



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006**

CONTENTS

- A. General description of project activity
- B. Application of a baseline and monitoring methodology
- C. Duration of the project activity / crediting period
- D. Environmental impacts
- E. Stakeholders' comments

Annexes

- Annex 1: Contact information on participants in the project activity
- Annex 2: Information regarding public funding
- Annex 3: Baseline information
- Annex 4: Monitoring plan

**SECTION A. General description of project activity****A.1 Title of the project activity:**

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Title of project activity - "Eco Energy Golan Animal Manure anaerobic treatment facility"
Version number 3
Date of completion – July 20th 2007

A.2. Description of the project activity:

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Description of the project activity:

In September 2004 Eco-Energy Golan LTd had initiated the program of collecting and treating manure from diary cow farms and poultry farms in the Golan heights and treating the manure in an anaerobic biogas facility.

The Eco-Energy Golan plant, is located in the area of the Golan Heights, which is characterized with an advanced milk production sector and high sensitivity of the gourd water due to its location near the sea of Galilee

Purpose of the project activity:

The purpose of this project is to reduce GHG emissions from animal manure management, while implementing an advanced technology of treating animal manure. The project activity aims to centralize the treatment in one complex, avoiding the percolation of polluting components in raw manure to the ground water and utilizing the biogas to generate renewable electricity to the grid.

Due to the fact that there are no regulatory requirements in Israel to mitigate the emissions of GHG (Green House Gas) from manure management in animal farms, a large amount of GHG, mostly methane, is being released to the atmosphere.

The goal of Eco Energy LTd's project activity is to:

- **Replace current** manure management systems which lead to GHG emissions through unmonitored livestock manure management.
- **Implement the technology to capture GHG emissions** from manure management in livestock farms in Israel.
- **Transfer the chlorine component in the manure** from hydrological sensitive areas to areas which are not hydrological sensitive at all.
- **Improving the quality of life of people in the villages, by mitigating odor and fly nuisance** occurring today in the area of livestock farms.
- **Contribute to Israel's renewable energy production.**

The implementation of the projects depends upon the generation of revenues from the sale of certified emission reductions (CER's), which will be used to partially finance the anaerobic digester facilities.

**Technology to be employed**

The project consists of improving in the current animal manure management and treatment which lead to the release of GHG.

The technology to be implemented is based on the anaerobic digester technology which has been implemented in facilities in Germany, Holland, Sweden and Denmark.

The following is the process of treating the manure:

- **Homogenization** - The manure entering the facility is cut, mixed and homogenized.
- **Pasteurization** – This process aims to eliminate polluting components such as pathogens in the manure before entering the digesters.
- **Anaerobic digestion** – A natural process where complex organic compounds break into smaller fractions by bacteria without any oxygen. This process reduces the organic waste volume, and generates useful byproducts such as biogas.

The expected result from this project activity will be a significant reduction in the volume of CH₄ and N₂O emissions as compared to emissions that would occur if the traditional cow manure treatment systems continue to operate.



Current situation of manure management in animal farms in Israel

A relatively high organic load, presence of pathogen viruses and high salinity characterizes animal manure.

Animal manure is a large contributor to the salting and contamination of the coast aquifer and the Sea of Galilee basin, which are Israel's largest water sources.

The Ministry of Agriculture and the water commission encourages the construction of Eco-Energy Golan anaerobic biogas plant, because the facility's operation will reduce the contamination of the underground aquifers from animal manure.

Cow Industry

The number of milking cows in Israel is about 105,000 and the annual milk production is 1,100,000 litres, which is one of the highest in the western world.

In addition to the milking cows, there are about 80,000 non milking cows situated in a proportional manner in the cowsheds.

The milking cow sector is regulated and monitored by well defined milk quota, and by setting a homogenous price per every liter of milk delivered from the cowshed.

Poultry Industry

The poultry industry in Israel is composed of **Layers, Broilers and Turkey.**

Layers

In Israel about 1,650 million eggs are produced and market every year.

About two thirds from the total egg production in Israel is in the Galilee area.

The egg production sector is a regulated and monitored by production and marketing quota, and by setting a homogenous price per every marketed egg.

Layers manure is mostly semi liquid, stored outside the farm and currently not treated. Egg production is usually done in small, family units.

Broilers

In Israel about 360,000 tons of broilers are produced and market every year.

The broiler production sector is regulated and monitored by marketing quota, but unlike the milk and egg sectors the price is not homogenous for all producers.

Turkey

In Israel about 90,000 tons of turkey are produced and market every year.

The turkey production sector is not regulated, there are no production quota, and the price per 1 KG of turkey is not defined.



Contribution of the project activity to sustainable development

The anaerobic biogas plant will treat animal manure produced in areas all around the facility and will totally change the agricultural waste treatment status in that area. The facility's operation will also contribute to the renewable energy production in Israel.

According to the Israeli DNA there are three Sustainable Development Indicators :

- **Economic and Technological impacts.**
- **Social sustainability impacts.**
- **Local/regional/global environmental impacts**

The projects contribution to Israel's sustainable development is examined with the above indicators

Economic and Technological contribution to sustainable development:

- Turning a nuisance (animal manure) into an asset (renewable energy) used to produce green electricity.
- Introducing a new and modern technology.
- Promoting a technology for reducing GHGs produced by animal manure.
- Supporting the growing tourism sector in the Golan heights area.
- Introducing of a financial model for funding animal manure treatment.

Social contribution to sustainable development:

- Creating additional employment opportunities.
- Training and educating local personnel for Operating the facility.
- High frequency manure evacuation from the villages.
- Improving in the air quality in the villages.
- Eliminating odor and fly nuisance in the villages and surrounding areas.
- Improving living standards in the villages.

Environmental contribution to sustainable development:

- Preventing the percolation of chlorine into the ground water – **since Israel has limited water resources, preventing the contamination of the underground aquifers is one of the most important contribution of the project to sustainable development.**
- Creating a decrease in the amount of GHGs emitted into the atmosphere.
- Avoiding potential dumping of waste into clean sources of water.

Environmental surveys.

The anaerobic facility gained the full approval of the Israeli Ministry of Environment only after preparing detailed environmental surveys about the construction and operation phases of the biogas facility.

In this detailed report, all the environmental impacts of both construction and operation phases of the plant were evaluated and received full approval.

**A.3. Project participants:**

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Name of Party involved (*) ((host indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Israel	Eco Energy Israel ltd	No

A.4. Technical description of the project activity:**A.4.1. Location of the project activity:**

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A.4.1.1. Host Party(ies):

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The host Country for this project activity is Israel.

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

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Facility name	Location	Coordinates (longitude and latitude)
Eco energy Golan plant	In the south area of the Golan Heights, east of the Sea of Galilee.	269,486 ; 740,727

A.4.1.3. City/Town/Community etc:

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N/A



A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

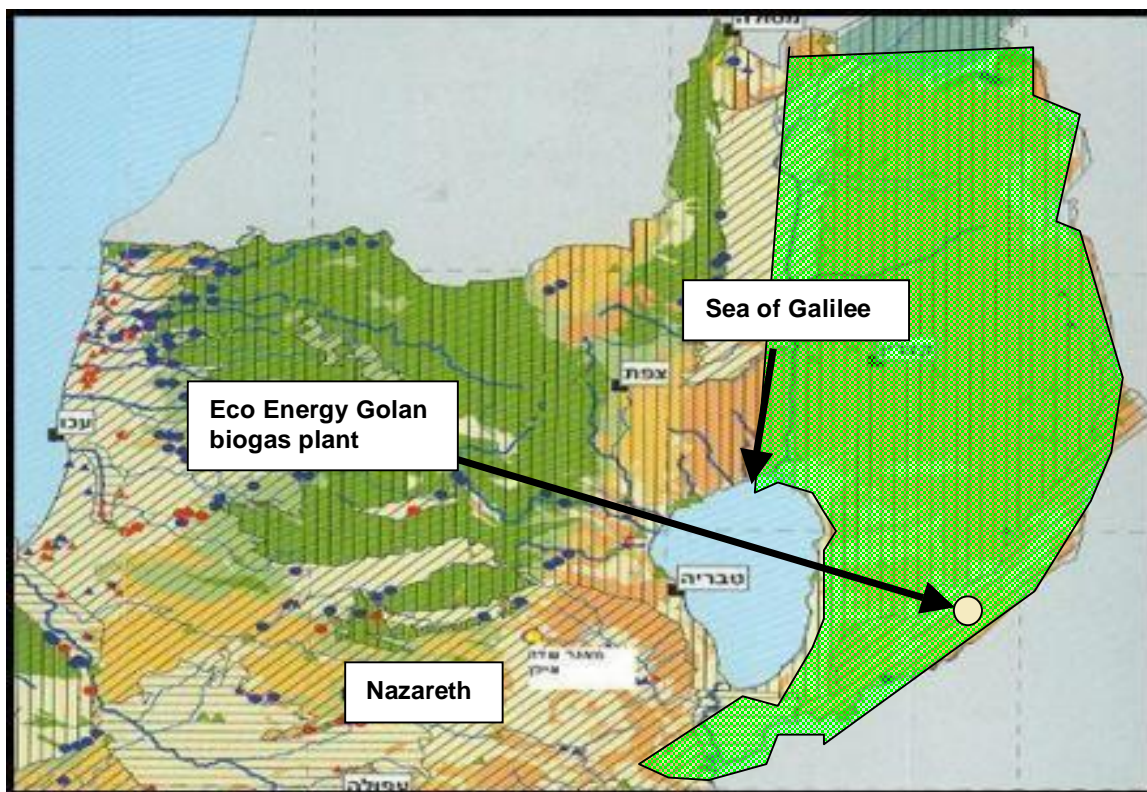
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Eco-Energy Golan plant -- is located 1 KM east of the village of Meitzar, in the south of the Golan Heights.

The facility will collect the animal manure from more than 100 farms located in more than 30 villages in the surrounding area.

The map below represents Israel's northern part and the Sea of Galilee water basin. The ground in this area is very hydrological sensitive due to the location near the Sea of Galilee, which is Israel's most important water source. The cow manure, due to the high chlorine content, contributes scientifically to the high salinity concentration in the ground water in this area.

The green area represents the locations of cow farms from where the manure will be collected to Eco Energy Golan biogas plant. Most of the area is on the East side of the Sea of Galilee basin, which is very hydrological sensitive.



**A.4.2. Category(ies) of project activity:**

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The categories utilized by the project are

Project activity	Sector	Description of the sector	Relevant GHG emissions
Preventing CH₄ emissions	Sectoral scope number 13	Waste Handling and Disposal	The release of CH₄ from the current manure management systems.
	Sectoral Scope number 15	Agriculture.	
Preventing N₂O emissions	Sectoral scope number 13	Waste Handling and Disposal	The release of N₂O from the current manure management systems.
	Sectoral Scope number 15	Agriculture.	
Renewable electricity generation	Sectoral scope number 1	Energy industries	The release of CO₂ from fossil based energy production plants.

**A.4.3. Technology to be employed by the project activity:**

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The technology to be employed by the project activity is the **Bio-Gas Technology**, known also as the Anaerobic Digesting Technology.

The anaerobic digesting technology has been implemented in many facilities in Germany, Holland, Sweden and Denmark and has the support of agriculture and environmental government offices around the globe.

The manure from the animal farms is collected and transported to the treatment plant by trucks and tractors in sealed tanks, according to a routine and frequent timetable. Poultry manure is transferred to the plant several times a year in trucks.

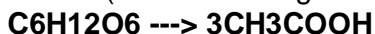
This activity includes the replacement of all current manure storage in animal farms which leads CH₄ and N₂O emissions.

The process consists of several stages as described below:

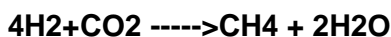
- **Receiving tank** -The manure being collected in the surrounding area enters the plant through this tank.
- **Mixing Tank** – from the receiving tank the manure is pumped to the mixing tank, where it is blended and mixed to a homogenized solution.
- **Digester** – from the mixing tank, through a series of pasteurization systems, the manure enters an enhanced concrete anaerobic digester, where it is digested for approximately three weeks at a temperature of 36° – 38° Celsius.
- **Bio-gas storage membrane** – a double layer membrane will be assembled to hold the biogas after the digestion and before entering the generators. This membrane can assure that no leakage can occur and that the quantity and quality of the gas can be controlled and monitored at any given time.
- **Biogas engines** – from the biogas storage membrane the biogas floats to the engines in order to produce green electricity. The system includes a scrubber facility which aims to clean the biogas from residues of sulfur pollutants.

Main phases in anaerobic process

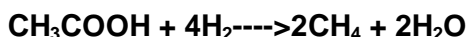
- **Phase A – hydrolysis** - Complex dissolved organic molecules are broken down into basic and smaller dissolved molecules (sugars, amino acids, fatty acids)
- **Phase B – acetogenesis** - acetogenic bacteria converts the dissolved molecules, via fermentation to acetic acid (70% of the organic matter) and hydrogen.



- **Phase C – Methanogenesis** - Anaerobic Bacteria uses hydrogen and acetic acid, as an electron donor while using Carbon Dioxide as an electron acceptor in redox processes resulting in the production of methane



Thermodynamic processes encourage acetic acid and hydrogen conversion in methane

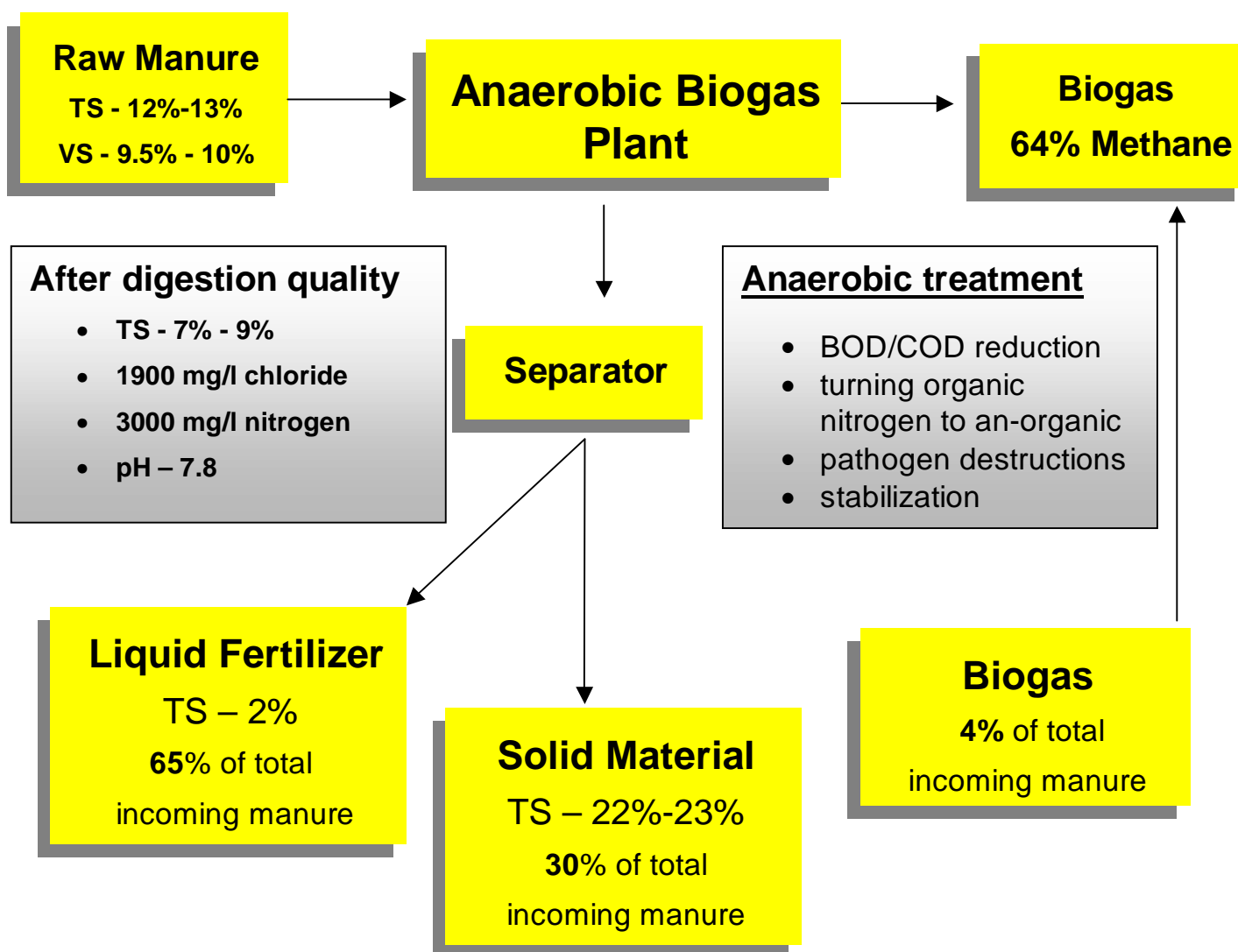




The outcomes of the manure digestion in the anaerobic digester are:

- **Fertilized water** – the liquid exiting the anaerobic digestion is sterilized and with almost no biological activity. The pathogens as like other organic components are totally destroyed. This liquid has a high fertilized component and can be used to replace some of the industrial fertilizers being used in fields around the facility.
- **Dry matter** – the dry material exiting the anaerobic plant is not active biologically, has no smell and is very dry. It can be used as an organic fertilizer or as dry matter in cowsheds.
- **Biogas** – the result of the digestion of the dairy cow manure in the anaerobic digester is the biogas. About 64% of the biogas consists of methane, 35% carbon dioxide and small percentages of hydrogen and hydrogen sulfide (H₂S)

Flow chart of the anaerobic biogas plant



**A.4.4 Estimated amount of emission reductions over the chosen crediting period:**

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The expected operational lifetime of the project activity is 25 years.

According to this, the chosen crediting period is 21 years.

The following table represents the results of the emission reduction calculation for the estimated amount of reductions over the chosen crediting period for the project.

year	Annual estimation of emission reduction in tonnes of CO ₂ e
2008	103,403
2009	103,403
2010	103,403
2011	103,403
2012	103,403
2013	103,403
2014	103,403
2015	103,403
2016	103,403
2017	103,403
2018	103,403
2019	103,403
2020	103,403
2021	103,403
2022	103,403
2023	103,403
2024	103,403
2025	103,403
2026	103,403
2027	103,403
2028	103,403
Total estimated reductions (tonnes of CO₂e)	2,171,471
Total number of crediting years	21
Annual average over the crediting period of estimated reductions (tonnes of CO₂ e)	103,403

**A.4.5. Public funding of the project activity:**

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The project will gain funding from the Israeli Ministry of Agriculture.

The grant for Eco-Energy Golan biogas project is given due to the fact that the salinity content in animal manure are transferred from hydrological sensitive areas, such as the coastal aquifer or the Sea of Galilee basin, to areas which are not hydrological sensitive. By supporting the implementation of Eco Energy's projects, the Israeli government encourages the modification of current manure management systems, where manure is stored in the farm for about 4 months and then spread in agricultural fields which are hydrological sensitive.

As explained above, the liquid exiting the anaerobic facility will be spread only in areas which are not hydrological sensitive.

In addition, the current manure management which consists on storing the manure in the farm for several months, lead to the direct release of CH₄, N₂O into the atmosphere as a result of the anaerobic digestion process that takes place inside the storage facilities.

Israel is not an Annex I party.

**SECTION B. Application of a baseline and monitoring methodology****B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:**

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The applicable approved baseline methodologies for this project are

- **“Consolidated baseline methodology for GHG emission reductions from manure management systems – version 2”** referenced as approved consolidated baseline methodology ACM0010.
The complete approved methodology can be found on the CDM-Executive Board website
- **“Grid connected renewable electricity generation – version 11”**, referenced as AMS-I.D. The latest version of the complete approved methodology can be found on the CDM-Executive Board website.

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

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The approved consolidated methodology ACM0010 was chosen because it offers a GHG emissions reduction model that characterizes the precise emission reduction that the project produces and because current manure management systems in Israel meet the applicability conditions of the methodology.

1. The animal manure collected and brought to the facility includes dairy cows and poultry.
2. The livestock population are managed under confined conditions.
3. The manure management system, as introduced in the project activity section, doesn't include the discharge of the manure into natural water resources.
4. The annual average temperature in the animal farms is higher than 5°C.
5. The minimum retention time of manure waste in the anaerobic treatment system is greater than 1 month.
6. The project activity ensures that no leakage of manure waste into ground water takes place.
7. The project aims to provide a sustaining solution for the manure, one that will improve over time, while providing economic sustainability and ensuring that mitigation measures result in a continuous and verifiable reduction of GHGs.

With regard to the "grid connected renewable energy production" , the methodology that was chosen is for small scale projects since the project would produce less than 15MWh of electricity.



B.3. Description of the sources and gases included in the project boundary

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For the purpose of calculating project emissions and baseline emissions, the project boundary was described using the charts below.

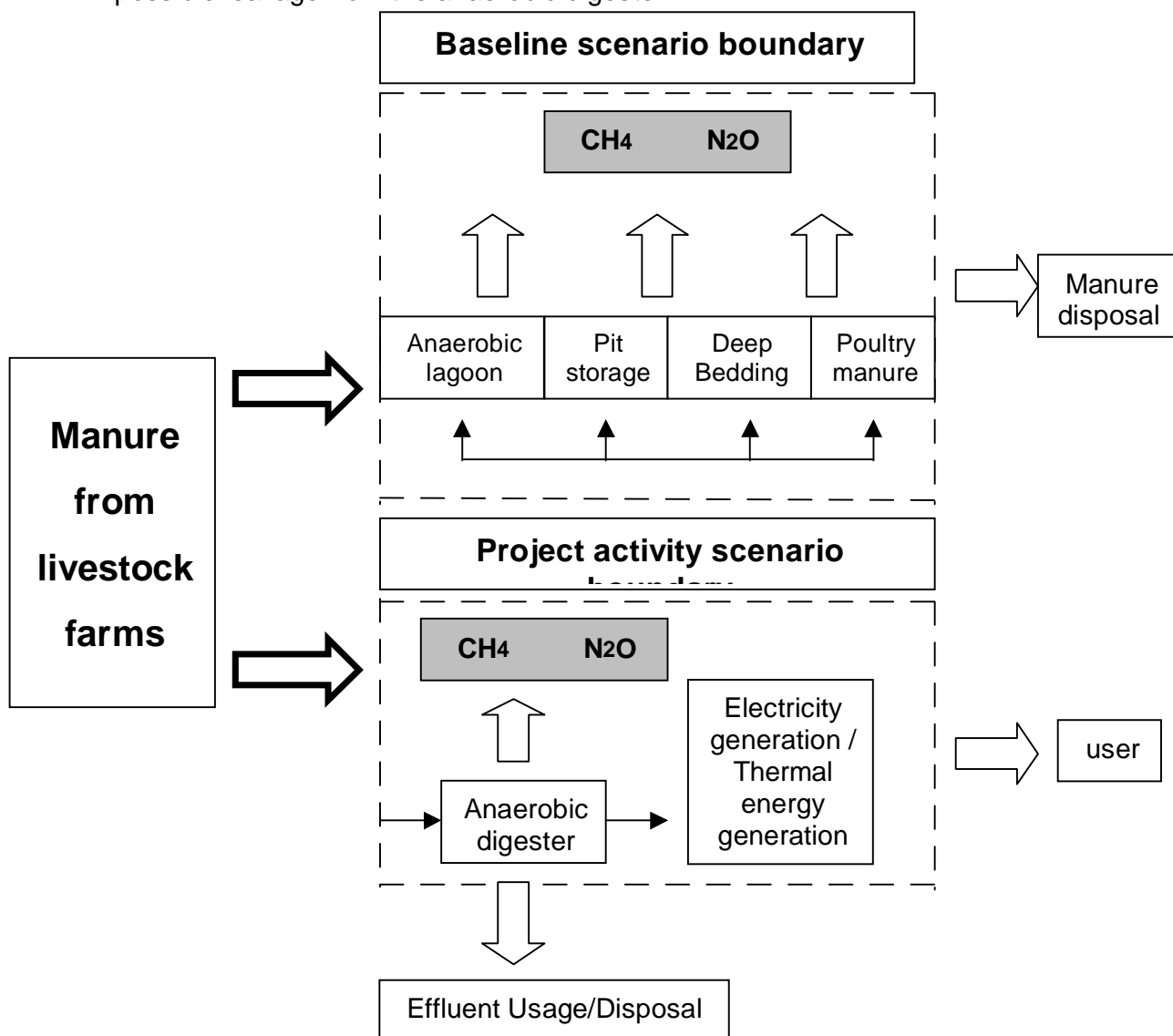
Emission sources and gases are included in the charts and the table on the next page.

Baseline scenario

The boundaries of the baseline scenario are onsite emissions occurring because current AMWS do not mitigate GHG emissions.

Project activity scenario

The boundaries of the project activity scenario are onsite emissions occurring from possible leakage from the anaerobic digester.





	Source	Gas		Justification / Explanation	
Baseline	Direct emissions from the waste treatment processes.	CH4	Included	The major source of emissions in the baseline	
		N2O	Included		
		CO2	Excluded	CO2 emissions from the decomposition of organic waste are not included.	
	Emissions from electricity generation	CO2	Included		Electricity produced onsite in the project activity will replace fossil based electricity from the grid
		CH4	Excluded		Excluded for simplification.
		N2O	Excluded		Excluded for simplification.
	Emissions from thermal energy generation	CO2	Included		Thermal Energy produced onsite in the project activity will replace fossil based electricity from the grid
		CH4	Excluded		Excluded for simplification.
		N2O	Excluded		Excluded for simplification.
Project	Direct emissions from the waste treatment processes.	CH4	Included	Emission from leakage or uncombusted methane.	
		N2O	Included		
		CO2	Excluded	CO2 emissions from the decomposition of organic waste are not included.	
	Emissions from electricity generation	CO2	Excluded		Since electricity is generated from collected biogas, these emissions are not included.
		CH4	Excluded		Excluded for simplification. This emission source is assumed to be very small.
		N2O	Excluded		Excluded for simplification. This emission source is assumed to be very small.
	Emissions from thermal energy generation	CO2	Excluded		Since thermal energy is generated from collected biogas, these emissions are not included.
		CH4	Excluded		Excluded for simplification. This emission source is assumed to be very small.
		N2O	Excluded		Excluded for simplification. This emission source is assumed to be very small.

**B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

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According to ACM0010, the Identification of the baseline scenario is determined by several steps.

Selected approach from paragraph 48 of the CDM modalities and procedure - "Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment"

Step I: Define alternative scenarios to the proposed CDM project activity

Plausible and credible alternatives for the project activity.

The following list of base line scenarios for manure management system was selected from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Chapter 10, Table 10.17) . It includes the following scenarios

- Solid storage
- Liquid/Slurry
- Uncovered Anaerobic lagoon
- Pit storage below animal confinements.
- Anaerobic digester
- Cattle deep bedding
- Composting
- Poultry manure
- Aerobic treatment

The following list contains a brief description of the manure management systems listed above and contains a justification for the exclusion of some manure management systems that cannot be considered as the baseline scenario:

1. **Solid Storage** – In this system, manure is stored in unconfined piles or stacks. This kind of system is not applicable for manure management in Israel which is only in confined conditions and therefore this scenario is not applicable for this project baseline scenario.
2. **Liquid/Slurry** – Since this system consists of building large storage tanks, there is an investment barrier that prevent this system from being employed. Therefore, this system is not applicable as a baseline scenario for this project.
3. **Uncovered anaerobic lagoon** – This system is a kind of liquid manure storage system and recognized in some cowsheds in Israel.



This system is compliant with environmental regulations in Israel and therefore applicable as a baseline scenario for this project.

4. **Pit storage below animal confinements** – This kind of system is recognized in many poultry farms in Israel. Approximately every 4 months the manure is taken out of the farm and spread in fields.
This system is compliant with environmental regulations in Israel and therefore applicable as a baseline scenario for this project.
5. **Anaerobic digester** – The anaerobic digester system consists of the fermentation of organic matter into biogas, containing mainly methane. The solid and liquid outcomes of the system can be used as organic fertilizer and the biogas for power generation.
Due to the barriers of implementing this technology, this system is not applicable for the baseline scenario.
This technology will most likely be the proposed project activity scenario.
6. **Cattle deep bedding** – In this system manure is accumulated for as long as 6 to 12 months and after that period is removed from the floor.
This system characterized in the best manner the current manure management in dairy cowsheds.
7. **Composting** – Some of the manure, after being in the anaerobic lagoons or in the pit storage below animal confinements, is used for composting.
This dry system can only be applied as a secondary / continuous stage after the storage of the manure. For this reason, this technology is not applicable for this project baseline scenario.
8. **Poultry manure** – manure is stored or piled up similar to the deep bedding of the cow manure. Since in Israel poultry manure accumulates beneath the animal confinements, a different manure management was chosen to describe the baseline scenario of poultry manure.
Therefore, This system is not applicable for this project baseline scenario for poultry manure.
9. **Aerobic treatment** – this technology consists mostly on forced aeration, which is a very high energy consumer, the solids in the manure increase the amount of oxygen needed for mixing.
Aerobic ponds need very big areas and therefore this system is not applicable for small or medium farms which are mostly common for this project baseline scenario.
The above manure management systems are in compliance with all applicable legal and regulatory requirements.



In order to verify the above, Sub-step 1b “Enforcement of applicable laws and regulations” of the latest version of the “Tool for the demonstration and assessment of additionality” (version 02) was applied.

Step II: Barriers analysis

The above list of possible manure management systems, includes also a justification for the exclusion of some manure management systems that cannot be considered as the baseline scenario.

The common manure management system in most animal farms in Israel, consists of storing animal manure for several months, and then spreading the manure in agricultural fields – as liquid or solid.

The selected baseline scenarios for baseline manure managements (as described in the end of section B.4) are in fact the current manure management system operating in most farms in Israel.

These manure management systems are in-line with all environmental laws and regulations in Israel and therefore in the absence of the proposed project activity, these systems would continue to operate.

Investment Barriers:

The following manure management systems were not employed in animal farms in Israel, mainly due to a large investment that should be made in order to construct the system or high operational costs:

Liquid/Slurry manure management system

As we explained above, this system consists of building large storage tanks, sufficient for storing animal manure for several months.

However, this manure management system is not employed today in small and medium farms, which characterizes the manure management systems in this project baseline scenario.

Aerobic treatment

Forced aeration is a very high energy consumer and also need vast areas for the aerobic lagoon.

Therefore, this manure management system is not commonly employed today in small and medium farms, which characterizes this project baseline scenario.



Anaerobic digester

The anaerobic digester system consists of the fermentation of organic matter into biogas. Manure from animal farms is collected and transferred to a central plant. The manure enters a digester and the biogas produced in the digester is collected to a storage balloon and then is used for producing green energy or flared. Anaerobic digester has a high investment and technological barrier.

Technological barriers

In the absence of the proposed project activity, the current system of manure management will continue to be employed.

Most current manure management systems require very low technological knowledge since it is based on storing the manure in the farms and spreading it in the fields.

The Anaerobic digester is a manure management system that requires technological skills, specific knowledge and skilled personnel, in addition to the high investments costs and due to those facts was not adopted in animal farms.

Barriers due to prevailing practice

The only other project for treating animal manure with anaerobic digesters in Israel is the “Emek Hefer Biogas Facility” which is also currently applying for CDM registration.

Manure management systems excluded for other reasons

The listed manure management systems were excluded from defining the baseline scenario for various reasons:

Solid Storage

In this system, manure is stored in piles or stacks.

Since the current manure management in Israel is based on storing the manure for several months on the farm, this system is not applicable for the baseline scenario.

Poultry manure

Since poultry farms in Israel use different kind manure management systems, this system is not applicable for this project baseline scenario.

composting

In current manure management systems in Israel, composting is applied only after the manure is stored in the farm.

Therefore this system can only be applied as a secondary / continuous stage after the storage of the manure. For this reason, this technology is not applicable for this project baseline scenario.



Step III: Investment analysis

The selected baseline scenario (described below) are in fact the current manure management systems in most animal farms in Israel and are common for all the farms that will send their manure to be treated in the facility.

Since these manure management systems are already in operation in Israel, it is clear that they do not face any of the barriers, as identified in Step II.

Therefore, there is no need in investment to be made in order to use the systems and no investment analysis is needed.

Selected baseline scenarios

The baseline scenarios for this project are the traditional use of manure management and other storage facilities for storing animal manure as liquid or solid.

These storages lead to the direct release of CH₄, N₂O and CO₂ into the atmosphere as a result of the anaerobic digestion process that takes place inside the lagoons.

The identified manure management systems for the baseline scenario are:

Diary cow farms

- § Active mixing deep Bedding
- § Uncovered anaerobic lagoons

Poultry farms

- § Pit storage below animal confinements.

Summary – barrier assessment

As a result of the barrier assessments, several alternatives were eliminated from further consideration. The baseline scenarios chosen are the best alternative for the project activity if the CDM project is not implemented.

Most of Israel's animal manure systems consist of storing the manure in the farm for several months in different storage systems.

After being stored for a period of time, the manure is evacuated and usually spread in fields – as liquid or solid.

In manure storage systems, the manure is partially digested by anaerobic organisms and therefore these systems generate GHG emission.

Due to the fact that the anaerobic biogas facility will treat manure from farms situated around the facility, the interface with the manure and the manure management system differ from animal farm to animal farm.

Therefore in this CDM project more than one baseline scenario is chosen.



B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

How GHGs are reduced by the CDM project activity

In this CDM project activity, GHG emissions are prevented by changing current manure management systems with an anaerobic digester.

The electricity and heat produced in the process are used in the facility and sold to the grid, thus substituting fossil based electricity and generating more GHG reduction. Eco Energy Golan Ltd had initiated this project with the perspective that animal waste can be treated in more advanced ways than it is treated today.

Eco Energy Golan facility includes an anaerobic digester that among its advantages, initiates the anaerobic process that currently and naturally occurs in nature.

In the next paragraph, there is a detailed description of the process in the facility. Emissions, which in the absence of this project would be emitted to the open air, are collected in the digester and then transferred to the collection balloon before being turned into electricity or flared.

The projects require high initial investment, operation and maintenance costs.

The project has significant environmental benefits, however, is not economical without the CER revenues.

It is most likely that in the absence of the proposed CDM project, the current animal waste management systems will continue to operate.

CDM project activity scenario - Anaerobic digester

The manure from animal farms is collected and transferred to the biogas plant.

When entering the plant, the solid manure is crushed and cut into small pieces and the liquid manure enters the receiving tank.

Both solid (after the crushing phase) and liquid fragments are mixed together in the homogenizer tank in order to receive a homogenized mixing solution.

From the homogenizer the manure is transferred to the pasteurization tank where it is heated to 70 degrees Celsius for at least one hour, in order to exterminate pathogens and stabilize the solution.

The next phase is the concrete made digester, where the manure digests for at least 21 days. The biogas produced in the digester is collected to a double layer membrane storage balloon before being turned into electricity or flared.

The effluent from the digester is pumped through a press (solid separator) for separation of the solid and liquid fragment.

The liquid and solid fragments can be utilized as organic fertilizer in fields which are not hydrological sensitive.



This organic fertilizer can replace a significant amount of chemical fertilizer from being spread, preventing more chlorine percolating to the ground and preventing more GHG emissions from the production of chemical fertilizer.

The solid fragment can also be used as bedding material for animal barns.

This process is fully controlled by many sensors in various stages of the process.

The biogas collection is efficient and fully mitigates the discharge of emissions.

Since this system consists of a large investment, technical knowledge, purchasing and maintenance of electro-mechanical equipment and a complex logistic manure collection and transfer system, this kind of manure management system has an investment and technological barrier that prevents it from being applicable for the baseline scenario.

Assessment of additionality – proposed CDM project activity

The Biogas project activity was not adopted on a national level due to several barriers that are described below.

In the absence of the proposed CDM project, the current animal manure system shall continue to operate, since farmers are not encouraged by legislation nor are they financially motivated to change the manure system so that GHG emission shall be reduced.

Step 0. Preliminary screening based on the starting date of the project activity

The starting date of the validation will take place before the starting date of the project activity.

Nevertheless, We wish to present evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity.

- | | |
|----------------|---|
| September 2004 | - Eco energy Golan initiated the process of constructing a centralized facility for collecting and treating animal manure. |
| January 2005 | - Eco Energy Golan launches a study on the possibility to receive CDM revenues from the project – it had good results. |
| July 2005 | - Eco Energy Golan contacted a number of consultation and Validation companies and after doing so, decided to prepare the PDD within the company. |
| June 2006 | - Eco Energy Golan begins a validation process which is postponed since the methodology used was in hold for consideration. |
| January 2007 | - After the new consolidated methodology for animal manure was Approved, Eco Energy begins the validation process. |



Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

In paragraph B.4 we have identified the alternative scenarios to the proposed CDM project activity.

A barrier analysis had been made and the chosen alternatives were examined to see if it is applicable under the current laws and regulations.

Due to the fact that the anaerobic biogas facility will treat manure from farms all over the Golan highest, the interface with the manure and the manure management system differ from animal farm to animal farm.

However the chosen baseline scenarios are common for the farms that will send their manure to be treated in the facility.

Therefore in this CDM project more than one baseline scenario is chosen.

The identified manure management systems for the baseline scenario are:

Diary cow farms

- § Active mixing deep Bedding
- § uncovered anaerobic lagoons

poultry farms

- § Pit storage below animal confinements.

Sub-step 1b. Enforcement of applicable laws and regulations:

The above manure management systems are in compliance with all environmental regulatory and legal requirements.

In order to verify the above, Sub-step 1b “Enforcement of applicable laws and regulations” of the latest version of the “Tool for the demonstration and assessment of additionality” (version 02) was applied.



Step 2. Investment analysis

The selected baseline scenarios, as described above, are in fact the current manure management systems in most animal farms in Israel.

Since these manure management systems are already in operation in Israel, there is no need in investment to be made in order to use the systems, so there is no place to financially or economically compare the selected baseline scenarios with the proposed project activity.

Without revenue from the sale of certified emission reductions (CERs) the proposed project activity is financially less attractive than all other alternatives.

Step 3. Barrier analysis

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity:

Investment Barriers:

The anaerobic manure treatment plant is unique compared to the manure management system that have been operating in Israel in the past years.

This manure treatment system is considered one of the most advanced practices in the world and due to high investment costs, has been implemented only in Western Europe countries which require the farmers to treat the manure before spreading it in fields.

The plant's digesters will be constructed from concrete in a unique method so that during the fermentation process there will be no possibility of methane emission.

The plant's electro-mechanical equipment includes pumps, agitators, blowers and other machinery that should maintain the manure and the biogas containing methane in confined tanks to prevent any kind of odor nuisance and methane emission.

In order to fulfill the environmental requirements in Israel, the plant operators need not only to collect the manure from the cowsheds and poultry farms, but also to be responsible for the disposal of all the liquid and solids which exit the plant.

Due to the high chlorine content in the cow manure which contributes today to the high salinity concentration in the ground water in Israel, the plant had to be placed in an area which is not hydrological sensitive, even if this location was not economical from the point of view of distances from the farms.

The liquid exiting the facility must be spread in areas which are considered not hydraulically sensitive.

In order to do so, the investment consists of a piping system that would transfer the liquids from the plant to fields where it can be spread, in areas which are not hydraulically sensitive, usually several kilometers away from the plant.

This particular requirement is unique only to Israel because of the scarce water resources and the crowded animal production.

It can be concluded that from the investment point of view the proposed anaerobic biogas plant is indeed additional.

**Technology Barriers:**

Since the initiative of Eco-Energy Golan facility was to treat every possible animal manure produced in confined conditions in a conservative radius from the facility, the plant's operators need to collect the manure from more than 100 cowsheds and poultry farms, located in more than 50 villages in surrounding areas of the biogas plant.

The logistics of collecting this amount of manure is very complicated and consists of very reliable machinery and manpower.

The use of anaerobic digesters for treating animal manure is relatively new in Israel and there is not a lot of experience in how to construct these kind of facilities.

In order to treat the volumes of manure entering the plant, a very sensitive and specific anaerobic bacterium will be grown, and the technology implemented in the plant should help provide this bacterium with the right nutrition, in the right temperature and needed capacities of manure.

Since some of the electro-mechanical equipment used in the plant is imported, maintenance and service for the equipment must evolve during the plant operation. The displacement of the salinity from hydrological sensitive areas to not sensitive areas is also a technological obstacle since the liquid has to be transferred in pipes to the fields and then be spread as fertilizer.

Since there are no experience personnel who can operate these facilities, operators would be trained during construction phases.

The operation and maintenance requirements of the plant will include a very detailed and efficient monitoring program that could send, at any given time, sufficient performance levels of the plants' products verses manure entries to assure optimal operational conditions.

The logistical, technological and O&M barriers indicate clearly that also from the technology point of view, the anaerobic biogas plant activity is additional.

Legal Constraints:

Since Israel is a country with few water sources, the need to protect them is at the highest environmental and legal consideration.

Due to that fact, the plant's operators have to make sure that all the liquid and solids which come out from the plant are spread in areas which are not considered hydraulically sensitive.

Apart from that, there is no specific legislation that requires specific manure treatment or GHG emission control.

Based on that, the proposed project activity is additional also from the legal point of view.

**National and sectoral policies and circumstances**

In the past five years, the state of Israel has initiated a reform in the dairy cow sector. This reform aims to standardize the manure collection in the cow shed farms, prevent an uncontrolled evacuation of manure from the farms, support long term planning and investment and to reduce the mixing between drainage water and sewage water from the dairy farm. The reform improved the quality of housing for cows in the farms and by doing so increased milk production and, as a result of that, also the quantity of manure produced in the farm.

By this very nature, the demand for ecological considerations is apt to bear heavily on small and medium-sized dairy operations and their economic survival.

The number of small and medium-sized dairy farms in Israel has decreased significantly by closing small dairies or by merging small farms together.

However, this reform had no regulatory requirements with regard to reducing the GHG emissions occurring from the collection and storage of the manure in the dairy farms.

The anaerobic treatment facility and the activities surrounding it will contribute to mitigation of anthropogenic GHG emissions due to the collection of the manure from the farms and controlling the biogas and methane production in the facility.

It can be concluded, that the emission reduction resulted from the projects are additional to any that would occur in the absence of the projects.

Barriers due to prevailing practice

The only other project for treating animal manure with anaerobic digesters in Israel is the “Emek Hefer Biogas Facility” which is also currently applying for CDM registration.



Sub-step 3 b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

The identified barriers above would **not** prevent the implementation of the alternatives that were chosen to describe the baseline scenario if the proposed project activity is not implemented.

The current manure management systems, consists of the following storage systems:

Diary cow manure

- § Uncovered anaerobic lagoon
- § Active mixing deep bedding

Poultry manure

- § Pit storage below animal confinements

The above manure management systems could continue to operate regardless of the above barriers. These manure management systems comply with the Israeli regulations. The only alternative that has to overcome technical and investment barriers is the anaerobic digester technology – the propose project activity.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

Current animal manure management systems in Israel consists of storing the manure for several months in the farm and then spreading the raw manure in fields near the farms. There is no regulation or enforcement of treating the animal manure in anaerobic facilities.

The anaerobic biogas facility will totally change animal manure treatment in the Goaln area, by constructing a centralized anaerobic facility storing the GHG in a specially designed balloon and using the biogas to create renewable electricity.

This kind of facility has a very short history in Israel.

The only other project for treating animal manure with anaerobic digesters is the “Emek Hefer Biogas Facility” which is also currently applying for CDM registration.

The project will definitely initiate a diffusion of this technology for treating other organic wastes in Israel.

**Sub-step 4b. Discuss any similar options that are occurring:**

As can be understood from the paragraph above, similar activities to Eco Energy's projects are not widespread and common in Israel.

Step 5. Impact of CDM registration

During the project initiation, the CDM revenue were given great consideration.

The anaerobic biogas projects face both financial and technical barriers and thus the project's implementation depends on revenues from CER.

The CER component in the financial analysis represents a major source of income to the projects and one that can not be ignored. Preliminary financial analysis showed that the project would not be financially attractive without revenues from CER's.

A feasibility study was launched to check the possibility of receiving CER revenues on the project and the study had good results, showing that the project is applicable to be registered as a CDM project.

Logistical, technical and technological barriers for the implementation of the project were all pre-discussed in the previous chapters. These barriers represent the enormous potential of environmental change that the project will cause in animal manure treatment in Israel.

By overcoming both technical and financial barriers, a model will be set up for diffusing the anaerobic biogas technology in other organic waste treatment facility and contribute to reducing more anthropogenic GHG emissions.

In the table below we have demonstrated the impact of the CDM registration and CER commercialization on the project:

Impact of CDM registration and CER commercialization on project IRR (Internal rate of return):

	Eco Energy biogas plant - IRR
No CER revenues	5%
CER = 4\$	15%
CER=8\$	25%

(The detailed financial analysis has been given to the DOE validation team.)

**B.6. Emission reductions:****B.6.1. Explanation of methodological choices:**

>>

The implementation of this CDM project will result in the reduction of GHG in the following perspectives.

- Mitigating methane and N₂O emissions by improving manure management systems.
- Mitigating CO₂ emissions by generating green and clean electricity and exporting it to the national grid.
- Mitigating CO₂ emissions by generating thermal energy that shall replace fossil fuel based equipment.

In order to calculate the emission reduction as a direct result from the implementation of the project, the following equations shall be used :

Equation number 1 - Baseline emissions

$$BE_y = BE_{CH_4,y} + BE_{N_2O,y} + BE_{elec/heat,y}$$

Where

- BE_y - Baseline emissions in year y, in tCO₂e/year.
 BE_{CH₄,y} - Baseline methane emissions in year y, in tCO₂e/year.
 BE_{N₂O,y} - Baseline N₂O emissions in year y, in tCO₂e/year.
 BE_{elec/heat,y} - Baseline CO₂ emissions from electricity and/or heat used in the baseline, in tCO₂e/year.

Equation number 2: CH₄ Emissions related to the baseline and project scenarios

$$BE_{ch_4,y} = GWP_{CH_4} \times D_{CH_4} \times \sum MCF \times B_{0,LT} \times N_{LT} \times VS_{LT,y} \times MS\%$$

Where:

- BE_{CH₄, y} - the annual baseline methane emissions in t CO₂e/y
 GWP_{CH₄} - Global Warming Potential (GWP) of CH₄.
 D_{CH₄} - CH₄ density (0.00067 t/m³ at room temperature (20 C) and 1atm pressure).
 MCF - Annual methane conversion factor (MCF) for the baseline AWMS from IPCC 2006 table 10.17, chapter 10, volume 4.
 B_{0,LT} - Maximum methane producing potential of the volatile solid generated, in m³CH₄/kg_{dm}, by animal type LT.
 N_{LT} - Number of animals of type LT for the year y, expressed in numbers.
 VS_{LT,y} - Annual volatile solid for livestock LT entering all AWMS [on a dry matter weight basis (kg-dm/animal/year)
 MS%_j - Fraction of manure handled in system j



Justification for using the parameters in the above equations

Determination of volatile solids (VS)

Methodology ACM0010 provides four options for the determination of volatile solids (VS) excretion rate:

- § Using published country specific data
- § Estimation of VS based on dietary intake of livestock
- § Scaling default IPCC values to adjust for a site-specific average animal weight.
- § Utilizing published IPCC defaults.

The first three choices are eliminated for the following reasons:

- § Country specific data is not used since there is no published data on VS.
- § Determination of the VS based on dietary intake of livestock is not possible due to lack of data.
- § Determination of the VS based on IPCC values adjusted for site-specific average animal weight is not used since animal weights are more similar to developed country IPCC default values.

According to the methodology, developed countries values can be used provided that several conditions are met:

- § The genetic source of the production operations livestock originate from an Annex I Party
- § The farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
- § The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.)
- § The project specific animal weights are more similar to developed country IPCC default values

Since farm operation conditions in Israel can be characterized according to the above conditions, developed countries values are in use for determining the emission reduction in this project.

Maximum Methane Production Potential (Bo):

Developed countries values are used since there is no country specific data on Bo.

Methane conversion factor (MCF):

MCF values given in table 10.17 of the 2006 IPCC Guidelines are used.

MCF values depend on the annual average temperature where the anaerobic manure treatment facility, in the baseline, existed.

For this project, The annual average temperature is 23 Celsius and the values are applied according to the manure management system in the baseline.

A conservative factor should be applied by multiplying MCF values with a value of 0.94, to account for the 20% uncertainty in the MCF values as reported by IPCC 2006.

**Equation number 3: N2O emissions from manure management**

$$BE_{N2O,y} = GWP_{N2O} \times CF_{N2O-N,N} / 1000 \times (E_{N2O,D,y} + E_{N2O,ID,y})$$

Where:

- $BE_{N2O,y}$ - Annual baseline N2O emissions in t CO₂e / yr
 GWP_{N2O} - Global Warming Potential (GWP) for N2O.
 $CF_{N2O-N,N}$ - Conversion factor N2O-N to N2O (44/28).
 $E_{N2O,D,y}$ - Direct N2O emission in kg N2O-N/year.
 $E_{N2O,ID,y}$ - Indirect N2O emission in kg N2O-N/year.

Equation number 4: Direct N2O emissions from manure management

$$E_{N2O,D,y} = \sum (EF_{N2O,D,j} \times NEX_{LT,y} \times N_{LT} \times MS_j)$$

Where:

- $E_{N2O,D,y}$ - Are the direct nitrous oxide emissions in kg of N2O per year.
 $EF_{N2O,D,j}$ - Is the direct N2O emission factor for the treatment system j of the manure management system in kg N2O-N/kg N (estimated with site-specific, regional or national data if such data is available, otherwise use default EF3 from table 10.21, chapter 10, volume 4, in the IPCC 2006 Guidelines for National Greenhouse Gas Inventories).
 $NEX_{LT,y}$ - Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2.
 MS_j - Fraction of manure handled in system j, in %
 N_{LT} - Number of animals of type LT for the year y, expressed in numbers.

**Equation number 5: In Direct N₂O emissions from manure management**

$$E_{N_2O, ID, y} = \sum (EF_{N_2O, ID, j} \times F_{GASM} \times NEX_{LT, y} \times N_{LT} \times MS_j)$$

Where:

- $E_{N_2O, ID, y}$ - Are the indirect nitrous oxide emissions in kg of N₂O per year.
- $EF_{N_2O, ID, j}$ - Is the indirect N₂O emission factor for N₂O emissions from atmospheric deposition of nitrogen on soils and water surfaces, kg N₂O-N/kg NH₃-N and NO_x-N emitted, estimated with site-specific, regional or national data if such data is available. Otherwise, default values for EF₄ from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories can be used.
- $NEX_{LT, y}$ - Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2.
- $MS\%_j$ - Fraction of manure handled in system j, in %
- F_{gasm} - Percent of managed manure nitrogen for livestock category that volatilises as NH₃ and NO_x in the manure management system.
- N_{LT} - Number of animals of type LT for the year y, expressed in numbers.

Equation number 6: annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year

$$NEX_{site} = (W_{site} / W_{default}) \times NEX_{IPCCdefault}$$

where:

- NEX_{site} - Is the adjusted annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year.
- W_{site} - Is the average animal weight of a defined population at the project site in kg.
- $W_{default}$ - Is the default average animal weight of a defined population in kg.
- $NEX_{IPCCdefault}$ - Is the default value (IPCC 2006 or US-EPA) for the nitrogen excretion per head of a defined livestock population in kg N/animal/year.

**Justification for using the parameters in the above equations**

As explained in paragraph, B-4, the baseline scenario of this project has few options for determining the baseline emissions since this project consists of collection manure from different areas and different animal farms.

CH₄ and N₂O emissions in the baseline scenario are based on parameters taken from different sources:

Parameters such as **GWP**, **D_{CH₄}**, **CF_{N₂O-N,N}** are taken from technical papers, such as the IPCC 2006 Guidelines.

On site and site specific parameters such as **N_{LT}**, **VS_{LT,y}**, **NEX_{site}**, **MCF** , **B_{0,LT}** are determined by using IPCC 2006 Guidelines for developed countries.

In paragraphs B6.2 and B7.1 there is more information regarding the parameters chosen and the justification for choosing each and every parameter used for calculation baseline emissions, project emissions and leakage.



Equation number 7: CO2 emission from electricity and heat within the project boundary

$$B_{e_{elec} / heat, y} = E_{G_{BL,y}} \times CEF_{Bl,elec,y} + E_{G_{d,y}} \times CEF_{grid} + H_{G_{BL,y}} \times CEF_{Bl,term,y}$$

Where:

- $E_{G_{BL,y}}$** - is the amount of electricity in the year y that would be consumed at the project site in the absence of the project activity (MWh) for operating AWMS.
- $CEF_{Bl,elec,y}$** - is the carbon emissions factor for electricity consumed at the project site in the absence of the project activity (tCO₂/MWh)
- $E_{G_{d,y}}$** - is the amount of electricity generated utilizing the biogas collected during project activity and exported to the grid during the year y (MWh)
- CEF_{grid}** - is the carbon emissions factor for the grid in the project scenario (tCO₂/MWh)
- $H_{G_{BL,y}}$** - is the quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity (MJ) using fossil fuel for operating AWMS.
- $CEF_{BL, therm}$** - is the CO₂ emissions intensity for thermal energy generation (tCO₂ e/MJ)

Justification for the parameters used in the above equation

$E_{G_{BL,y}} = 0$ since the renewable electricity production didn't replace any electricity consumption before the implementation of the CDM project.

$E_{G_{d,y}}$ will be calculated according to actual electricity exported to the grid.

CEF_{grid} will be calculated according to the grid emission factor in the simplified baseline methodology for small-scale CDM project activity AMS.I.D. - since the project would produce less than 15MWh of electricity.

$H_{G_{BL,y}}$ will be calculated according to actual thermal energy produced and exported from the project site or used at the project site.

**Determination of CEFgrid:**

According to ACM 0010, If the renewable energy generation capacity is **less than 15 MW**, CEFgrid could be calculated according to simplified baseline methodology for small-scale CDM project activity - AMS.I.D

According to AMS I.D. "Grid connected renewable electricity generation", the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO₂e/kWh) calculated in a transparent and conservative manner as:

Paragraph 9(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002.

OR

Paragraph 9(b) The weighted average emissions (in kg CO₂e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

It is not possible at the moment to calculate the combined margin (CM), since there is no publicly available information of the operating margin (OM) and build margin (BM) required for calculating the combined margin (CM).

Therefore Paragraph 9(b) shall be used to estimate the emission coefficient in a conservative manner.

By applying the above baseline scenario the electricity emission factor is calculated to be 0.805 tCO₂e/MWh.

Source of the information used for calculating the emission factor was obtained from the Israeli electrical company environmental report fro 2005, that can be downloaded from the IEC internet site - <http://www.israel-electric.co.il> and also from the IPCC 2006 guidelines, that can be downloaded from the IPCC internet site - <http://www.ipcc-nggip.iges.or.jp/> .

**Equation number 8 - Project emissions**

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N_2O,y} + PE_{PL,y} + PE_{flare,y} + PE_{elec/heat}$$

$PE_{AD,y}$	- Leakage from AWMS systems that capture's methane in t CO ₂ e/yr
$PE_{Aer,y}$	- Methane emissions from AWMS that aerobically treats the manure in t CO ₂ e/yr
$PE_{N_2O,y}$	- Nitrous oxide emission from project manure waste management system in t CO ₂ e/yr
$PE_{PL,y}$	- Physical leakage of emissions from biogas network to flare the captured methane or supply to the facility where it is used for heat and/or electricity generation in t CO ₂ e/yr
$PE_{flare,y}$	- Project emissions from flaring of the residual gas stream in t CO ₂ e/yr
$PE_{elec/heat}$	- Project emissions from use of heat and/or electricity in the project case in t CO ₂ e/yr

Equation number 9 - Methane emissions (leakage) from AWMS where gas is captured (project scenario – anaerobic digester)

$$PE_{AD,y} = GWP_{CH_4} \times D_{CH_4} \times LF_{AD} \times F_{AD} \times \sum (B_{0,LT} \times N_{LT} \times VS_{LT,y})$$

Where:

$PE_{AD,y}$	- Leakage from AWMS systems that capture methane in t CO ₂ e/yr
GWP_{CH_4}	- Global Warming Potential (GWP) of CH ₄ .
D_{CH_4}	- CH ₄ density (0.00067 t/m ³ at room temperature (20 C) and 1atm pressure).
LF_{AD}	- Methane leakage from Anaerobic digesters, default of 0.15 multiplied by methane content of biogas.
F_{AD}	- Fraction of volatile solid directed to anaerobic digester.
$B_{0,LT}$	- Maximum methane producing potential of the volatile solid generated, in m ³ CH ₄ /kg _{dm} , by animal type LT.
N_{LT}	- Number of animals of type LT for the year y, expressed in numbers.
$VS_{LT,y}$	- Annual volatile solid for livestock LT entering all AWMS [on a dry matter weight basis (kg-dm/animal/year)

Remark – Since no aerobic treatment is included in the project boundaries, there are no leakage calculations with regard to such treatment.

**Equation number 10 - N2O emissions from manure management**

$$PE_{N2O,y} = GWP_{N2O} \times CF_{N2O-N,N} / 1000 \times (E_{N2O,D,y} + E_{N2O,ID,y})$$

Where:

- $PE_{N2O,y}$ - Annual project N2O emissions in t CO2e / yr
 GWP_{N2O} - Global Warming Potential (GWP) for N2O.
 $CF_{N2O-N,N}$ - Conversion factor N2O-N to N2O (44/28).
 $E_{N2O,D,y}$ - Direct N2O emission in kg N2O-N/year.
 $E_{N2O,ID,y}$ - Indirect N2O emission in kg N2O-N/year.

Equation number 11: Direct N2O emissions from manure management

$$E_{N2O,D,y} = \sum (EF_{N2O,D,j} \times NEX_{LT,y} \times N_{LT} \times MS_j)$$

Where:

- $E_{N2O,D,y}$ - Are the direct nitrous oxide emissions in kg of N2O per year.
 $EF_{N2O,D,j}$ - Is the direct N2O emission factor for the treatment system j of the manure management system in kg N2O-N/kg N (estimated with site-specific, regional or national data if such data is available, otherwise use default EF3 from table 10.21, chapter 10, volume 4, in the IPCC 2006 Guidelines for National Greenhouse Gas Inventories).
 $NEX_{LT,y}$ - Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2.
 MS_j - Fraction of manure handled in system j, in %
 N_{LT} - Number of animals of type LT for the year y, expressed in numbers.

**Equation number 12: In Direct N₂O emissions from manure management**

$$E_{N_2O,ID,y} = \sum (EF_{N_2O,ID,j} \times F_{GASM} \times NEX_{LT,y} \times N_{LT} \times MS_j)$$

Where:

- $E_{N_2O,ID,y}$ - Are the indirect nitrous oxide emissions in kg of N₂O per year.
- $EF_{N_2O,ID,j}$ - Is the indirect N₂O emission factor for N₂O emissions from atmospheric deposition of nitrogen on soils and water surfaces, kg N₂O-N/kg NH₃-N and NO_x-N emitted, estimated with site-specific, regional or national data if such data is available. Otherwise, default values for EF₄ from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories can be used.
- $NEX_{LT,y}$ - Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2.
- $MS\%_j$ - Fraction of manure handled in system j, in %
- F_{gasm} - Percent of managed manure nitrogen for livestock category that volatilises as NH₃ and NO_x in the manure management system.
- N_{LT} - Number of animals of type LT for the year y, expressed in numbers.

Physical Leakage from distribution network of the captured methane (PEPL)

This equation refers to calculate leaks in the biogas system from the biogas pipeline delivery system.

In this project scenario, the biogas produced in the anaerobic digesters in the facility is delivered to the generators to produce electricity \ heat or flared.

The pipeline from collection point to the generator \ flare is very short (i.e., less than 1 km, and for on site delivery only).

As a result of the above data, the physical leakage may be considered as zero.

The sum of the quantities of captured methane fed to the flare, to the power plant and to the boiler (measured as per the monitoring plan) must be compared annually with the total methane generated as measured by meter at the outlet of the methane generating digester.

The difference between the monitored value of methane generated and that consumed in flare/electricity generation/heat shall be accounted as leakage from the pipelines.

**Project emissions from flaring of the residual gas stream ($PE_{flare,y}$):**

According to ACM 0010, Project emissions from flaring of the residual gas stream should be determined following the procedure described in the “Tool to determine project emissions from flaring gases containing Methane”.

In this project, $PE_{flare,y} = 0$

Justification for $PE_{CH_4 IC,y} = 0$

In this project, the produced biogas shall be used for generating electricity and heat through biogas generators assembled on the project site.

Biogas containing methane will be flared only on very rare situation when there is a malfunction for a period of time that the gas storage can't hold any more gas and some of it must be flared.

This combination of malfunctions is very rare, and since some of the incomes of the project operators is from the electricity exported to the grid, it will be in their best interest to fix the failure as soon as possible.

Since the equation of the project emissions from flaring gases containing Methane is based also on the fraction of time in which the flare is operational (when the gas is being flared), it can be assumed that project emissions from flaring gases containing Methane may be considered as zero.



Equation number 13 : Project emissions from heat use and electricity use
(PE_{elec/heat}):

$$PE_{elec/heat,y} = EL_{Pr,y} * CEF_d + HG_{Pr,y} * CEF_{Pr,therm,y}$$

Where:

- EL_{Pr,y}** - is the amount of electricity in the year y that is consumed at the project site in the project case (MWh).
- CEF_d** - is the carbon emissions factor for electricity consumed at the project site during the project activity (tCO₂/MWh), estimated as described below. Factor is zero if biogas is used to produce electricity.
- HG_{Pr,y}** - is the quantity of thermal energy consumed in year y at the project site in the project case (MJ).
- CEF_{Pr,therm,y}** - is the CO₂ emissions intensity for thermal energy generation (tCO_{2e}/MJ),. Factor is zero if biogas is used for generating thermal energy.

In this project, PE_{elec/heat,y} = 0

Justification for PE_{elec/heat,y} = 0

According to the above formula, the Factor is zero if biogas is produced and used for generating electricity and heat.

Leakage

Leakage covers the emissions from land application of treated manure, outside the project boundary.

The baseline scenario of this project is described as manure storage facilities, where manure is kept for several months and then spread in fields as solid or liquid.

The project activity includes collecting the manure, treating it with anaerobic digesters and spreading the effluent in fields after the treatment.

The above calculations prove without a doubt that GHG emissions are reduced due to the implementation of this project.

Since leakage emissions are estimated as net of those released under project activity and those released in the baseline scenario and net leakage of N₂O and CH₄ are only considered if they are positive, there is no leakage in this project.

Emission Reduction

The emission reduction ER_y by the project activity during a given year y is the difference between the baseline emissions (BE_y) and the sum of project emissions (PE_y) and leakage, as follows:

$$ER_y = BE_y - PE_y - LE_y$$

**B.6.2. Data and parameters that are available at validation:***(Copy this table for each data and parameter)*

The following **data and parameters are not monitored** throughout the crediting period but are determined only once, and thus remain fixed throughout the crediting period.

General and Baseline parameters

Data / Parameter:	GWP_{CH4}
Data unit:	tCO ₂ e/Tch ₄
Description:	Global warming potential for CH ₄
Source of data used:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Shall be updated according to any future COP/MOP decisions.

Data / Parameter:	GWP_{N2O}
Data unit:	tCO ₂ e/tN ₂ O
Description:	Global warming potential for N ₂ O
Source of data used:	IPCC
Value applied:	310
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Shall be updated according to any future COP/MOP decisions.



CDM – Executive Board

page 42

Data / Parameter:	D_{CH4}
Data unit:	t/m ³
Description:	Density of methane
Source of data used:	IPCC , Technical literature
Value applied:	0.00067 tCH ₄ /m ³ CH ₄ at room temperature 20oC and 1 atm pressure
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	According to ACM 0001 - At standard temperature and pressure (0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 tCH ₄ /m ³ CH ₄ .

Data / Parameter:	MCF baseline
Data unit:	Fraction
Description:	Methane conversion factor for baseline calculation according to the baseline scenario.
Source of data used:	IPCC 2006 Guidelines table 10.17 pages 10.44 to 10.47
Value applied:	79% for uncovered anaerobic lagoons, 55% for pit storage under animal confinements and 55% for deep bedding.
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the baseline identification, the above scenarios characterize, in the best manner, the current manure management in the animal farms included in this project. The MCF fraction was chosen from IPCC 2006 guidelines, according to the yearly average temperature in the area where the plant will be situated.
Any comment:	



CDM – Executive Board

page 43

Data / Parameter:	B₀LT
Data unit:	M ³ CH ₄ /kg-VS,
Description:	Maximum methane production potential of volatile solid generated
Source of data used:	IPCC 2006 Guidelines table 10A-4 to 10A-9 pages 10.78 to 10.83
Value applied:	Dairy cow – 0.24, Non Dairy cow – 0.19, Layers – 0.39.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value is taken from tables 10A-4 through 10A-9 (IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter 10) - according to the animals average weight.
Any comment:	

Data / Parameter:	MS%
Data unit:	Fraction
Description:	Fraction of manure handled in system j in the baseline
Source of data used:	Project proponents
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Archive electronically during project plus 5 years



CDM – Executive Board

page 44

Data / Parameter:	ndy
Data unit:	Number
Description:	Number of days treatment plant was operational in year y
Source of data used:	Project proponents
Value applied:	365
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Archive electronic for the duration of project + 5 yrs

Data / Parameter:	CF_{N2O-N,N}
Data unit:	-
Description:	Conversion factor = 44/28
Source of data used:	Technical literature
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Archive electronic for the duration of project + 5 yrs



CDM – Executive Board

page 45

Data / Parameter:	EF_{N2O,D,j}, EF_{N2O,ID,j}
Data unit:	kg N ₂ O-N/ kg N and kg N ₂ O-N/ kg NH ₃ -N and NO _x -N
Description:	N ₂ O emission factors (direct and indirect emissions)
Source of data used:	IPCC 2006 Guidelines, EF3 - table 10.21 page 10.62 and EF4 – table 11.3 page 11.26
Value applied:	EF3 - uncovered lagoon – 0 , pit storage – 0.002, deep bedding – 0.07 EF4 – 0.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the baseline identification, the above scenarios characterize, in the best manner, the current manure management in the animal farms included in this project. EF3, EF4 were chosen according to IPCC 2006 Guidelines, according to the country specific temperature.
Any comment:	Archive electronic for the duration of project + 5 yrs

Data / Parameter:	F_{gasm}
Data unit:	Fraction
Description:	Fraction of N lost due to volatilization
Source of data used:	IPCC 2006 Guidelines table 11.3 page 11.26
Value applied:	0.02
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Archive electronic for the duration of project + 5 yrs

**B.6.3 Ex-ante calculation of emission reductions:**

>>

For calculating Ex-ante emission reduction, all the equations and parameters as detailed above shall be used.

Baseline emissions

Methane (CH4) emissions for the baseline were calculated using ACM0010 equation number 2.

Nitrous oxide (N2O) emissions for the baseline were calculated using ACM0010 equations number 3, 4,5 and 6

Carbon dioxide (CO2) emissions from CO2 emission reduction by power generation using biogas within the project activity were calculated using ASMI.D. and equation number 7 of ACM0010.

The following table presents annual baseline activity GHG emissions by sources in CO2 equivalents:

Baseline GHG emission (t CO2eq)			
CH4	N2O	CO2	Total
44,522	47,596	13,446	105,563

Project activity GHG emissions:

Methane (CH4) emissions for the project activity were calculated using ACM0010 equation number 9.

Nitrous oxide (N2O) emissions for the project activity were calculated using ACM0010 Equations number 10, 11 and 12.

Project emissions from flaring of the residual gas stream ($PE_{flare,y}$) and Project emissions from heat use and electricity use ($PE_{elec/heat}$) = 0

The following table presents annual baseline activity GHG emissions by sources in CO2 equivalents:

Project activity GHG emission (t CO2eq)			
CH4	N2O	CO2	Total
476	1,683	0	2,159



Leakage emissions

The methane (CH₄) leakage from AWMS where gas is captured (project scenario – anaerobic digester) were included in the project scenario.

The nitrous oxide (N₂O) leakage emissions from manure management in the project scenario were calculated in the project scenario.

Physical Leakage from distribution network of the captured methane (PEPL) -
In this project scenario, The pipeline from collection point of the biogas to the generator \ flare is very short (i.e., less than 1 km, and for on site delivery only).
As a result of the above data, the physical leakage may be considered as zero.

Leakage – land application

Leakage covers the emissions from CH₄ and N₂O land application of treated manure, outside the project boundary.

The baseline scenario of this project is described as manure storage facilities, where manure is kept for several months and then spread in fields as solid or liquid.

The project activity includes collecting the manure, treating it with anaerobic digesters and spreading the effluent in fields after the treatment.

Leakage emissions are estimated as net of those released under project activity and those released in the baseline scenario.

Net leakage of N₂O and CH₄ are only considered if they are positive, therefore their leakage in this project may be considered as zero.

Total emission reductions

The following table presents total annual emission reductions by sources in CO₂ equivalents:

Total GHG emission reduction (t CO₂eq)			
CH₄	N₂O	CO₂	Total
44,045	45,913	13,446	103,403

**B.6.4 Summary of the ex-ante estimation of emission reductions:**

>>

year	Estimation of project activity emissions (tonnes ofCO ₂ e)	Estimation of baseline emissions (tonnes ofCO ₂ e)	Estimation of leakage (tonnes ofCO ₂ e)	estimation of overall emission reduction (tones of CO ₂ e)
2008	2,159	105,563	0	103,403
2009	2,159	105,563	0	103,403
2010	2,159	105,563	0	103,403
2011	2,159	105,563	0	103,403
2012	2,159	105,563	0	103,403
2013	2,159	105,563	0	103,403
2014	2,159	105,563	0	103,403
2015	2,159	105,563	0	103,403
2016	2,159	105,563	0	103,403
2017	2,159	105,563	0	103,403
2018	2,159	105,563	0	103,403
2019	2,159	105,563	0	103,403
2020	2,159	105,563	0	103,403
2021	2,159	105,563	0	103,403
2022	2,159	105,563	0	103,403
2023	2,159	105,563	0	103,403
2024	2,159	105,563	0	103,403
2025	2,159	105,563	0	103,403
2026	2,159	105,563	0	103,403
2027	2,159	105,563	0	103,403
2028	2,159	105,563	0	103,403
Total (tonnes of CO₂e)	45,348	2,216,819	0	2,171,471

**B.7 Application of the monitoring methodology and description of the monitoring plan:****B.7.1 Data and parameters monitored:***(Copy this table for each data and parameter)*

According to ACM0010 - “Consolidated Methodology for GHG Emission Reductions from Manure Management Systems” , the monitoring comprises of several activities including inspections for manure coming into the plant and inspections in the project boundary.

General and Baseline parameters

Data / Parameter:	NLT
Data unit:	Number
Description:	Average livestock population used in both baseline and project case emissions estimation.
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	According to each animal type.
Description of measurement methods and procedures to be applied:	Archive electronically during project plus 5 years
QA/QC procedures to be applied:	-
Any comment:	



CDM – Executive Board

page 50

Data / Parameter:	VS_{LT,y}
Data unit:	kg dry matter/animal/year
Description:	Volatile solid excretion per animal per day
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	According to each animal type and weight and by applying equation number 3 - Volatile solids content in raw manure (Vs)
Description of measurement methods and procedures to be applied:	Archive electronically during project plus 5 years
QA/QC procedures to be applied:	The monitoring frequency will be Annually and based on country specific published information and on IPCC
Any comment:	

Data / Parameter:	NEX_{LT,y}
Data unit:	kg N/animal/year
Description:	Annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year.
Source of data to be used:	IPCC 2006 Guidelines, table 10.19 page 10.59
Value of data applied for the purpose of calculating expected emission reductions in section B.5	According to each animal type and weight and by applying equation number 6 - annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year
Description of measurement methods and procedures to be applied:	Archive electronically during project plus 5 years
QA/QC procedures to be applied:	
Any comment:	



CDM – Executive Board

page 51

Data / Parameter:	W_{site}
Data unit:	kg
Description:	Weight of livestock
Source of data to be used:	Country publications
Value of data applied for the purpose of calculating expected emission reductions in section B.5	According to each animal type and weight.
Description of measurement methods and procedures to be applied:	Archive electronically during project plus 5 years
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	EG_{d,y}
Data unit:	MWh
Description:	Electricity exported to grid
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	According to electricity meters.
Description of measurement methods and procedures to be applied:	Archive electronically during project plus 5 years
QA/QC procedures to be applied:	Electricity meters will undergo maintenance/calibration subject to appropriate industry standards. The accuracy of the meter readings will be verified by receipts issued by the purchasing power company. Uncertainty of the meters to be obtained from the manufacturers. This uncertainty to be included in a conservative manner while calculating CERs and procedure for doing so should be described in the CDM-PDD.
Any comment:	



CDM – Executive Board

page 52

Data / Parameter:	CEF_{grid}
Data unit:	tCO ₂ /MWh
Description:	Emission factor of exported electricity
Source of data to be used:	Country publications
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Archive electronically during project plus 5 years
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	LF_{AD}
Data unit:	Fraction
Description:	Fraction of methane leakage from anaerobic digester
Source of data to be used:	IPCC 2006 Guidelines
Value of data applied for the purpose of calculating expected emission reductions in section B.5	According to the methodology, the value should be a default of 0.15 multiplied by methane content in biogas, which is 60%. But in the anaerobic digester we assume that there are no leakage from the digester and therefore a default value of 1% multiplied by 60% content of CH ₄ will be used.
Description of measurement methods and procedures to be applied:	Archive electronically during project plus 5 years
QA/QC procedures to be applied:	
Any comment:	



Data / Parameter:	F_{AD}
Data unit:	Fraction
Description:	Fraction of volatile solids directed to anaerobic digesters
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	It is assumed that all the manure entering the facility, will eventually enter the digester. Therefore the value of F _{AD} is 1.
Description of measurement methods and procedures to be applied:	Archive electronically during project plus 5 years
QA/QC procedures to be applied:	
Any comment:	

**B.7.2 Description of the monitoring plan:**

>>

The anaerobic biogas plant monitoring plan is based on the control system installed in the facility.

The monitoring plan is implemented to ensure that the reported values and long term GHG reductions are constantly monitored, measured and reported.

This advanced control system consists of a continuous monitoring, recording and processing of all the parameters monitored in the plant, some of these parameters, which are relevant for the GHG reduction monitoring plan, are described in section B.7.1.

The anaerobic biogas plant control system

The anaerobic biogas plant has a control system which enables the plants operator to control the plant parameters and operation variables.

All devices and installations will be implemented so that any kind of leakage or other malfunction will be noticed immediately and taken care of.

All the records and monitored values shall be made available for the selected DOE to verify project performance at the verification and certification stages.

The control system displays the flows inside the plant, as well as most of the important process variables and plant sections.

Among its other advantages, the control system enables the plant's operator to do the following:

- § Display and record the process variables and Operational data.
- § Activate the Alarm system.
- § Analyze and store process variables and operational data.

Display Analyze and store process variables and operational data

All important process variables and measurement values are recorded and stored, according to the plant operators requirements.

At any given time, process variables may be output and displayed.

Alarm system

According to the plant operators requirements, the alarm system of the control system can indicate any malfunction in any unit in the plant.

Monitoring the emission reductions

The emission reduction is calculated based on monitored values and IPCC values.

All monitored parameters like raw manure flow rate, solids concentration and others, are constantly measured.

All the leakage effects such as digester losses are already included in the project activity calculations.



B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

Date of completion of the final draft of this baseline section (dd/mm/yyyy):

30.12.06

Name of person / entity determining the baseline:

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**SECTION C. Duration of the project activity / crediting period****C.1 Duration of the project activity:****C.1.1. Starting date of the project activity:**

>>

The starting date of the project activity is 01/01/2008

C.1.2. Expected operational lifetime of the project activity:

>>

The expected operational lifetime of the project activity is 25y 0m.

C.2 Choice of the crediting period and related information:**C.2.1. Renewable crediting period****C.2.1.1. Starting date of the first crediting period:**

>>

The starting date of the first crediting period is 01/01/2008

C.2.1.2. Length of the first crediting period:

>>

7 years 0 months

C.2.2. Fixed crediting period:**C.2.2.1. Starting date:**

>>

Not Applicable

C.2.2.2. Length:

>>

Not Applicable

**SECTION D. Environmental impacts**

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D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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The Israeli Ministry of Environment required Eco Energy Golan to prepare environmental survey concerning the planned biogas facility. In this detailed report, all the environmental impacts of the plant are evaluated. This environmental report took into account all the regional data of the surrounding area where the facility is planned to be built.

Among the issues raised in the environmental survey were:

- Geological and hydro geological survey of the area where the facility will be constructed.
- Wind speed and wind direction survey.
- Full environmental impact assessment of the plant's operation during its construction phase and operation phase.
- How ground water will not be harmed by the plant's operation.
- All the social-economical benefits of the plant operation and location including its sustainable development approach toward the treatment of the animal manure.

The Israeli Ministry of Environment has issued its permits for the facility. Once the construction of the facility will start, a full and detailed monitoring plan will be issued to verify that the facility maintains its environmental obligations.

The anaerobic biogas plant will treat animal manure produced in areas all around the facility and thus, totally change the agricultural waste treatment status in the Golan. The biogas facility will contribute significantly to the renewable energy production in Israel.

The manure waste treatment proposed by the project will provide several environmental benefits.

- The treatment of the manure will take place in one treatment facility, rather than the current situation where the manure is collected on the farm for several months and then spread in fields without any treatment.
- The facility's operation will prevent the percolation of chlorine to the ground water by transferring the salts from hydrological sensitive areas to areas which are less hydrological sensitive.
- The treatment facility will reduce odor and fly nuisance occurring today in the villages.
- The facility's operation will contribute to the quality of life in the villages through the high frequency of manure evacuation from the farms.
- The facility's operation will contribute to Israel's need for renewable energy production.



As described above, the project contributes to sustainable development, manure treatment and to the lives of people in the villages surrounding the facility, while promoting the greenhouse gases emission reduction.

The pasteurization and anaerobic digester within the process of the biogas facility, contribute to the environment through the following items

- The treatment reduces the organic matter content in the manure
- The treatment exterminates pathogens
- During the treatment organic nitrogen transfers into its inorganic form – one which is much more available to crops.
- The unpleasant odor of the manure is totally destroyed and exterminated.

Eco Energy Golan biogas project is expected to initiate the anaerobic digester as the leading treatment of animal manure in Israel.

The facility is facing great investment, technological and logistical challenges that by overcoming them - will stimulate other facilities and industries to improve the existing waste treatment in order to reduce the environmental impact of waste in general, reduce anthropogenic GHG emissions due to organic waste treatment and improve livestock manure management systems in specific.

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

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SECTION E. Stakeholders' comments

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E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

E.2. Summary of the comments received:

>>

E.3. Report on how due account was taken of any comments received:

>>

Annex 1**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project will gain funding from the Israeli Ministry of Agriculture.

The grant for Eco-Energy Golan biogas project is given only due to the fact that the salinity content in animal manure are transferred from hydrological sensitive areas, such as the coastal aquifer or the Sea of Galilee basin, to areas which are not hydrological sensitive.

By supporting the implementation of Eco Energy Golan project, the Israeli government encourages the modification of current manure management systems, where manure is stored in the farm for about 4 months and then spread in agricultural fields which are hydrological sensitive.

As explained above, the liquid exiting the anaerobic facility will be spread only in areas which are not hydrological sensitive.

In addition, the current manure management which consists on storing the manure in the farm for several months, lead to the direct release of CH₄, N₂O into the atmosphere as a result of the anaerobic digestion process that takes place inside the storage facilities.

Israel is not an Annex I party.



Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION
