogas amount produced
9. OIL	Oil consumed in emergency boiler	Volume scale and/or delivery receipt	m^3	m	when applicable	100%	Analysis report, electronic or paper	To calculate emissions by sources of the project activity in the emergency event of a breakdown of the biomass fired boiler

From the data recorded according to table D.2, in compliance with the applied methodologies the GHG reductions are calculated ex-post as follows :

1. Equations for CH4 emissions from manure management systems and agricultural and food wastes (AMS-III.D Methane Recovery)

The following formulas are used for the calculations :

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

With:

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

Where:

GHGred,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 Nm³
AF	is the adjustment factor, which ensures a conservative estimation of the realised emission
BGCOi	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 m³
MC	is the average annual methane content in the biogas, in Nm³ methane / Nm³ biogas
MCCOi	is the average methane content arising in the biogas through digesting a non-waste co-ferment i, in Nm³ methane / Nm³ biogas
D	is the density of methane, set to 0,7168 kg CH_4 / Nm³ CH_4 according to ACM0001
GWP_{CH4}	is the Global Warming Potential of methane, set to 21 t CO_{2e} / t CH_4 according to UNFCCC
$dm_{nw, I}$	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

*Remark: The adjustment factor is calculated annually based on the monitored amounts of proceeded manure, waste co-ferments and non-waste co-ferments using the formula above.

2. Equations for replacement of fossil fuels for hygienization (AMS-I.C Thermal Energy for the user)

No direct measurement of the heat displaced will be done. Instead theoretic values will be used based on the actual amount of manure used in the biogas plant.

The following formula is used for the calculations :

$GHG_{red, IC\_Hyg} = Fuel_{Hyg} \bullet Hu_{Propane} \bullet D_{Propane} \bullet CEF \bullet FCO \bullet 44/12 \text{ t } CO_2 / \text{ t } C_{ox}$

GHG_{red,IC_Hyg}	is the annual emission from the theoretical combustion of propane in the hygienization system, in t CO_2 = t CO_2e
$Fuel_{Hyg}$	is the theoretical average annual consumption of propane in the hygienization system, in t
$Hu_{Propane}$	is the lower heating value of propane set to 92.890 kJ/m³ (gaseous)
$D_{Propane}$	is the density of propane, set to 2,02 kg/m³ (gaseous)

CEF is the carbon emission factor for propane, set to 17,7 t C / TJ
FCO is the fraction of carbon oxidised, set to 0,995 t COx / t C according to IPCC
With

$Fuel_{Hyg} = Manure \bullet Cap_{Heat} \bullet (T_{Hyg} - T_{Inlet}) \bullet 1 / Eff_{Hex}$

Where:

$Fuel_{Hyg}$ is the average annual consumption of propane in the hygienization system, in Nm^3
Manure is the annual manure excreted from the animals in kg
T_{Hyg} is the needed hygienization temperature, set to 71 °C
Cap_{Heat} is the heat capacity of the manure to be pre-heated, set to the capacity of water 4,18 kJ/kg K
T_{Inlet} is the manure inlet temperature to the hygienization system, set to the average ambient temperature 10 °C
Eff_{HEx} is the heat exchanger efficiency, set to 88 %

3. Total emission reduction

The total GHG reduction caused by the project acitivity are determined ex-post by

$GHG_{red,total} = GHG_{red, IIID} + GHG_{red, IC}$

D.3. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

>>

The emission reduction is calculated based on monitored values, it is not directly measured. However, direct monitoring of raw manure volume or weight is foreseen. Thus the most important parameter will be directly measured.

All monitored data shall be stored electronically or on paper for at least 12 years.

A qualitative judgement of the uncertainties to be expected is given below :

Data	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1. BGP	low (approx. < 1%)	Based on inductive flow measuring, volume flow measuring is standard technique applied in industrial processes for long, no special QA/QC procedures necessary.
2. MC	low (approx. < 3%)	Determination of methane volume content is a standard analysis method for long, no special QA/QC procedures are necessary.
3. FT	low (approx. < 1%)	Runtime hour recording is a standard measurement method, no special QA/QC procedures are necessary.
4. ETP	Not used	Not used
5. EEP	very low (approx. < 0,5%)	Power meters are standard installations being highly precise, additionally referred to delivery accounting, no special QA/QC procedures are necessary.
6. EEI	very low (approx. < 0,5%)	Power meters are standard installations being highly precise, additionally referred to delivery accounting, no special QA/QC procedures are necessary.

7. $MCOF_i$	low (approx. < 3%)	High mass scales are very robust mechanical instruments being resistant of deviation within the uncertainty level, no special QA/QC procedures are necessary.
8. MANURE	low (approx. < 3%)	High mass scales are very robust mechanical instruments being resistant of deviation within the uncertainty level, no special QA/QC procedures are necessary.

D.4. Brief description of the operational and management structure that will be applied in implementing the monitoring plan:

>>
The project monitoring including the quality control and the quality assurance will be conducted by the project owner and project operator :

Agrokracht
Verlorenhoek 3
5446 Wanroij
The Netherlands

All services and on-site requirements associated with the carbon management of the project activity are supervised by :
ARA Carbon Finance GmbH
Großer Burstah 31
20457 Hamburg
Germany

In order to ensure a successful operation of the project and the credibility and verifiability of the ERU's achieved, Agrokracht recognises that the project must have a well defined management and operational system. The management and operation of the project is the sole responsibility of Agrokracht i.e. ensuring the environmental credibility of the project through accurate and systematic monitoring of the project's implementation and operation. This is also including the generation of trustworthy ERU's. ARA Carbon Finance being the carbon manager as well as independent verifiers will audit the operator and his management systems to ensure credibility and transparency of the projects reported ERU's and other performance indicators.

The person who will be legally assigned to be responsible for the performing of the entire monitoring process within Agrokracht is Mr. Eric Verbruggen, the managing director. The operative execution of the monitoring process and the quality assurance will be continuously performed by technical staff of Agrokracht under the supervision of Mr. Verbruggen.

ARA has been contracted for 10 years by Agrokracht as the carbon manager being responsible for the project determination and the implementation and maintenance of the monitoring concept.
In detail, ARA will perform the supervision of the monitoring concept including the training of the staff responsible for data recording. It will further execute the continuous evaluation of the recorded data and the preparation of the monitoring report for periodic verification and certification.
ARA assigned project manager is Mr. Norbert Heidelmann.

The following management system is proposed for internal audits on GHG project compliance, for project performance and corrective actions :

- Quality assurance and work flow :
  Routine procedures and forms will be defined and declared for mandatory use under the monitoring plan. A sign-off process on all GHG emission worksheets will be introduced.
- Data handling:
  The project operator will establish a transparent system for the collection, computation and storage of data, including adequate record keeping and data monitoring systems. Valid management process descriptions must be made available and be observed by the individual operators.
- Reporting:
  Mr. Verbruggen will prepare data compilations as needed for audit and verification purposes in due time. This will also include the preparation of a brief annual report which should include: information on overall project performance, emission reductions generated and verified and comparison with targets. The report will be combined with the periodic verification report. The official report will be prepared by ARA Carbon Finance upon the data compilation provided by the operator and later provided to the verifiers and to the Dutch JI focal point, if applicable.
- Training: ARA Carbon Finance will conduct an initial training for the Agrokracht staff on issues important to the generation of GHG. Thereafter it is the responsibility of Agrokracht to ensure that the required capacity and further training is made available to its operational staff to enable them to undertake the tasks as defined in the monitoring plan.
- Corrective Actions : ARA Carbon Finance together with the management of Agrokracht will periodically undertake performance reviews as part of its ongoing operation and management. Where corrective actions are required, eg. by complaints of the carbon manager, the Dutch authorities or the verifiers, these will be acted upon within a reasonable timescale.

A detailed Monitoring Plan will be established at a later stage.

D.5. Name of person(s)/entity(ies) establishing the monitoring plan:

>>

Organisation	ARA Carbon Finance GmbH
Address	Grosser Burstah 31
Postal Zip/city	20457 Hamburg
Country	Germany
Represented by:	
Salutation	Mr.
Last Name	Heidelmann
First Name	Norbert
Telephone	+ 49 - 40 – 809063 105
Fax	+ 49 - 40 – 809063 115
Email	heidelmann@ara-co2.de

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions and formulae used in the estimation:

>>

This section is based on the equations used on the approved consolidated methodology AMSIII.D and AMSI.C.

The following emissions of the project activity have not been considered :

- Excluded : Emissions from the truck transportation of manure :

Annual quantity of manure :	27.000	tons per year,
Average distance to plant :	10	km
Resulting transport load per year :	270.000	ton km
Diesel oil consumption of truck :	0,2	l/ton km
Resulting diesel oil consumption :	54.000	l per year
Emission factor diesel oil :	2,68	kg CO_2/l
Resulting emissions :	144	t CO_2 per year,

  due to insignificant quantity (< 2% of baseline emissions)
- Excluded : Emissions during construction and installation,
  due to insignificant quantity
- Excluded : Emissions from burning biogas in the CHP engines,
  as emissions factor is zero
- Excluded : Emissions from reduced or unnecessary logistics and transport for fossil fuels displaced by waste heat or biogas,
  due to insignificant quantity
- Not occurring : Methane emissions not captured by the project and released to the atmosphere,
  due to treatment of entire manure within the project boundary as defined;
- Not occurring : Methane emissions captured but not burned, this would only happen in case of a severe process failure, monitored if occurring,
  as not part of the standard scenario
- Not existent : Emissions from combustion of non-biogenic methane,
  as no non-biogenic methane present or used
- Neutralized : emissions from displaced fossil sources through electricity produced and fed into the grid,
  as per European double allocation prohibition
- Neutralized : emissions from use of electrical energy to drive plant components, treated as fed into the grid and received back,
  as per European double allocation prohibition
- Neutralized : N_2O emissions of the manure respectively digestate during storage and application on the fields,
  as emission factor assumed to be equal

1. CH4 emissions from manure management systems (AMS-III.D Methane Recovery)

No additional GHG emissions do occur by sources in the project scenario. The manure treatment system does not emit GHG into the atmosphere when the project is installed (with the considerations of B.3).

Therefore the annual methane emissions are reduced to **0 t CO_2e** due to the capture and disposal of methane released from stored manure and agricultural wastes.

2. Replacement of fossil fuels for heating (AMS-I.C Thermal Energy for the user)

No additional GHG emissions do occur by sources in the project scenario. The heating and hygienization heat demand is completely covered by the waste heat of the biogas power plant, and no fossil energy is burned any more. Thus no GHG is emitted into the atmosphere when the project is installed (with the considerations of B.3).

Therefore the annual methane emissions are reduced to **0 t CO_2e** due to the replacement of fossil fuels for thermal purposes such as heating and hygienization.

4. Total project activity emissions

The total GHG emissions caused by the project activity is zero.

The net GHG mitigation from the electricity approach (production amount minus operating demand) is neutralized in order to avoid conflicts with the Act of March 2006 amending the Environmental Management Act to implement the EU linking directive).
The net power balance is very positive, as the electricity production of the biogas power plant is much higher than the parasitic load of the power plant internal consumers and also much higher than the electricity consumption to be covered from the grid in case of non-operation.

E.2. Estimated leakage and formulae used in the estimation, if applicable:

>>
We suppose that no leakage calculation is required. We do not expect significant emissions generated outside the project boundary that are reasonably attributable to changes in the manure handling system.

The mechanic components of the project especially the CHP units had not been taken from an existing GHG-reducing project. Thus, no emissions caused by the cancellation of a GHG-reducing project outside the project boundaries have to be considered.

E.3. Sum of E.1. and E.2.:

>>
Since we suppose that no leakage calculation is required the sum of E.1 and E.2 is equal to E.1. = 0 t CO_2e.

E.4. Estimated baseline emissions and formulae used in the estimation:

>>
For the determination of the baseline emissions the same approved baseline methodologies are used as for determining the project activity emissions :

1. Equations for CH4 emissions from manure management systems (AMS-III.D Methane Recovery)

According to the [1]IPCC tier 2 approach, the methane emissions of an animal group calculates as follows:

$$E_{CH4,i} = VS_{i\text{-daily}} \bullet 365\ \text{days/year} \bullet B_{oi} \bullet 0{,}67\ \text{kg/m}^3 \bullet \Sigma\ MCF_{jk} \bullet MS_{ijk}$$

or

$$E_{CH4,i} = VS_{i\text{-annually}} \bullet B_{oi} \bullet 0{,}67\ \text{kg/m}^3 \bullet \Sigma\ MCF_{jk} \bullet MS_{ijk}$$

Where:

E_{CH4i} is the annual emission factor of the defined livestock population i, in kg CH_4

[1] Equation 16, page 4.26; *Revisd 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual*; Or equation 4.17, page 4.34, *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*

$VS_{i\text{-annually}}$ is the annual volatile solid excreted from animal within the defined population i, in kg

B_{oi} is the maximum CH_4 producing capacity for manure produced by an animal within the defined population i, in m^3/ kg of VS

MCF_{jk} are the CH_4 conversion factors for each manure management system by climate region k

MS_{ijk} is the fraction of animal species/category i's manure handled using manure system j in climate region k

And :

$VS_{i\text{-annually}}$ $= m \bullet dmc \bullet dom$

m is the annual incoming manure in kg/a

dmc is the average dry matter content of the manure in %

dom is the average dry organic matter content of the manure in %

With i representing the defined populations of cattle and pork and GWPCH4 representing the global warming potential of methane versus carbon dioxide, the baseline emissions through methane generated during storage of manure is finally determined through

$$GHG_{Bl,\,IIID} = GWP_{CH4} \bullet E_{CH4,cattle} + GWP_{CH4} \bullet E_{CH4,Pork} = GHG_{Bl,\,IIID,\,cattle} + GHG_{Bl,\,IIID,\,pig}$$

Applying the data according to Section E.6, the calculation delivers the annual baseline methane emissions of

9.139 t CO_2e

released from stored manure.

The baseline calculation of the emission reduction from the capture of methane coming from agricultural wastes has been excluded from this PDD. This is since the utilization of agricultural wastes was envisaged, but type and amounts not firmly contracted with such wastes having a large spread in biogas production dependent on the different types of wastes. The formulas will be developed during the monitoring phase.

2. Equation for CO_2 emissions from fossil fuels used for heating (AMS-I.C Thermal Energy for the user)

The baseline consumption for the hygienization units is derived by a simple calculation with media properties and thermo-dynamics. No historic data on fuel consumption is available as the hygienization system has only been installed after the commissioning of the biogas plant.

In the baseline the same amount of manure which is used in the biogas would have been needed to be hygienizised. In the vessel the manure is heated to 71 °C and kept on this temperature level for min. 1 hour.
The fuel consumption for hygienization is dependent on the entrance temperature of the manure into the heating vessel. In the baseline the manure would have come from the open storage lagoons, thus the inlet temperature equals to the ambient temperature. Since the energy consumption is linear to the inlet temperature the below equation is based on the annual average ambient temperature.
No natural gas pipeline is present in the vicinity of the project site nor the various farms. In the baseline case the hygienization would have been conducted with propane gas.

In accordance to the above the CO_2 emissions from the heat use in the hygienization system are calculated as follows :

GHG_{Bl, IC_Hyg} = $Fuel_{Hyg} \bullet Hu_{Propane} \bullet D_{Propane} \bullet CEF \bullet FCO \bullet 44/12$ t CO_2 / t C_{ox}

GHG_{Bl,IC_Hyg}	is the annual emission from the combustion of propane in the hygienization system, in t CO_2 = t CO_2e
$Fuel_{Hyg}$	is the average annual consumption of propane in the hygienization system, in t
$Hu_{Propane}$	is the lower heating value of propane set to 92.890 kJ/m³ (gaseous)
$D_{Propane}$	is the density of propane, set to 2,02 kg/m³ (gaseous)
CEF	is the carbon emission factor for propane, set to 17,7 t C / TJ
FCO	is the fraction of carbon oxidised, set to 0,995 t COx / t C according to IPCC

With
$Fuel_{Hyg}$ = $Manure \bullet Cap_{Heat} \bullet (T_{Hyg} - T_{Inlet}) \bullet 1 / Eff_{Hex}$

Where:

$Fuel_{Hyg}$	is the average annual consumption of propane in the hygienization system, in Nm³
Manure	is the annual manure excreted from the animals in kg
T_{Hyg}	is the needed hygienization temperature, set to 71 °C
Cap_{Heat}	is the heat capacity of the manure to be pre-heated, set to the capacity of water 4,18 kJ/kg K
T_{Inlet}	is the manure inlet temperature to the hygienization system, set to the average ambient temperature 10 °C
Eff_{HEx}	is the heat exchanger efficiency, set to 88 %

Applying the data according to Section E.6, the calculation delivers the annual baseline emissions of

504 t CO_2e

released from the otherwise fossil fuel fired hygienization system.

4. Total baseline emissions

The total GHG baseline emissions are determined by

$GHG_{Bl,total} = GHG_{Bl, IIID} + GHG_{Bl, IC}$

Adding the various emissions using the data according to Section E.6, the calculation delivers annual baseline emissions of

9.643 t CO_2e

The GHG emissions from the use of grid supplied electricity is neutralized in order to avoid conflicts with the legal act in The Netherlands of the EU linking directive).

E.5. Difference between E.4. and E.3. representing the emission reductions of the project:

>>
During an annual period, the project activity leads to emissions reductions as follows:

The net GHG mitigation from the electricity approach (production amount minus operating demand) is neutralized in order to avoid conflicts with other legal acts in The Netherlands, eg. the regulation covering the bonus payment for electricity produced from biogas as per "Regeling subsidiebedragen milieukwaliteit elektriciteitsproductie 2006" as well as the Dutch act enforcing the EU Linking Directive).

Electricity generation was accounted with an average CO_2 emission of 442 g/kWhel.

Approach	Baseline	Project Activity	Leakage	GHG Reduction
AMS IIID/ Methane [t CO_2e]	9.139	0	0	9.139
AMS IC/ Thermal Energy [t CO_2e]	504	0	0	504
Electricity [t CO_2e]	3.712[1)]	0	0	3.712
Subtotal [t CO_2e]	13.355	0	0	13.355
Neutralizing Electricity [t CO_2e]	-3.712	0	0	-3.712
Total [t CO_2e]	**9.643**	**0**	**0**	**9.643**

Thus, based on an ex-ante calculation the total accountable emissions reductions of the Cleanergy project will accrue to annually 9.643 t CO2e during normal operation in phase 1.

E.6. Table providing values obtained when applying formulae above:

>>
The below tables are presenting the input and output values for the emission calculations for the different cases during baseline and project activity.

1. Baseline Emissions

AMS III-D, Methane capture

Parameter	Symbol	Unit	Value	Reference
Transfer mass	m	kg/ a	26.000.000	Project setup
Dry matter content	dmc	kg dmc/ kg	0,07	Handreichung Biogasgewinnung und –nutzung, FNR 2004, p. 95
Dry organic matter	dom	kg dom/ kg dmc	0,86	Handreichung Biogasgewinnung und –nutzung, FNR 2004, p. 95
Volatile solid	$VS_{annually}$	kg dom/ a	1.565.200	Calculated from m, dmc, dom
CH_4 capacity	Bo	m^3 CH_4/ kg VS	0,45	Revised IPCC Good Practice Guidelines, page 4.23

Conversion factor	MCF	---	0,9	IPCC Good Practice Guidance, chapt. 4, p.4.36, "Anaerobic lagoons"
Animal fraction	MS	---	1,00	Baseline setup
Global warming Potent.	GWP	kg CO_2e/ kg CH_4	21,00	UNFCCC
Baseline emissions	**$E_{III-D,}$ pig**	**t CH_4/a**	**424,7**	**Calculated**
Baseline emissions	**$GHG_{Bl,III-D,}$ pig**	**t CO_2e/a**	**8.919**	**Calculated**

Figure 12 - Calculated Methane Baseline Emissions Pig Manure

Parameter	Symbol	Unit	Value	Reference
Transfer mass	m	kg/ a	1.000	Project setup
Dry matter content	dmc	kg dmc/ kg	0,11	Handreichung Biogasgewinnung und –nutzung, FNR 2004, p. 95
Dry organic matter	dom	kg dom/ kg dmc	0,82	Handreichung Biogasgewinnung und –nutzung, FNR 2004, p. 95
Volatile solid	$VS_{annually}$	kg dom/ a	90.200	Calculated from m, dmc, dom
CH_4 capacity	Bo	m^3 CH_4/ kg VS	0,24	Revised 1996 IPCC Guidelines, page 4.23
Conversion factor	MCF	---	0,9	IPCC Good Practice Guidance, chapt. 4, p.4.36, "Anaerobic Lagoon"
Animal fraction	MS	---	1,00	Baseline setup
Global warming Potent.	GWP	kg CO_2e/ kg CH_4	21,00	UNFCCC
Baseline emissions	**$E_{III-D,}$ cattle**	**t CH_4/a**	**13**	**Calculated**
Baseline emissions	**$GHG_{Bl,III-D,}$ cattle**	**t CO_2e/a**	**274**	**Calculated**

Figure 13 - Calculated Methane Baseline Emissions Cattle Manure

Parameter	Symbol	Unit	Value	Reference
Baseline emissions	$GHG_{Bl,III-D,}$ cattle	t CO_2e/a	274	Calculated
Baseline emissions	$GHG_{Bl,III-D,}$ pig	t CO_2e/a	8.919	Calculated
Baseline emissions	**$GHG_{Bl,III-D,}$ total**	**t CO_2e/a**	**9.139**	**Calculated**

Figure 14 - Calculated total Methane Baseline Emissions from livestock Manure

AMS I-C, Thermal energy

Parameter	Symbol	Unit	Value	Reference
Propane Consumption	Fuel	Nm³	84.000	Hygienization demand
Heating Value	$HU_{Propane}$	kJ/kg	92.890	Supplier fuel data sheet
Fuel Density	$D_{Propane}$	Kg/m³	2	Supplier fuel data sheet
Carbon emission factor	CEF	t C/ TJ	17,7	Own calculation
Fraction of carbon oxidised	FCO	kg C_{ox}/ kg C	0,995	Revised 1996 IPCC Guidelines, page 1.29, "gases"
Molaric weight ratio	F_{molar}	kg CO_2/ kg C_{ox}	3,67	44 g/mol / 12 g/mol
Baseline emissions	**$GHG_{Bl,I-C}$**	**t CO_2e/a**	**504**	**Calculated**

Figure 15 - Calculated Baseline Emissions Heat Usage

2. Emission reductions

Topic	Unit	Value
AMS III-D, Methane capture	t CO_2e/a	9.139
AMS I-C, Thermal energy	t CO_2e/a	504
Project Activity emissions	**t CO_2e/a**	**9.643**

Figure 16 – Estimated Project Activity Emission Reductions

As described before the above emission reductions are not reached in the first year of operation due to the staggered commissioning of the fermenters and CHP motors, leading to a lower manure consumption than under design point full load. Consequently to the reduced electricity generation capability, also the available waste heat will be lower than under design conditions. However, the useable or needed waste heat amount is far lower than the available energy even under theses start-up conditions. It is therefore assumed that also in the first year of operation the complete heating energy can be replaced as per design.
Further, also the hygienization system was only commissioned in 2 steps with the first unit in October 2006 and the secnd unit in March 2007. The first year consumption of waste heat for hygienization purpose is thus lower than design value.

Figure 18 is presenting the estimated manure amounts, the hygienization heat demand and the resulting emission reductions for the first year of operation.

Parameter	Symbol	Unit	Value	Reference
Transfer mass pig manure	m	kg/ a	20.000.000	Project setup
Transfer mass cattle manure	m	kg/ a	0	Project setup
Fuel Consumption Hygienization	Fuel	Nm³	25.000	Calculated data

Baseline emissions Pig manure 1st year	**$GHG_{Bl,III-D}$**	**t CO_2e/a**	**6.870**	**Calculated**
Baseline emissions Cattle manure 1st year	**$GHG_{Bl,III-D,}$ total**	**t CO_2e/a**	**0**	**Calculated**
Baseline emissions Hygienization 1st year	**$GHG_{Bl,I-C}$**	**t CO_2e/a**	**150**	**Calculated**
Baseline emissions total 1st year	**GHG_{Bl}**	**t CO_2e/a**	**7.020**	**Calculated**

Figure 17 - Calculated Baseline Emissions First Year

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

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The proposed project activity is a Combined Heat and Power Plant that will utilize biogas produced by efficiently managing the manure production within the project boundary.
The main objective of the project is to eliminate GHG emissions in the form of methane and CO_2 from pig and cattle manure stored in storage devices open to the atmosphere. Additionally a mitigation of GHG's is reached by replacing fossil fuels used to generate heat energy for certain users within the project boundary. The effect of replacing fossil fuels used to generate electricity is not counted, as this is not accountable to the methodology of a JI project in The Netherlands.

The Cleanergy project has been formally and finally approved by the responsible regional authorities of the Netherlands in accordance to 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 fermenters, CHP modules, etc.

F.2. If environmental impacts are considered significant by the project participants or the host Party, provision of conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>
According to the Dutch legislation biogas plants below a manure capacity of 30.000 t do not require a full environmental impact assessment, but an environmental impact check. The project activity falls below this limit. 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.

The authorisation process for the plant was initiated in 2001. Various applications including the environmental reports were lodged and had to be revised before the approvals for the construction and operation had been granted in 2005.

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

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The Dutch "Wet milieubeheer" environmental law and also the building law "Wet op de Ruimtelijke Ordening" implies public involvement during the authorisation process of the project. This is including the submission and public display of certain project application documents (such as plans, drawings, studies). Public stakeholders have

the right to comment on the project and apply for rejection. The public had been informed by the responsible permitting authority about the final decision and the content/reasoning of this decision. Additionally to these legal aspects, the regional press reported about the project well before it started.

All stakeholders were informed and had the chance to comment on this project and – if desired – litigate against the project at the administrative court.
No such action was taken whatsoever. Whenever stakeholders gave feedback it was very positive due to the advantageous economical and environmental consequences of the project to the region, the local economy, population and society. Several stakeholders were convinced that this project will motivate other communities throughout and even beyond the region to build similar manure utilizing biogas plants. Further, discussions with local representatives have resulted in a commitment of full support for the project.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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