BYZ GLOBAL ENERGY BIOGAS PLANT

Document Prepared by

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1 PROJECT DETAILS

1.1 Summary Description of the Project

BYZ Global Energy Biogas Plant project (hereafter referred to as the project) is a biogas-to-energy project that will generate renewable energy by capturing biogas from cattle manure -via anaerobic digestion- and utilizing it to produce thermal and electric energy through biogas systems. The project is being implemented by BYZ GLOBAL ENERJİ VE GÜBRE ÜRETİMİ TİCARET SANAYİ ANONİM ŞİRKETİ in Kocasinan district, Kayseri province, in Turkey.

Agricultural activities have been a main household income sources for those living in Kocasinan. However, whilst number of stockbreeders and poultry farms has substantially increased for the last years in the region, cattle manure generated at farms, which is left to decay at and around farms in aerobic conditions, has become a major environmental, economic and legal problem for cattle breeders and poultry farmers, as well as for the local people living around farms.

The common practice for the livestock and poultry farm owners to manage the manure generated at their farms is to have uncovered anaerobic lagoons/ponds at their farms in the region. Since there is no legal regulation to mandate the livestock and poultry farm owners to implement different anaerobic lagoon design and to capture and/or utilize methane generated at these lagoons, the continuum of this common practice - without making any modification of their existing manure management systems which are based on uncovered anaerobic lagoons/ponds- is the most economic, viable and reasonable for cattle farm owners. In other words, the baseline scenario for the cattle manure is to be left to decay anaerobically in uncovered lagoons/ponds at the farms.

The project whose main feedstock will be cattle and chicken manure generated at farms in Kocasinan, provides an environmentally friendly solution to this manure management problem.

It is estimated that approximately 120 tons of cattle manure and 80 tons of chicken manure generated at animal farms will be collected daily through special sewage trucks equipped with close-tanks in order to prevent any odor and/or manure leakages and to be fed into the anaerobic digesters at the proposed biogas power plant.

Within the scope of the project, biodegradation of organic wastes coming to the Biogas Plant in anaerobic environment will take place. The biogas that will be released during the biodegradation of organic wastes will be used for electricity and heat production in biogas unit. The proposed project activity has one biogas engine installed at the biogas power plant, with the total capacity of 1,501 KWe/h. Accordingly, the biogas generator system to be installed will be designed with a total power of 1.501 MWe/h. The annual feed-in electricity is estimated to be 12,968,640 KWh. Whilst heat generated at the plant is used at the facility to warm the digesters, the electricity generated is directly fed to the national grid.

Whilst providing sustainable development benefits to the host communities and the host country, the proposed project activity will reduce greenhouse gas (GHG) emissions mainly by

- preventing GHG emissions, methane in particular, from being emitted directly to the atmosphere from cattle manure that would be otherwise left to decay in aerobic conditions;
- replacing the electricity that would have otherwise been generated by the national grid which is heavily dependent on fossil-fuel-based resources, through generating renewable energy and feeding it to the grid;
- producing organic compost from solid waste stored in anaerobic digesters.

The project has obtained the approval of Environmental Impact Assessment (EIA) issued by the Ministry of Environment and Urbanization in Turkey on September 27th, 2018 and the Electricity Generation License (EGL) issued by the Energy Market Regulatory Authority (EMRA) in Turkey on October 18th, 2018.

The project has begun to generate electricity on July 30th, 2019, which is regarded as the project start date.

This project adopts the fixed crediting period of 10 years. The expected average annual emission reductions are 50,576 tCO_2eq/y. Accordingly, the project is expected to generate 505,760 tCO_2eq emissions reduction throughout its fixed crediting period.

1.2 Sectoral Scope and Project Type

The project falls into sectoral scope 01: Energy industries (renewable - / non-renewable sources), sectoral scope 13: Waste handling and disposal. The project is not a grouped project.

1.3 Project Eligibility

The project is a biogas project, capturing Greenhouse Gases (GHGs), methane in particular, generated from animal manure in anaerobic conditions and utilizing them via biogas generator units, for electricity generation, which is eligible under Version 4 of the VCS Standard.

1.4 Project Design

The project is not a grouped project.

1.5 Project Proponent

Organization name	BIO SOLUTIONS LLC.
Contact person	Dr. Umut ÖNDER
Title	Founder
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Organization name	KUZEY GLOBAL ENERJİ VE GÜBRE A.Ş. on behalf of BYZ Global Enerji ve Gübre Üretimi Ticaret Sanayi Anonim Şirketi[1]
Contact person	Başar BEYAZOĞLU
Title	Chairperson
Address	Bostancı Mahallesi, Kitapçı Mehmet Sk., A Blok Köşk Apt. No: 11/1, Kadıköy, İstanbul/TURKEY, 34744

[1] Please see the Annex containing the Board Decision assigning Mr. BEYAZOĞLU as the designated/authorized Carbon Manager on behalf of BYZ Global Enerji ve Gübre Üretimi Ticaret Sanayi Anonim Şirketi.

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1.6 Other Entities Involved in the Project

Organization name	BIO SOLUTIONS LLC.
Role in the project	Project Developer / Proponent
Contact person	Dr. Umut ÖNDER
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1.7 Ownership

Both the attached approval of Environmental Impact Assessment (EIA) issued by the Ministry of Environment and Urbanization in Turkey and the attached Electricity Generation License (EGL) issued by the Energy Market Regulatory Authority (EMRA) in Turkey established the project ownership to BYZ Global Enerji ve Gübre Üretimi Ticaret Sanayi Anonim Şirketi. These official documents are accordingly establishing the property and contractual right both in the plant and equipment that generate GHG emission reductions. Nevertheless, it is important to note here that the Board assigned Mr. Başar BEYAZOĞLU, the Chairperson of KUZEY GLOBAL ENERJİ VE GÜBRE A.Ş., as the Company's designated/authorized Carbon Manager.

1.8 Project Start Date

The project start date is 30 July 2019, as the operation start date on which the project began to generate not only renewable energy, but also emission reductions.

1.9 Project Crediting Period

This project adopts the fixed crediting period of 10 years, from 30/07/2019 to 30/07/2029 (the start and end dates included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Indicate the scale of the project (project or large project) and the estimated annual GHG emission reductions or removals for the project crediting period.

Project Scale	
Project	√
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
30/07/2019 – 31/12/2019	21,073.3[2]
2020	50,576
2021	50,576
2022	50,576
2023	50,576
2024	50,576
2025	50,576
2026	50,576
2027	50,576

[2] These estimations are based on the preliminary feasibility study conducted for the project's eligibility to apply voluntary emission scheme. Estimated GHG emission reductions or removals (tCO_2e) are going to be measured in detail and finalized in accordance with the methodologies applied to the project in the final version of this PDT which will be submitted to a Designated operational Entity (DoE) for the project's validation.

2028	50,576
01/01/2029 – 30/07/2029	29,502.7
Total estimated ERs	500,576
Total number of crediting years	10
Average annual ERs	50,576

1.11 Description of the Project Activity

As described in section 1.1., the scenario existing prior the project's implementation is the continuum of common practice for the livestock and poultry farm owners in the region to leave cattle and chicken manure generated at their farms to decay aerobically resulting in greenhouse gases generated from animal manure, methane in particular, were released directly into atmosphere.

Emissions associated with the baseline scenario are the CH_4 emissions due to the atmospheric release of methane sourced from animal manure left to decay aerobically and CO_2 emissions due to the power generation by the national grid which is dominated by fossil fuel burning power plants. Through the project's implementation, the methane previously released from animal manure left to decay aerobically will be captured via anaerobic digestion and utilized to produce thermal and electric energy through biogas generator systems in the biogas power plant. In addition, the electricity generated at the plant will be directly fed to the national grid, avoiding and/replacing the dispatch of the same amount of electricity from fossil-fuel based power plants connected to the national grid. Thus, none of the equipment installed within the project boundary exists in the baseline scenario.

In the proposed project activity's technical feasibility study, it is expected that the project will consist of the installation of parking area; wheel washing unit; weighbridge; waste receiving unit; liquid fermented product storage unit; solid fermented product warehouse; fermenter tank; hydrolysis tank; separator; hygiene unit; wastewater treatment plant; biogas generator system; desulphurization system; biogas burning chimney (flare); engine room; administrative building; gas engine; biogas processing; absorption towers; biogas drying units; ceramic and gravel filters; electricity transmission-monitoring and control units; plant and process monitoring-control and management systems.

UNIT NAME	NUMBER OF UNITS (Unit)
Parking Area	1
Wheel Washing unit	1
Weighbridge	1
Waste Feeding and Pre-Pools (Waste Receiving Tanks)	1
Fermenter Tank	1
Hygiene Tank	1
Separator	1
Liquid Fermented Product Storage Unit	1
Solid Fermented Product Warehouse	2
Biogas Generator System	1
Desulphurization System	1
Biogas Burning Chimney	1
Transformer	1
Engine room	1
Generator	1
Administrative Building	1

- Parking Area

A 65 m2 vehicle parking area will be created at the entrance of the operation area, where all vehicles coming to the facility can park.

- Wheel Washing Unit

A wheel washing unit will be established on an area of 80 m2 in order to ensure the disinfection of vehicles entering and leaving the facility. The wheel washing unit will consist of a 40 cm deep pool and a pressurized washing system. Washing wastewater to be collected in the settling pond connected to the wheel washing unit will be drawn by a vacuum truck and sent to the nearest wastewater treatment plant.

Figure 1.2. Wheel Washing Unit (Example)

- Weighbridge

Animal wastes will be brought to the facility by vacuum trucks or closed box trucks belonging to the company or to be rented, and vehicles will enter the waste reception area after they are weighed at the weighbridge at the entrance. All wastes brought to the facility will be accepted after they are weighed and recorded. A data recording system will be established that includes information such as the source, amount, and access method of the waste accepted to the facility. The weighbridge to be used in the facility will be 15 meters long and 60 tons capacity.

Figure 1.3. Weighbridge (Example)

- Waste Receiving Unit

Wastes shall be accepted to the facility in a way that does not pose an environmental risk and necessary control systems shall be established to monitor the processing of wastes. In order to collect the animal wastes brought to the facility daily and prepare them to be shipped to the fermenting tanks with a pump, a pool made of C30 concrete with impermeability insulation will be constructed. This pool will be used for preliminary acceptance of bovine animals' waste. The pool with a volume of 600 m3 will also be used as a unit where the amount of bovine animals' solid matter is balanced. Animal wastes that will be accepted to the facility through vacuum trucks, pumps or closed box trucks will be loaded into the bovine animals pre-pool unit.

A total of 290 tons/day of animal waste from PVC pipes will be loaded into the fermenter tank by means of the manure pump in the engine room, through pneumatically controlled valves.

The top of the pool will be made of closed reinforced concrete so as not to prevent waste acceptance. Animal wastes accepted will not be kept in ponds too long and will be transferred to fermenter units within 7 days at most. In addition to 230 tons of waste per day, 100 m3 of water will be added per day.

The waste reception unit will be built as top-covered with permanent construction material to provide protection against the effects of meteorological events. The base of the waste reception unit will be made of C30 concrete and non-flammable material with a thickness of at least 30 cm to ensure sealing. A separate collection mechanism will be developed to prevent the waste from contacting with groundwater, sewage or surface water or leaking. The ground will be inclined properly in order to collect the leachate that will occur in the waste reception area.

- Liquid Fermented Product Storage Unit

The fermented product can be used as a liquid or a solid by dehydrating. Products with a dry matter content of up to 15 % are considered liquid fermented products. In case the liquid fermented product is dehydrated, the oxygenated process is applied to ensure that the solid product obtained provides the stability values in Annex-4 of this Communiqué.

The liquid fermented product coming from the separator will be stored in a closed pool with a total area of 7,200 m3. Liquid fermented product storage unit will be built in the facility area. The unit, which is planned to be 25 meters long, 57.6 meters wide and 5 meters deep, and will be built in a way not to be affected by meteorological events, will have an impermeable structure that will be insulated with EPDM membrane.

According to the Communiqué, in case the liquid fermented product is placed on the market, this process will be carried out in accordance with the provisions of the Regulation on the Production, Import, Export and Putting on the Market of Organic, Organomineral Fertilizers and Soil Regulators Used in Agriculture and Other Products with Microbial, Enzyme and Organic Sources, published in the Official Gazette dated 23/02/2018 and numbered 30341. The products listed in the annexes of this Regulation shall be placed on the market as packaged and registered. Products are placed on the market in a way that they cannot be restored when their packaging is opened.

- Solid Fermented Product Warehouse

As stated in the "Mechanical Separation, Bio-Drying and Biomethanization Plants and Fermented Product Management Communiqué ", for 30.8 tons/day of solid fermented product coming out of the solid fermented product hygiene and drying unit, a storage area with a total area of 760 m2 will be built, in a size where these products will be deposited for at least 6.5 months without being affected by meteorological events.

The solid fermented product obtained will be used as fertilizer in our lands. In order for the solid fermented product obtained as a result of biomethanization to be used as soil improver, it must meet the criteria in Annex-3 and Annex-4 of this Communiqué. In the solid fermented product obtained from biodegradable wastes, the criteria in Annex-3 of this Communiqué shall be met in accordance with the provisions of the Regulation on the Production, Import, Export and Putting on the Market of Organic, Organomineral Fertilizers and Soil Regulators Used in Agriculture and Other Products with Microbial, Enzyme and Organic Sources, published in the Official Gazette dated 23/02/2018 and numbered 30341.

- Fermenter Tank

Within the scope of the project, it is a pool with a capacity of 5,500 m3, where the waste coming from the pre-pool is collected and the animal waste is fermented for 35-45 days. It will be covered with EPDM membrane and water and heat insulation will be performed. There will be a heating system in the fermenter where the hot water obtained from the biogas generator system will be circulated. The length of pipes required for the heating system will be determined according to the heat loss calculation, and the fittings will be installed on the base and side walls of the fermenter units. Heat insulation will be made on the ground and exterior of the fermenter in order to protect the heat inside.

Temperature, pressure, pH, solids content, organic loading values, alkalinity, volatile fatty acids and biogas production in the reactor where the fermentation process takes place shall be continuously monitored.

There will be a temperature control system through which the reactor temperature will be monitored, an appropriate mixing system for the fragmentation of the wastes fed into the reactor within the specified waiting period and the formation of methane gas at the optimum level, the gas storage unit where the gas obtained will be accumulated, the unit with the gas purification system, an early warning system to prevent possible gas leaks.

Figure 1.4. Fermenter Tank (Example)

The gas accumulated in the reactor will be stored in the membrane that covers the reactor and is completely impermeable to air. Double membrane will be used and the space between the two membranes will be filled with air. The purpose of this is to increase the durability and life of the membrane, and the gas will be stored in the membrane with constant pressure. The waiting period of the wastes in the digesting reactor was designed in equal volume for operational flexibility, and the total hydraulic retention time of the wastes was determined as 28 days. There is no feedback to the system.

Our pH value, which is one of the criteria for feeding fermentors, is 7-7.5, in addition to this, our C/N ratio is 25%. There is no additive in our clean water and fermented liquid. Our dry matter / volatile dry matter ratio is 47%. Particle size is max. 8 mm.

- Hydrolysis Tank

It is the tank where the fermentation first starts and is used to separate the materials such as sand in the manure from the manure. In addition, pre-mixing will be performed. It is a concrete fabricated tank. There will be a heating system in which hot water will be circulated. There will be a mixer in the tank.

- Separator

The separator is the machine necessary for the conversion of animal waste fermented in biogas plants to solid and liquid form. One separator will be used within the scope of the project. The fermented output will be separated in a separator with a power of 5.5-7.5 kW, operating according to the squeezing screw filter principle to be transformed into the final product in liquid and solid form.

Figure 1. 5. Separator (Example)

The separator to be used will be capable of separating 20% solid fermented and 80% liquid fermented. The separator will have a part that will remove the solid part separated from the liquid with the help of a welt that opens to the outside. The separator will be designed in a way that it enables to remove the liquid ferment by gravity or a pump.

- **Hygiene Unit**

Within the scope of "Mechanical Separation, Bio-Drying and Biomethanization Plants and Fermented Product Management Communiqué", 149,2 tons/day of liquid fermented product shall be heat treated for 1 hour at 70°C in a separate pool in order to meet the "Liquid Fermented Product Quality Criteria" listed in Annex-2, and hygiene will be ensured. The liquid fermented product coming out of the hygiene pool will be transferred to the liquid fermented product storage pool with a volume of 7,200 m3. Within the scope of the project, it is planned to sell 53,712 tons of liquid fermented products (149.2 tons of liquid fermented fertilizer per day x 360 days = 53,712 tons).

If the liquid fermented product cannot be sold, the liquid fermented product will be stored for at least one month in a fully covered pool with a volume of 7,200 m3 in a way it is not affected by meteorological events, and will be used as fertilizer in our lands in accordance with the provisions of the "Mechanical Separation, Bio-Drying and Biomethanization Plants and Fermented Product Management Communiqué". Within the framework of the provisions of the Regulation on the Production, Import, Export and Putting on the Market of Organic, Organomineral Fertilizers and Soil Regulators Used in Agriculture and Other Products with Microbial, Enzyme and Organic Sources, it will be ensured that it meets the values specified in Annex-2 of this Communiqué and that the maximum nitrogen amount in the soil is 170 kgN/ha year, by the method of injection to the surface of the land, by using appropriate tools and equipment, in a way that will not pollute the environment.

Within the scope of "Mechanical Separation, Bio-Drying and Biomethanization Plants and Fermented Product Management Communiqué", solid fermented product shall be heat treated for 1 hour at 70°C in the drying step in order to meet the "Solid Fermented Product Quality Criteria" listed in Annex-3, and hygiene will be ensured.

If the liquid fermented product cannot be sold and cannot be used on our own lands, it will be sent to the wastewater treatment plant, if not, a treatment facility will be established.

- Wastewater Treatment Plant

If the liquid fermented product collected in the liquid fermented product collection warehouse cannot be sold; a wastewater treatment plant with 120 m3/day capacity will be established to treat the liquid fermented product and other wastewater (domestic wastewater) of the facility. Wastewater will be treated in the wastewater treatment facility and discharged to the receiving environment after meeting the discharge standards specified in the Water Pollution Control Regulation. If a wastewater treatment plant is not established, it shall be treated to comply with the discharge standards in line with the Water Pollution Control Regulation published in the Official Gazette dated 31/12/2004 and numbered 25687. It will be transported to the nearest wastewater treatment plant by vacuum truck.

- Biogas Generator/Engine System

There will be one biogas engine unit within the scope of the facility. 1,501 kWh of electricity will be generated per hour in the biogas generator unit.

- **Desulphurization System**

The methane gas obtained will be taken to the desulphurization device by blower. Desulphurisation device shall reduce the unwanted H_2S in the biogas below 200 ppm and at the same time keep the biogas constant at the desired 150 mbar pressure at the zero pressure regulator inlet of the biogas engine. As long as the pressure and m3 values of the biogas are kept under the desired conditions, electricity production shall be carried out by starting the biogas unit.

1 gr of $Fe(OH)_3$ and Fe_2O_3 have approximately 850 gr H_2S removal capacity . The density of biogas is 1.2 kg/m3, there is 1-2% H_2S in 1 m3 of biogas.

- **Biogas Burning Chimney (Flare)**

If a problem is encountered in the biogas power plant, a torch (emergency gas burning system) with 850 biogas/h flow and approximately 1700 kW thermal power will be used to stabilize the gas in the safest way in the case that the gas cannot be spent in the biogas unit and stored.

Figure 1.6. Torch/Flare system (Example)

The security fire to be used will have the characteristics to operate at 20-60 millibar gas pressure. The pipe entrance of the security fire to be used will be 10 cm in diameter and its total height will be in the range of 500-540 cm. The safety fire will have manual and process-managed automatic opening and closing units, flame traps, ignition systems and incinerators. It will also have its own automation system so that it can be activated automatically when there is a problem in the system and shut down when necessary. It will have the ability to burn with a flame diameter of 60-70 cm. It will have burning efficiency of 95-98%. The security fire will have a completely stainless-steel main body. The combustion temperature of our biogas burning unit is 800°C and more.

- **Engine Room**

In the facility, an engine room with an area of 210 m2 will be established, in which there will be pump ensuring the transfer between the tanks, screens through which the pressure fertilizer levels in the collector tanks will be monitored and control panels.

- **Administrative Building**

Within the scope of the project, an administrative building with an area of 250 m2 will be built within the operation site.

- **Gas Engine**

The gas produced in the reactor is cooled in a humidifier and the excess moisture is removed. Here, it is transferred to the gas engine with the help of a blower. In the gas engine, there is a system that we call the gas train and evaluates the parameters related to the gas in its content. In order for the gas engine efficiency to be 45%, it is transferred with 120 mbar and humidity below 80%. The purpose of this is not to damage the gas engine and to get 100% performance. Combustion occurs after the gas passing through here is mixed with air in the gas engine. The mechanical energy generated here is transferred to the alternator by the shaft in order to convert it into electrical energy. Mechanical energy is converted into electrical energy here and sent first to the transformers and then to the network line.

OUTPUT / FUEL CONSUMPTION		
Power according to ISO Standards ICFN	kW	1.540
Effective fuel pressure and nominal speed	Bar	20.17
Fuel Type		Biogas
Methane content / Minimum methane content	MZ	135 (117 d)
Compression Ratio	Epsilon	12.5
Min. / Max. gas pressure (gas train inlet)	mbar	120 -200 c)
Gas pressure max. fluctuation	mbar/sec	10
Section 2 inlet temperature	^oC	55
Specific engine fuel consumption	g/kWh	0.20
Max. oil temperature	^oC	85
Jacket water temperature max.	^oC	95
Oil tank capacity (filling)	Lit	~437

TECHNICAL DATA		
Manner of work		4 cycle
Configuration		V 70
Number of cylinders		20
Diameter	mm	145
Piston travel	mm	185
Nominal speed	rpm	1,500
Average piston speed	m/s	9.25
Length	mm	3,750
Width	mm	1,580
Height	mm	2,033

Empty weight	kg	7,200
Gross weight	kg	7,900
Moment of inertia	kgm2	11.64
Rotation direction (from flywheel view)		Left
Radio interference level VDE 0875		N
Starter motor output	kW	13
Starter motor voltage	V	24

- **Biogas Processing**

The produced gas is collected in the membrane on the fermentor that is used to store the gas. For the desulphurisation process, O2 between 3% and 5% is added to the gas accumulated in the membrane. The purpose of adding O2 is to reduce the amount of H2S in the gas. The H2S, which is around 4000 ppm, is reduced to 500 ppm at the end of the aeration process. After the desulphurisation process is finished, the gas is sent to the gas engine with the help of a blower. It enters the dehumidification column first. Here, the humidity of the gas with high humidity is reduced by cooling. Pressurized gas is transmitted to the gas engine with the help of the blower.

- **Absorption Towers**

Gas absorption is the process of obtaining liquid solutions of gaseous components by contacting with a suitable liquid to dissolve one or more components contained in a gas mixture. That is, absorption can be defined as the removal of the soluble gaseous component from a gas stream by dissolving it in a solvent liquid. This process is also performed with absorption towers in biogas plants.

- **Biogas Drying Units**

Biogas from the digester contains a certain amount of moisture. This moisture causes corrosion in gas engines and turbines during combustion. As a result, high repair costs and long downtimes during these repairs occur in gas engines. In order to prevent this, it is necessary to use biogas drying units in biogas lines, before gas engines and turbines.

- **Ceramic and Gravel Filters**

There are water and various particles in the biogas coming from the digester or biogas reactor. These particles must be removed by filtering to prevent them from damaging the equipment in the biogas lines.

- **Electricity Transmission-Monitoring and Control Units**

Measurement and monitoring units are used in electricity production and distribution facilities to monitor energy consumption and quality. Monitoring current and voltage harmonics together with other energy quality parameters will give an accurate idea of the state of the power system. Monitoring the energy quality is a vital issue due to the increasing non-linear loads on the network.

- **Plant and Process Monitoring-Control and Management Systems**

Industrial facilities are operated, monitored and controlled through process management systems. The process management concept adapts to the process engineering structure of the facility. Maximum security, state-of-the-art usability and flexible expansion capabilities are achieved by configuring the plant horizontally into function units with specific control and automation tasks. In this way, a clearly structured, hierarchical and consequently transparent facility structure is achieved. Redundant structures related to the process are not cancelled with the control system.

SURFACE WATER AND WASTEWATER MANAGEMENT

- **Surface Water Management**

Biogas power plant from animal waste shall be designed in a way to prevent contamination of the receiving environment, soil, surface and underground waters in accordance with the provisions of "Mechanical Separation , Bio-drying and Biomethanization Plants and Fermented Product Management communiqué".

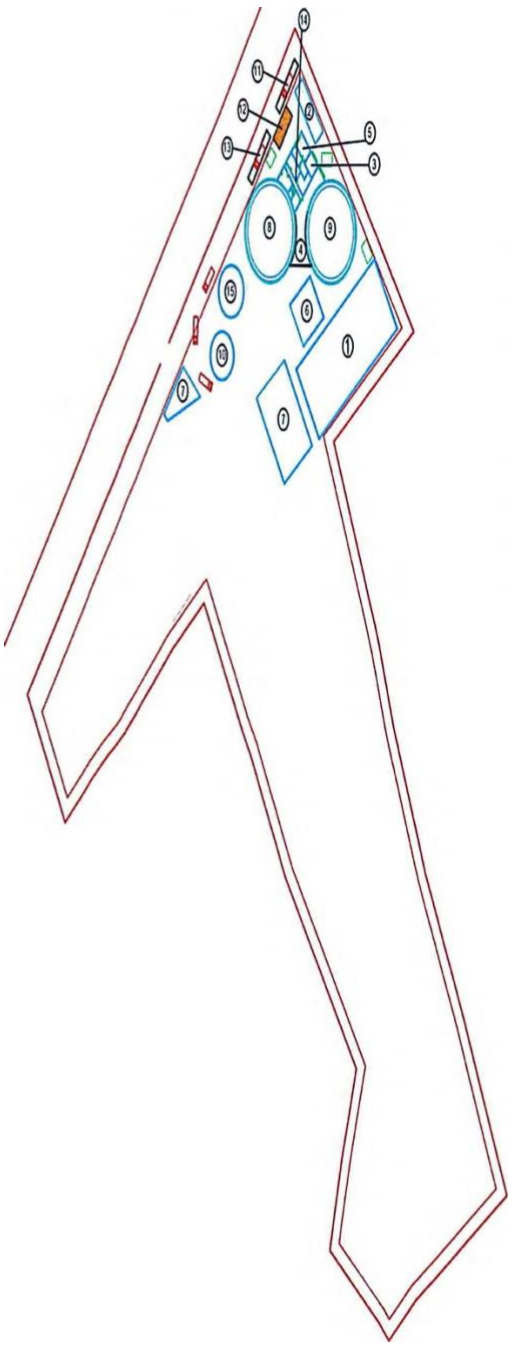
Separate collection of rainwater, washing and similar wastewater to be generated throughout the enterprise will be ensured. According to the topography of the operation area and the locations of the units, rainwater collection channels will be created by sloping the ground properly to collect the rainwater separately that will fall into the operation area. The collected rainwater will be directed to the canal located near the facility.

MEASURES THAT MAY BE TAKEN AGAINST THE EFFECTS OF WASTES ON UNDERGROUND WATER

Fermenter tanks and other units where leakage can occur (waste feeding and pre-pools, mixture tank and liquid fermented product storage) to be used within the scope of the project shall be designed in a way to prevent contamination of the receiving environment, soil, surface and underground waters in accordance with the provisions of "Mechanical Separation, Bio-drying and Biomethanization Plants and Fermented Product Management communiqué". The base of the waste reception unit will be made of C30 concrete and non-flammable material with a thickness of at least 30 cm to ensure sealing. A separate collection system will be established on the floor to prevent the waste from coming into contact with or leakage of groundwater, sewage or surface water, and the ground will be properly inclined in order to collect the leachate that will occur in the waste receiving area.

During the construction phase of the fermenter tanks and other units where leakage may occur (waste feeding and pre-pools, mixture tank and liquid fermented product storage), the ground will be covered with a membrane (HDPE) and collection channels will be created around these areas to collect possible leaks. Any leachate will be collected and transferred to waste feeding and pre-pool units. In addition, separate collection systems will be established for separate collection of rainwater, washing and similar wastewater and the ground of the operation area will be completely covered with concrete, and pollution of the receiving environment, soil, surface waters and underground waters will be prevented. During these procedures, the provisions of the Law No.167 on Groundwater, the Regulation on the Protection of Groundwater against Pollution and Degradation and the Water Pollution Control Regulation will be complied with.

GENERAL LAYOUT PLAN



1 - LIQUID FERMENTED PRODUCT STORAGE UNIT

2- TRANSFORMER

3 - DESULFIRIZATION UNIT

4 - ENGINE ROOM

5 - BIOGAS GENERATOR SYSTEM

6- SEPARATOR

7 - SOLID FERMENTED PRODUCT STORAGE

8- FERMANTOR TANK

9- HYGIENIZATION TANK

10- WASTE RECEPTION UNIT

11 WHEEL WASHING UNIT

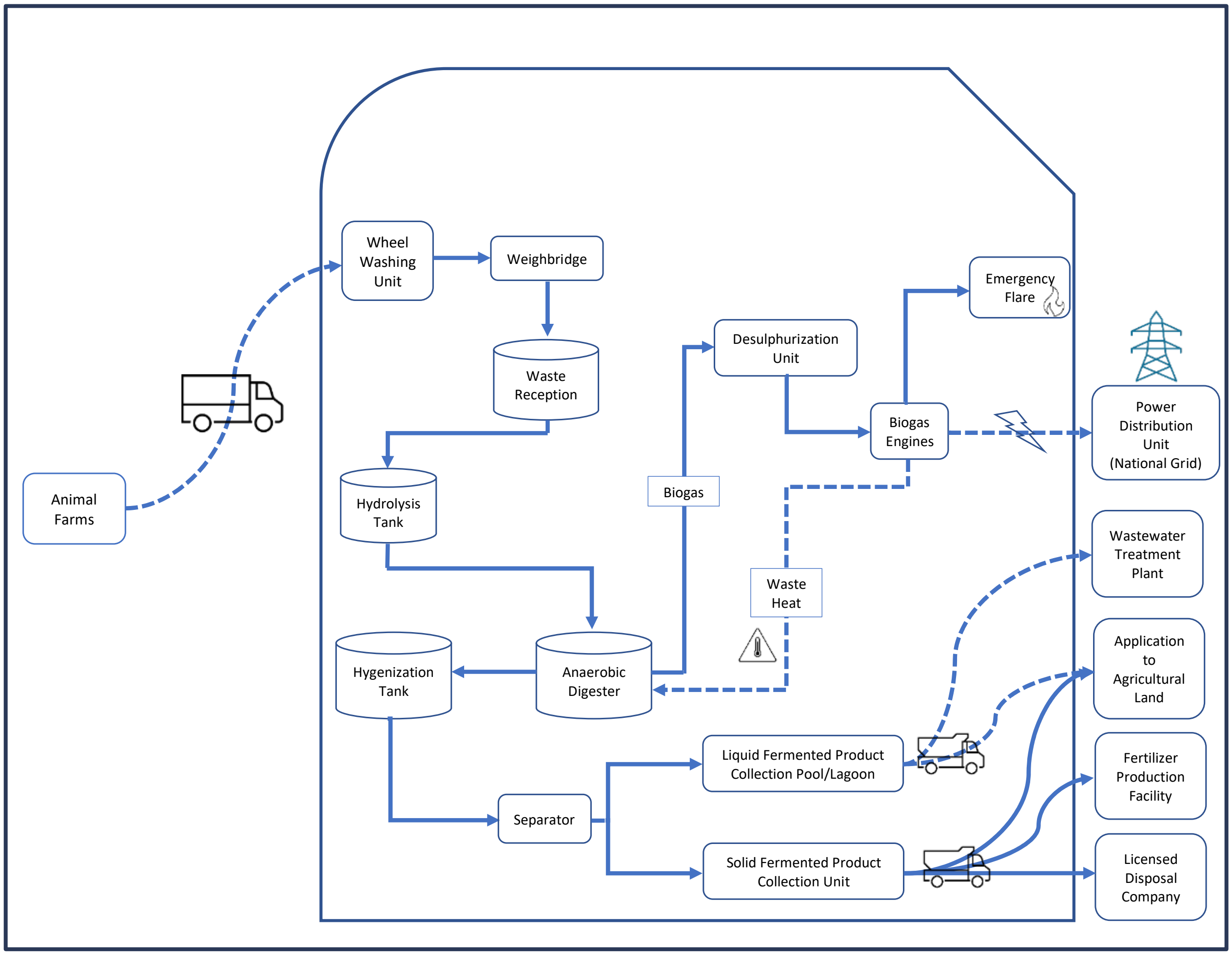
12 VEHICLE PARK AREA

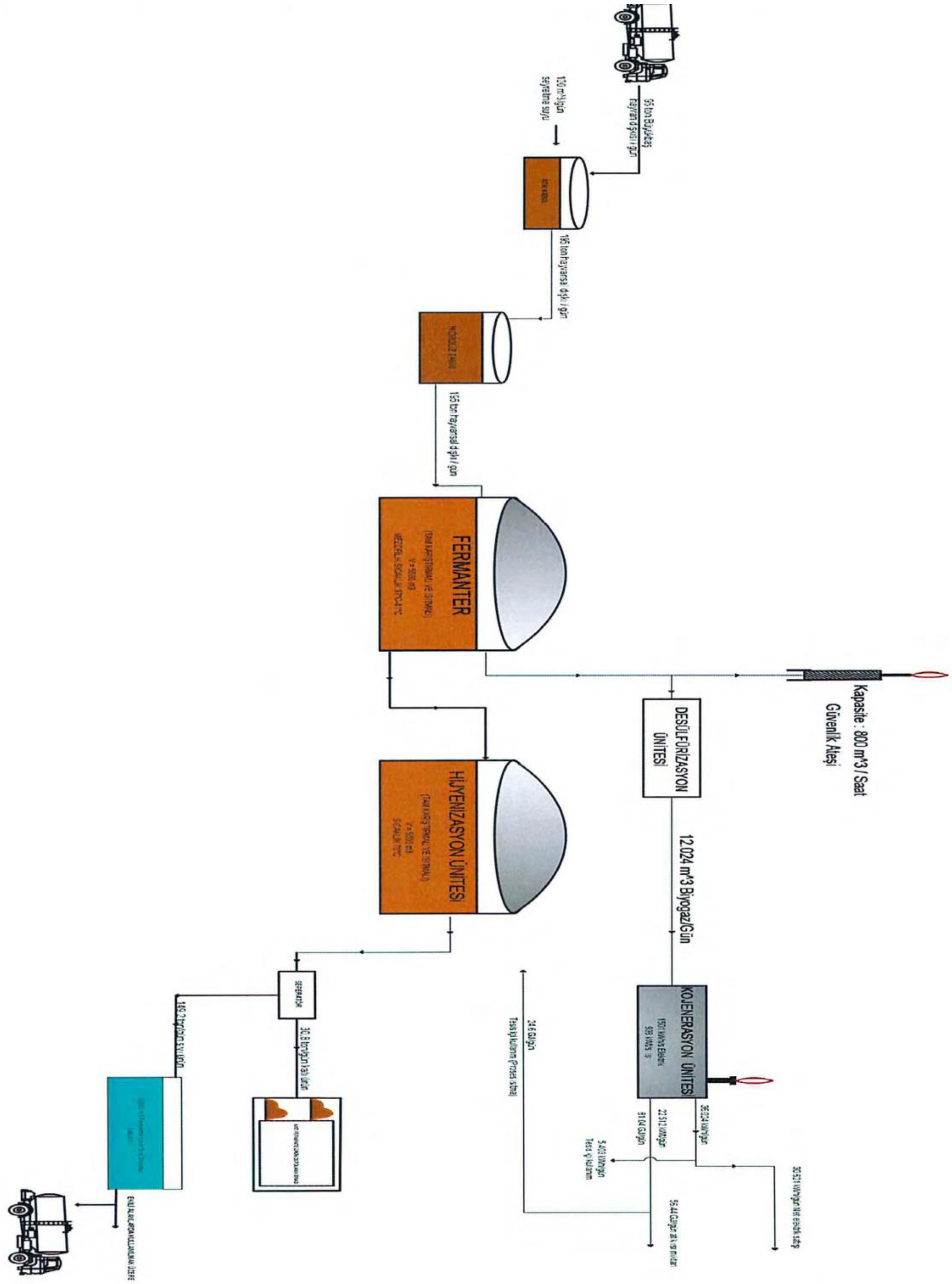
13 WEIGHBRIDGE

14 ADMINISTRATIVE BUILDING

15 HYDRAULIS TANK

PLANT FLOW CHART




FERMANTER
HIJYENIZASYON ÜNİTESİ
DESÜLFÜRİZASYON ÜNİTESİ
12.024 m^3 Biyogaz/Gün
Kapasite : 800 m^3 / Saat
Güvenlik Ateşi
KOJENERASYON ÜNİTESİ

BIOGAS AND LEACHATE MANAGEMENT

- **Biogas Management**

Biogas will be obtained from animal waste at the biogas power plant. With the biogas obtained, 1,501 kWh of electricity will be produced per hour.

If a problem is encountered in the biogas power plant, a torch (emergency gas burning system) with 850 biogas/h flow and approximately 1700 kW thermal power will be used to stabilize the gas in the safest way in the case that the gas cannot be spent in the biogas engine unit and stored.

Heat will be released in the facility. This amount will be used for heating the heat fermenter tanks.

- **Leachate Management**

Fermenter tanks and other units where leakage can occur (waste feeding and pre-pools, mixture tank and liquid fermented product storage) to be used within the scope of the project shall be designed in a way to prevent contamination of the receiving environment, soil, surface and underground waters in accordance with the provisions of "Mechanical Separation, Bio-drying and Biomethanization Plants and Fermented Product Management communiqué".

In this context, the waste reception unit will be built as top-covered with permanent construction material to provide protection against the effects of meteorological events. The base of the waste reception unit will be made of C30 concrete and non-flammable material with a thickness of at least 30 cm to ensure sealing.

A separate collection system will be established on the floor to prevent the waste from coming into contact with or leakage of groundwater, sewage or surface water, and the ground will be properly inclined in order to collect the leachate that will occur in the waste receiving area.

During the construction phase of the fermenter tanks and other units where leakage may occur (waste feeding and pre-pools, mixture tank and liquid fermented product storage), the ground will be covered with a membrane and collection channels will be created around these areas to collect possible leaks. Any leachate will be collected and transferred to waste feeding and pre-pool units. During these processes, the provisions of the "Regulation on the Amendment of the regulation on Surface Water Quality" dated 10.08.2016 and numbered 29797 will be followed.

Since the fertilizer brought to the facility will not be kept waiting anywhere and will be loaded into the fermenters immediately, there is no danger related to leachate in our facility.

AMOUNT OF WASTE AND PROJECTION

BYZ Global Enerji ve Gübre Üretimi Ticaret Sanayi Anonim Şirketi plans to establish and operate "BYZ Global Enerji Biogas Plant" on 6431 block, 107 parcel in Kayseri Province, Kocasinan District, Buğdaylı Neighborhood. According to the data related to Kocasinan District obtained from the Provincial Directorate of Food, Agriculture and Livestock, the number of registered bovine animals is given in the Table below.

District	Number of Bovine Animals
Kocasinan	64,000

For the " BYZ Global Enerji Biogas Plant", a total of 200 tons/day of animal waste will be collected from the cattle farms in the region. Biogas will be obtained from the animal wastes to be accepted to the facility by anaerobic fermentation method under mesophilic conditions, and the biogas obtained will be converted into electrical energy by burning in the biogas engine unit. Liquid and solid fermented product will be obtained by separating the sludge formed during anaerobic fermentation by means of separator. In the proposed project activity's technical feasibility study, the calculation about the electricity generation capacity of the biogas plant with 1.501 kWh capacity is given below.

- *Cattle Manure*

B. Bovine Animals Feces = 120 t /day

Amount Dry Matter Rate = 13%

Volatile Dry Matter Rate = 71,6%

Volatile Dry Matter Biogas	= 465 m^3/t
Methane Ratio	= 64%
Engine Efficiency	= 41.8%
Hours of Operation	= 7,500 hours

Calculation

120 X 13%	= 15.60 t/day
36.80 X 71.6%	= 11.1696 t/day
22.816 x465	= 5,193.864 m^3/day
5,193.864 / 24	= 216.4 m^3
216.4 X 64%	= 138.496 m^3
$\frac{138.496 \times 24 \times 365 \times 41.8\% \times 10}{7,500}$	= 676 kWh

- *Hens Manure*

Chicken Manure	= 80 t /day
Amount Dry Matter Rate	= 20%
Volatile Dry Matter Rate	= 72.0%
Volatile Dry Matter Biogas	= 550 m^3/t
Methane Ratio	= 64%
Engine Efficiency	= 41.8%
Hours of Operation	= 7,500 hours

Calculation

80 X 20%	= 16.00 t/day
16.00 X 72.0%	= 11.52 t/day
11.52 x 550	= 6,336 m^3/day

6,336 / 24 = 264 m^3

264 X 64% = 168.96 m^3

$$\frac{168.96 \times 24 \times 365 \times 41.8\% \times 10}{7{,}500} = 825 \text{ kWh}$$

Cattle + Hens Manure in Total

676+825 = 1,501.01 kWh

1501 x 24 = 36,024 kW (Daily Electricity Generation)

Fermented Solid and Liquid Feces

Quantity Density = 1. 25 t/m^3

Biogas = 11,529.14 m^3/day

Animal manure Converted to

Gas 11,529.14 X 1.25 = 14.4 t/day

Fermenter Output Animal feces Amount

200 -14.4 = 185.6 t/day

Solid - Liquid Feces Amount After Separator

Separator solid matter output rate = 20% - 25% (Solid Content Ratio) Dry matter ratio of the waste entering into the separator = 8%

The ratio of the dry matter coming out of the separator in the solid fermented waste = 50% Dry Matter Amount = 185.6 t/day x 8.55% = 15.8688 t/day

15.8688 t/day x 50% = 7.93 t/day

Daily Output of Solid Fermented Product = 7.93 t/day / 25% = 31.7376 t/day

Daily Output of Liquid Fermented Product = 185.6 - 31.7376 = 153.8624 t/day

The amount of waste to be processed and the amount of biogas to be obtained, electrical energy and solid-liquid fermented product amounts of the “Biogas Power Plant from Animal Wastes” are given in the Table below.

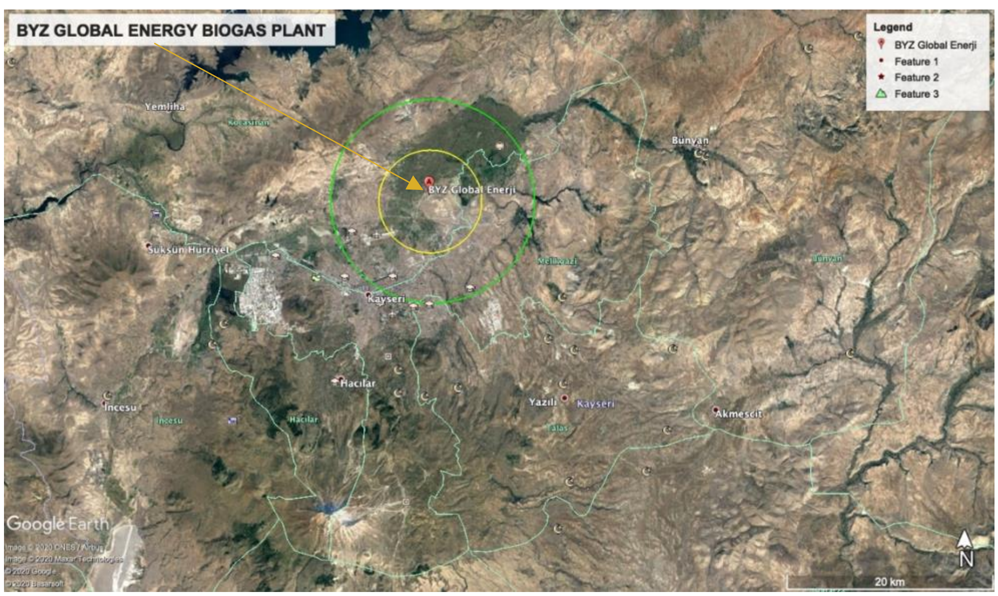
	Bovine and chicken Animals Feces Amount (tons)	Biogas Amount to Be Obtained (ml)	Amount of Electricity to be Generated (kWh)	Solid Fermented Amount to Be Obtained (tons)	Liquid to be Obtained Fermented Amount* (tons)
Daily	200	11,529.14	36,024	31.7376	153.8624
Monthly	6000	345,874.2	1,080,720	952.128	4,615.872
Yearly	72000	4,150,490.4	12,968,640	11,425.536	55,390.464

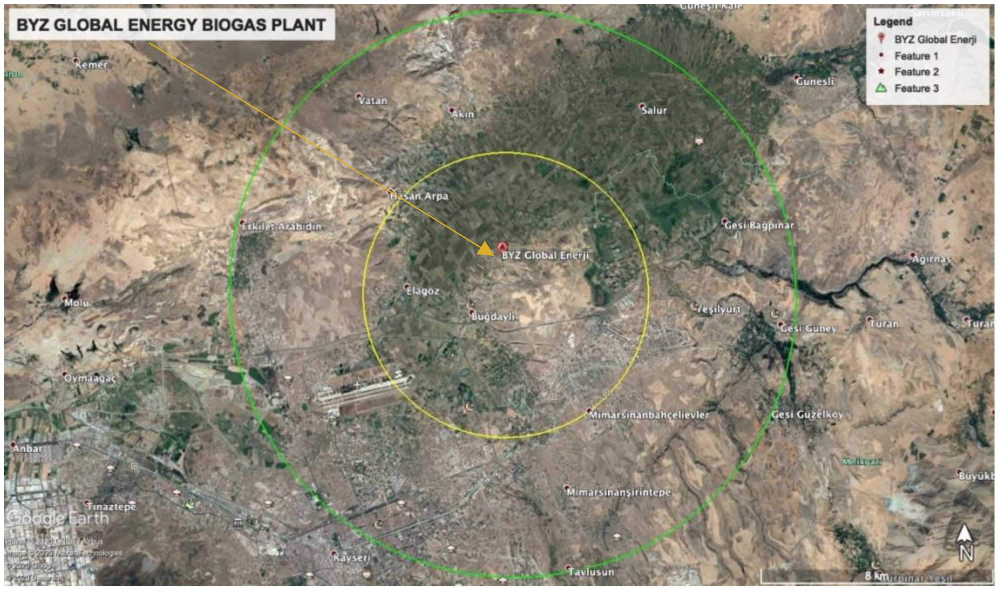
Table: BYZ Global Energy Biogas Plant Project Waste Processing and Production Capacity

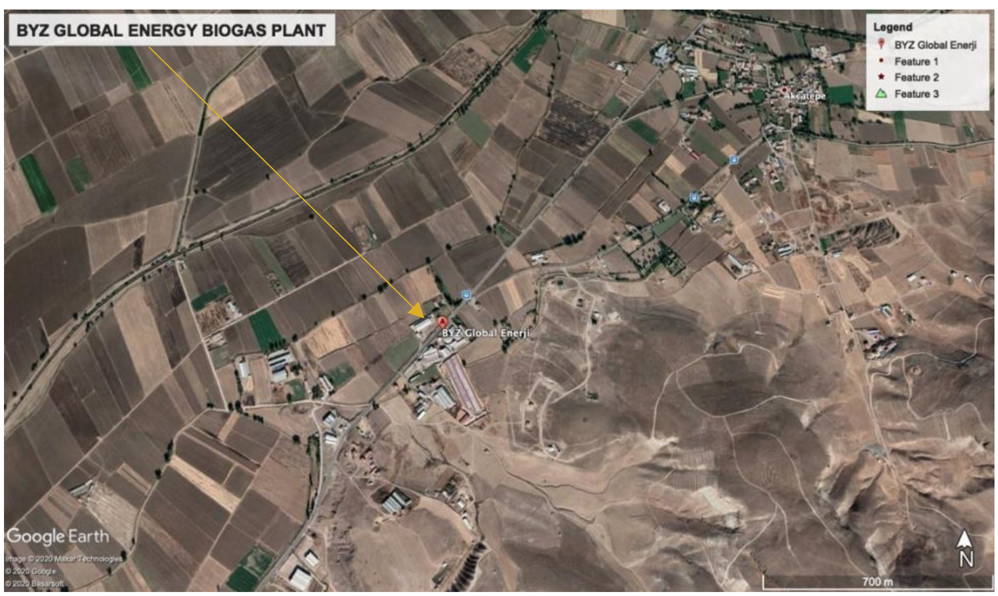
1.12 Project Location

The project is located in Buğdaylı village, Kocasinan district, Kayseri province, Turkey. The central coordinated of the project location are longitude of -35.5514131 and latitude of +38.8171642.


BYZ GLOBAL ENERGY BIOGAS PLANT
Legend
BYZ Global Enerji
Feature 1
Feature 2
Feature 3
Black Sea
BYZ Global Enerji
Google Earth
400 km


BYZ GLOBAL ENERGY BIOGAS PLANT
Legend
BYZ Global Enerji
Feature 1
Feature 2
Feature 3
BYZ Global Enerji
Kayseri
Google Earth
20 km


BYZ GLOBAL ENERGY BIOGAS PLANT
Legend
BYZ Global Enerji
Feature 1
Feature 2
Feature 3
BYZ Global Enerji
Google Earth
8 km


BYZ GLOBAL ENERGY BIOGAS PLANT
Legend
BYZ Global Enerji
Feature 1
Feature 2
Feature 3
BYZ Global Enerji
Google Earth
700 m

1.13 Conditions Prior to Project Initiation

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

Before the project activity, cattle and chicken manure generated at cattle breeding and poultry farms were left to decay in aerobic conditions. Hence, greenhouse gases generated from animal manure were released directly into atmosphere. In addition, the quantity of electricity produced using biogas technologies would have been produced by power plants connected to the national grid in Turkey which is heavily dependent on fossil fuel resources.

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

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The two of main regulatory approvals for such project types to prove that they are in compliance with relevant laws, statues and regulatory frameworks in Turkey are the Environmental Impact Assessment and the Electricity Generation License whose obtainments are required for projects being in compliance with other relevant legal requirements.

The project has obtained the approval of Environmental Impact Assessment (EIA) issued by the Ministry of Environment and Urbanization in Turkey on September 27th, 2018 and the Electricity Generation License (EGL) issued by the Energy Market Regulatory Authority (EMRA) in Turkey on October 18th, 2018.

Hence, the project is in compliance with laws, status and other regulatory frameworks.

1.15 Participation under Other GHG Programs

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

The project has not been registered or is seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

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

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The project has not sought or received another form of GHG-related credit or renewable energy certificates.

1.17 Additional Information Relevant to the Project

Leakage Management

In accordance with the methodologies applied to the project, no leakage effects are accounted for.

Commercially Sensitive Information

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

Sustainable Development

Describe how the project contributes to achieving any nationally stated sustainable development priorities, including any provisions for monitoring and reporting same.

To Be Defined (TBD)

The proposed project activity's positive impacts on sustainable development will be defined in detail in the final version of the PDT. Moreover, the project developer aims to complete the VERRA's new "Sustainable Development Contributions Report"[3] for the project.

Nevertheless, it is still possible to note that the project will make positive contributions to at least three Sustainable Development Goals (SDGs). These are:

- SDG Goal 7: Affordable and Clean Energy

The proposed project activity is a biogas-to-energy project that will generate renewable energy by capturing biogas mainly from cattle-manure -via anaerobic digestion- and utilising it to produce thermal and electric energy through biogas generator systems. By supplying renewable energy generated at the Plant to the national grid, the proposed Project will contribute to increasing not only the share of renewable energy in the global energy mix, but also the proportion of population with primary reliance on clean fuels and technology.

[3] https://verra.org/sustainable-development-contributions-report-template-now-available/

- **SDG Goal 8: Decent Work and Economic Growth**

The demand for food and electric energy is rapidly increasing in Turkey for various reasons, such as industrialisation, urbanisation, economic development and population growth. The country's external dependence on agricultural products has intensified because the increasing demand cannot be met by a decreasing domestic agricultural production capacity which is due to several reasons, such as shrinkage of agricultural land, increasing migration to urban spaces from rural areas where agricultural production is densely located, and dramatic increase in the cost of inputs for agricultural production. Therewithal, Turkey, which cannot meet its increasing electricity demand due to the deprivation of conventional resources used to generate energy, such as coal, oil and natural gas, has also become foreign-dependent on energy. Through its implementation, the proposed project activity will contribute to reduce Turkey's foreign dependency by generating renewable energy out of disposing cattle manure and agricultural/agro-industrial wastes. In addition, the proposed project activity, as a biogas-based renewable energy technology implementation, will contribute to achieve higher levels of economic productivity; hence, to increase annual growth rate of real GDP per employed person. Moreover, it will increase the employment capacity in the region, whilst enabling unemployment rate to decrease.

- **SDG Goal 13: Climate Action**

The proposed project activity will reduce GHG's emissions by capturing and utilising methane, one of the most potent GHGs triggering climate change. It is estimated that the annual emission reduction that the proposed Project will generate is around 50,576 tCO_2. In addition, the Project owner plans to engage with the National Education Directorate in the Kocasinan district in order to organise two field-trips annually for high school students through which they would attend a brief seminar on climate change and its impacts, along with learning how a cattle manure-based biogas plant works. Such field trips will raise awareness amongst young generations on climate change and one of the ways in which it needs to be tackled, waste-to-energy systems.

As noted above, the proposed project activity's positive impacts on sustainable development will be defined in detail in the final version of the PDT. Moreover, the project developer aims to complete the VERRA's new "Sustainable Development Contributions Report"[4] for the project.

Further Information

N/A

2 SAFEGUARDS

2.1 No Net Harm

Summarize any potential negative environmental and socio-economic impacts and the steps taken to mitigate them.

The Environmental Impact Assessment (EIA) Report has been approved and issued by the Ministry of Environment and Urbanization in Turkey on September 27th, 2018. In accordance with the Turkish laws and regulations, EIA's approval shall be only made if a project subjected to the approval does not make any negative environmental and socio-economic impacts. Considering the fact that the proposed project activity already obtained EIA approval by the Ministry of Environment and Urbanization in Turkey, it is therefore possible to claim that there is no net harm linked to the project.

2.2 Local Stakeholder Consultation

To Be Defined (TBD)

The proposed project's local stakeholder consultation meeting is postponed due to the CoVid-19 measures for not being the public at risk. Once the pandemical conditions finish, the LSC meeting is going to take place in line with the VCS v4.0 rules and modalities.

[4] https://verra.org/sustainable-development-contributions-report-template-now-available/

2.3 Environmental Impact

TBD

2.4 Public Comments

TBD

2.5 AFOLU-Specific Safeguards

Since the project is a non-AFOLU project, this section is not required.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Applied approved baseline and monitoring methodologies:

- ***AMS-III.D.: "Methane recovery in animal manure management systems", Version 21.0***[5]
  - Sectoral scopes:
    - 13 – Waste handling and disposal
- ***AMS-I.D.: "Grid connected renewable electricity generation", Version 18.0***[6]
  - Sectoral scopes:
    - 1 – Energy industries (renewable - / non-renewable sources)

Applied tools:

[5] https://cdm.unfccc.int/methodologies/DB/H9DVSB24O7GEZQYLYNWUX23YS6G4RC

[6] https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", Version 03.0;
- "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation", Version 03.0;
- "Project emissions from flaring", Version 03.0;
- "Project and leakage emissions from anaerobic digesters", Version 02.0;
- "Tool to calculate the emission factor for an electricity system", Version 07.0;
- "Tool to determine the remaining lifetime of equipment", Version 01;
- "Project and leakage emissions from biomass", Version 04.0;

3.2 Applicability of Methodology

Category III.D.: Methane recovery in animal manure management system.

The Methodology of AMS-III.D. covers project activities involving the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant.

The proposed project activity consists of a cattle manure based renewable energy power plant which modifies the existing anaerobic manure management in livestock farms. The manure is collected from several farms to a centralized plant where the project achieves methane recovery, and the recovered methane is used gainfully to generate electricity. As such the project activity satisfies all the three conditions and is a Type III.D small-scale CDM project activity.

The methodology is applicable under the following conditions:

		Applicability of AMS-III.D. – v21.0	
Ref.		***Application Criteria***	***Applicability***
		The methodology is applicable under the following conditions:	
1.	**(a)**	*The livestock population in the farm is managed under confined conditions;*	The Project's primary feedstock, cattle-manure, will be supplied mainly by animal farms. These farms function under the control of the Ministry of Agriculture and Forestry in Turkey. The farm owners manage the livestock population in their farms in accordance with the relevant Turkish laws and regulations confining conditions, especially regarding animal health, such as Law No. 5996[7], Law No. 3285[8] and Regulation on Livestock Farms[9]. These farms are constantly inspected by the relevant governmental institutions to check whether they are managed under confined conditions set by the relevant Turkish laws and regulations. *As such, this project activity qualifies*

[7] https://www.tarimorman.gov.tr/Belgeler/ENG/Legislation/law_veterinary_services.pdf

[8] http://www.zmo.org.tr/mevzuat/mevzuat_detay.php?kod=55

[9] http://www.resmigazete.gov.tr/eskiler/2006/08/20060809-4.htm

			as a Type III.D small-scale CDM project activity. In time of Validation, relevant licenses given to the farms by the Turkish government will be provided as documentary evidence to confirm that manure are supplied from farms where animals are managed under confined conditions.
	(b)	*Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise "AMS-III.H Methane recovery in wastewater treatment" shall be applied;*	As shown in the Section 1.11. of the PDD, the waste streams after the treatment will not be discharged into natural water resources. The refined and processed fermented product will be sent to the separator and decanter (dehydration unit) to be separated (please see the Section 1.11. of the PDD). Both the liquid and solid parts of the residual waste from the digestion will be further used as organic fertilizers. In the baseline scenario, as noted above, the farms where manure is collected for the Project are managed in accordance with the relevant laws and regulations which prohibit manure to directly discharge into natural water resources. Hence, the proposed

			project activity complies with this criteria/condition. In addition, both the biogas power plant and the farms from where manure is supplied to the plant are constantly inspected by the relevant governmental institutions to check whether they are in compliance with the environmental laws and regulations which also cover dischargement of waste into natural water sources. In time of validation, relevant governmental licenses and reports on this issue will be provided as documentary evidence to confirm that manure or the streams obtained after treatment is not be discharged into natural water resources.
	(c)	*The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C;*	The annual average temperature of baseline site where manure is collected from multiple farms in KAYSERİ is 10.6°C[10]. Hence, the proposed project activity complies with this criteria/condition.
	(d)	*In the baseline scenario the retention time of manure waste in the*	In the baseline scenario, cattle manure generated at farms is

[10] https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=undefined&m=KAYSERI

		anaerobic treatment system is greater than one month, and if anaerobic lagoons are used in the baseline, their depths are at least 1 m;	stored generally in lagoons in anaerobic conditions. Lagoons' depths, when applicable, are more than 1 m. In addition, the retention time of manure waste is greater than one month in the baseline scenario. In time of validation, results of baseline surveys, along with supporting documents, will be provided as documentary evidence to confirm that the proposed project activity complies with these two criteria.
	(e)	*No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario*	In the project activity, the baseline scenario consists of uncovered lagoons that generate methane emissions in anaerobic conditions. However, no methane recovery and destruction by flaring, combustion or gainful use takes place. As noted above, the common practice for the livestock and poultry farm owners to manage the manure generated at their farms is to have uncovered anaerobic lagoons/ponds at their farms in the region. Since there is no legal regulation to mandate the livestock and poultry farm owners to implement different

			anaerobic lagoon design and to capture and/or utilize methane generated at these lagoons, the continuum of this common practice - without making any modification of their existing manure management systems which are based on uncovered anaerobic lagoons/ponds- is the most economic, viable and reasonable for cattle farm owners. In other words, the baseline scenario for the cattle manure is to be left to decay anaerobically in uncovered lagoons/ponds at the farms. Similar to the previous criteria above, in time of validation, results of baseline survey will be provided as documentary evidence to confirm that no methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario.
2.	**(a)**	*The residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of "AMS-III.AO Methane recovery through controlled anaerobic*	The residual waste after the construction of the project will be handled aerobically utilized as fertilizer which will not result in methane emissions.

		digestion". In the case of soil application, proper conditions and procedures (not resulting in methane emissions) must be ensured;	The residual waste will be utilized as organic fertilizer in a neighboring fertilizer/composting production facility. Thus, this criteria/condition is met by the proposed project activity.
	(b)	*Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared;*	In the project activity, the technical measures considered in the design ensures that all the biogas produced by the digester is used. In case of emergencies, flaring system is also provided. Hence, the proposed project activity complies with this criteria/condition.
	(c)	*The storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester. If the project proponent can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply*	The anaerobic digesters under the project are constructed right beside the animal barns. The manure after removal from the animal barns will be transferred into the anaerobic digesters via pre-treatment pool within same day.
3.		*Projects that recover methane from landfills shall use "AMS-III.G Landfill methane recovery" and projects for wastewater treatment shall use AMS-III.H. Projects for composting of animal manure shall use "AMS-III.F Avoidance*	In the project activity, methane is not recovered from landfills and hence AMS-III.G is not applicable. Similarly, the project does not involve wastewater treatment, hence AMS-III.H is not applicable.

	of methane emissions through composting". Project activities involving co-digestion of animal manure and other organic matters shall use the methodology "AMS-III.AO Methane recovery through controlled anaerobic digestion";	Moreover, the project boundaries do not include composting of animal manure and hence AMS-III.F is not applicable. Further, project does not involve co-digestion of animal manure and other organic matter and hence AMS-III.AO is not applicable.
4.	*Utilization of the recovered biogas in one of the options detailed in AMS-III.H is also eligible under this methodology. The respective procedures in AMS-III.H shall be followed in this regard. If the recovered biogas is used to power auxiliary equipment of the project activity, it should be taken into account accordingly, using zero as its emission factor; however, energy used for such purposes is not eligible as an SSC CDM Type I project component*	The recovered biogas is used to produce and deliver power to the grid. Thus, AMS-III.D. is applied to the proposed project activity.
5.	*New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the "General guidelines for SSC CDM methodologies"*	The design of this greenfiield project activity is limited to 1.5MWe/h which is within the limit of the maximum output capacity equivalent to up to 15MW and hence complies with the related and relevant requirements in the "Guideline: General Guidelines for SSC CDM methodologies, Version 23[11]". In addition, the estimated

[11] https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20190916153417994/MethSSC_guid25.pdf

		annual emission reductions that will be generated from the implementation of the proposed project activity is 50,576 tCO_2e/y, which is lower than the threshold of 60,000 tCO_2e/y set in the Guideline. Therefore, the proposed project activity complies with the Guideline. In addition, 4.11, Para 37, of the Guideline, "Procedure to determine baseline scenario for Type II and Type II greenfield projects" lays down a step-wise procedure to identify the baseline scenarios. Accordingly, in Section 3.4. of the PDD, all the alternatives of manure disposal presently followed by the farms have been presented and the one applicable baseline scenario has been chosen. Hence, alternatives have been included.
6.	*The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the "General guidelines for SSC CDM methodologies"*	The project is a Greenfield project, does not involve the replaced equipment; therefore, this condition is not applicable to the proposed project activity.

7.	*Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO2 equivalent annually from all Type III components of the project activity*	The generation of the project's emission reductions is estimated as 50,576 tCO_2e/y, which is lower than the threshold of 60,000 tCO_2e/y. Therefore, the proposed project activity complies with this condition.

Category I.D.: Grid connected renewable electricity generation.

The Methodology of AMS-I.D. comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:

(a) Supplying electricity to a national or a regional grid; or

(b) Supplying electricity to an identifier consumer facility via national/regional grid through a contractual agreement such as wheeling.

Illustration of respective situations under which each of the methodology (i.e. "AMS-I.D.: Grid connected renewable electricity generation", "AMS-I.F.: Renewable electricity generation for captive use and mini-grid" and "AMS-I.A.: Electricity generation by the user) applies is included in the appendix.

The project activity will utilize the biogas collected from the anaerobic digester to generate electricity, and the power will be fed directly to the Turkish national grid. Thus, the project is in line with applicability condition illustrated in Table 1 "Scope of AMS-I.D., AMS-I.F. and AMS-I.A. based on project types" in Appendix of AMS-I.D., Version 18.0[12].

[12] https://cdm.unfccc.int/UserManagement/FileStorage/2P7FS6ZQAR84LG3NMKYUH50WI9ODBC

Also, it is important to note that AMS-I.D. is applicable to the proposed project activity since the project falls under the renewable biomass category as per "Clarifications on Definition of Biomass and Consideration of Changes in Carbon Pools due to a CDM Project Activity[13]" reported in the CDM-EB's 20th Meeting as Annex 8. The Annex clarifies that "biomass also includes gases and liquids recovered from decomposition of non-fossilized and biodegradable organic material."

The methodology is applicable under the following conditions:

		Applicability of AMS-I.D. – v18.0	
Ref.		***Application Criteria***	***Applicability***
		The methodology is applicable under the following conditions:	
1.	**(a)**	*Install a Greenfield plant;*	The proposed project activity is implemented as a Greenfield Power Plant at the site where there was no renewable energy power plant operating prior to the implementation of the project activity. Hence, the project implies with this condition.
	(b)	*Involve a capacity addition in (an) existing plant(s);*	N/A
	(c)	*Involve a retrofit of (an) existing plant(s);*	N/A

[13] https://cdm.unfccc.int/Reference/Guidclarif/ar/methAR_guid07_v01.pdf

	(d)	*Involve a rehabilitation of (an) existing plant(s)/unit(s); or*	N/A
	(e)	*Involve a replacement of (an) existing plant(s)*	N/A
2.	**Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:**		
	(a)	*The project activity is implemented in an existing reservoir with no change in the volume of reservoir;*	Since the proposed project activity is not a hydro power plant, this condition is not applicable to the project.
	(b)	*The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m2;*	N/A
	(c)	*The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m2*	N/A
3.		*If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the*	The proposed project activity only involves biogas power generation system, without non- renewable components, thus this condition is not applicable for the project.

	entire unit shall not exceed the limit of 15 MW	
4.	*Combined heat and power (co-generation) systems are not eligible under this category.*	The project activity generates electricity from biogas recovered from animal manure via biogas generators/engines/units and is not a combined heat and power system. Although waste heat generated out of biogas engines may be used to warm the digesters, it is not a cogeneration project as per the definition of cogeneration in ACM0018, Version 4.0[14], i.e. a "Cogeneration plant is a heat and power plant in which at least one heat engine simultaneously generates both heat and power". Since there is no heat engine installed within the project boundaries, the proposed project activity shall be considered neither as a cogeneration plant nor a project involving co-generation systems.
5.	*In the case of project activities that involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the*	This project activity is a green-field project activity which does not involve addition of renewable energy generation units at an existing renewable power generation facility. Hence, the

[14] https://cdm.unfccc.int/UserManagement/FileStorage/ZI5NXTD6R4AQGOC307L82MYEK9JSHV

	project should be lower than 15 MW and should be physically distinct from the existing units	proposed project activity complies with this condition.
6.	*In the case of retrofit, rehabilitation or replacement, to qualify as a small-scale project, the total output of the retrofitted, rehabilitated or replacement power plant/unit shall not exceed the limit of 15 MW*	As a greenfield project, the proposed project activity the project activity does not involve retrofit or replacement of an existing facility. Therefore, this condition is met by the project.
7.	*In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as "AMS-I.C.: Thermal energy production with or without electricity" shall be explored*	Methane is recovered from the type III component of project activity and the baseline for the type I component of project activity is determined in accordance with AMS-I.D. As noted in the fourth applicability condition of AMS-I.D. above - regarding to be co-generation plant-, the proposed project activity aims to recover and utilize the methane from animal manure in digesters via biogas engines/units/generators to generate electricity which will be fed directly to the national grid in Turkey. Thus, the baseline for the electricity component shall be in accordance with procedure prescribed under AMS-I.D.
8.	*In case biomass is sourced from dedicated plantations, the applicability criteria in the tool*	The proposed project activity's main feedstock is animal manure.

	"Project emissions from cultivation of biomass" shall apply	Thus, this condition is not applicable to the project.

3.3 Project Boundary

As noted above, the baseline and monitoring methodologies applied to the proposed project activity are AMS-III.D. "Methane recovery in animal manure management systems", Version 21.0, and AMS-I.D. "Grid connected renewable electricity generation", Version 18.0.

In accordance with these Methodologies, the project boundary includes:

- The livestock;
- Animal manure management systems (including centralized manure treatment plant);
- Facilities which recover and flare/combust or use methane;
- The project power plant and all power plants connected physically to the electricity system that the proposed project power plant is connected to.

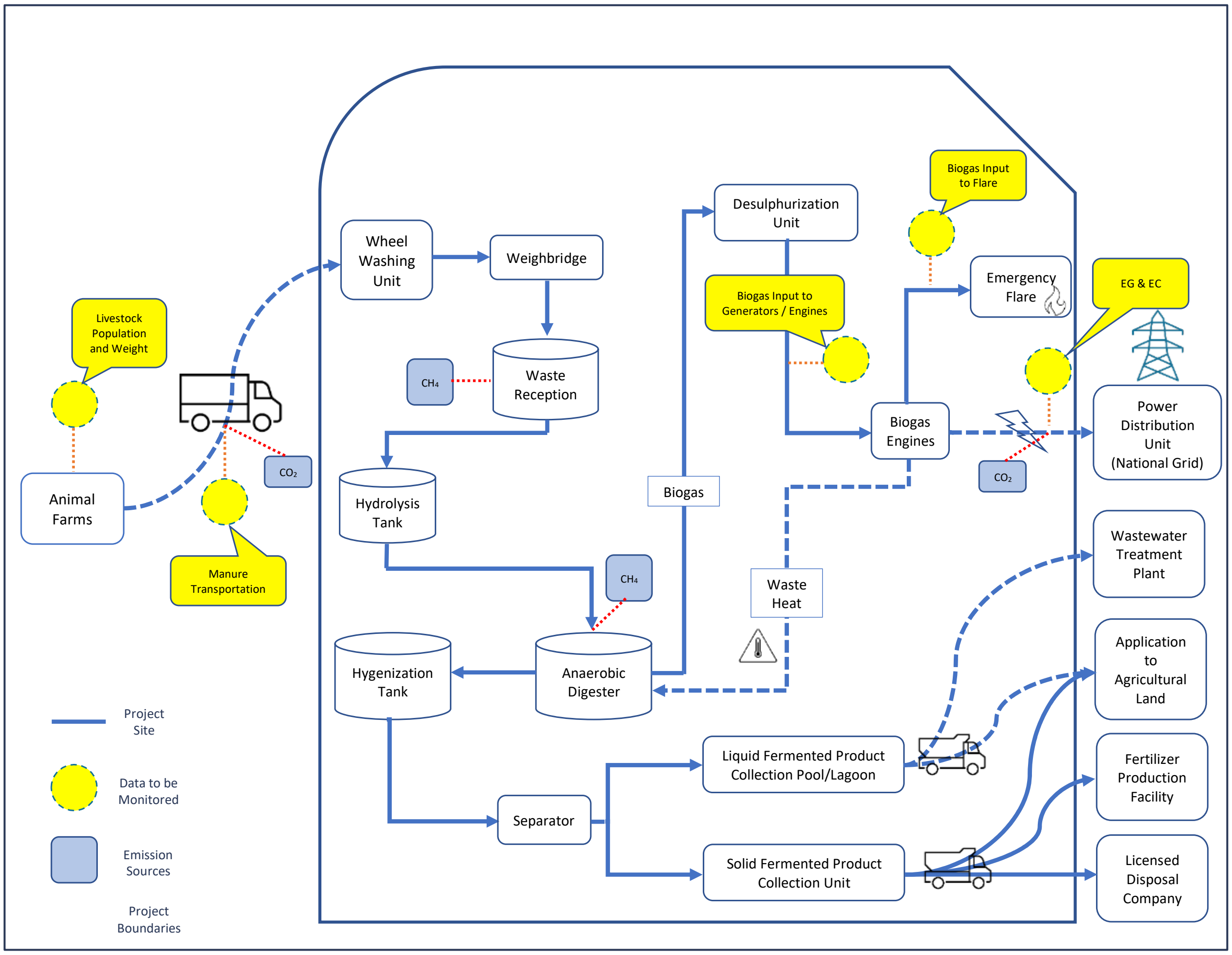
The relevant GHG sources included in or excluded from the project boundary are shown on the Table below.

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

Source		Gas	Included?	Justification/Explanation
	Emissions from electricity consumption / generation	CO_2	Yes	Major source of emissions in the baseline
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
		Other	-	N/A
Project	Physical leakage of biogas	CO_2	No	Excluded for simplification.
		CH_4	Yes	Main emission source. Leakage from biogas digester has been considered.
		N_2O	No	Excluded for simplification.
		Other	-	N/A
	Emissions from on-site electricity or fossil fuel use	CO_2	Yes	The emission from use of electricity is accounted for, since the proposed project will consume electricity from the national grid. However, since the proposed project activity does not involve fossil fuel consumption, the emission form use of fossil fuel is not included.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
		Other	-	N/A
	Emissions from flaring or combustion of the gas stream	CO_2	No	The flare system would be used only in exigencies. In case the flare operation, the emission reduction will be excluded during this period, and thus emission source is not included.
		CH_4	No	
		N_2O	No	
		Other	-	N/A
	Emissions from incremental	CO_2	Yes	May be an important emission source. Hence, they are accounted.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.

Source		Gas	Included?	Justification/Explanation
	transportation distances	N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
		Other	-	N/A
	Emissions from storage of manure	CO_2	No	Excluded for simplification.
		CH_4	No	The anaerobic digesters under the project are constructed close to the animal barns, the manure after removal from the animal barns will be transferred into the anaerobic digesters via pre-treatment pool within same day, so the storage time of manure is less than 24 hours, this source of emissions is not accounted for according to AMS-III.D. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification.
		Other	-	N/A

In addition, the diagram of the project boundary below shows clearly the physical locations of the various installations or management activities taking place as part of the project activity.



3.4 Baseline Scenario

The proposed project activity has two major GHG emission reduction components. The first one is the reduction of methane emissions resulting from improved animal manure management, whilst the second one is the use of biogas recovered from improved animal manure management for generating power and feeding the electricity generated directly to the national electricity grid network.

Primary Component of the Proposed Project Activity as per AMS-III.D., version 21.0

The primary component of the proposed project activity includes improved animal manure management and biogas recovery resulting in the decrease of the extent of methane emissions that emanate from the present mode of animal manure management at the farms whose manure is supplied to the project. And, hence the proposed project activity is considered as a replacement of the existing environmentally unfriendly animal manure management systems that results in anaerobic lagoon conditions and aims to achieve methane recovery and gainful use of recovered methane. Hence, the applicable baseline as per the approved methodology AMS-III.D., version 21.0, for the first component of the project activity is the following:

- The maximum methane-producing capacity of manure (B_o) varies by species and diet, and
- The organic material in livestock manure measured as Volatile Solids (VS) which consist of both biodegradable and non-biodegradable fractions.

The above parameters are used along with Global Warming Potential of methane, methane density, methane conversion factor, number and type of livestock, fraction of manure handled and correction factors appropriately and the baseline emissions measured in t CO_2e is calculated in a conservative and transparent manner as per the approved methodology AMS-III.D., version 21.0.

With reference to AMS-III.D., version 21.0, for project activities involving methane recovery in animal manure management, the baseline scenario fits well the scenario defined in the paragraph 17 of the approved methodology:

> "in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere".

The baseline methodology selected approach from paragraph 48 of the CDM modalities and procedures[15] called "existing actual or historical emissions, as applicable" have been applied in the context of the project activity. The approach selected in the baseline methodology checks

[15] https://cdm.unfccc.int/Reference/COPMOP/08a01_abbr.pdf

the additionality of the project activity and determines the baseline emission factor for selected baseline scenario.

The applicable baseline scenario is animal manure being left to decay anaerobically within the project boundary and methane being emitted directly to the atmosphere in the absence of the proposed project activity. The results of the baseline survey which is going to be presented in time of validation as a documentary evidence, confirm that the common practice for livestock farm owners to treat manure generated at their farms is to store manure in uncovered anaerobic lagoons/ponds for several months till manure taking away. As such, the baseline scenario can be characterized as anaerobic lagoon.

Identification of Baseline Scenario

As per the paragraph 7 of the approved methodology AMS-III.D., version 21.0, the proposed project activity, as a Greenfield project, compared to the baseline scenario is only eligible if it complies with the related and relevant requirements in the "General guidelines for SSC CDM methodologies", version 23.0[16]. The Section 4.11 of the Guidelines describes the “procedure to determine baseline scenario for Type II and Type III Greenfield projects” which is a 4-step process to be followed in order to determine whether the requirements are met.

Step 1: Identify the various alternatives to the project proponent that deliver comparable levels of service, including the proposed project activity undertaken without being registered as a CDM project activity.

The table 10.14 in Chapter 10, Volume 4 of 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories[17] provides a list of possible manure management systems for different livestock species, including dairy cattle, non dairy cattle and poultry, three

[16] https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20190916153417994/MethSSC_guid25.pdf

[17] https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf

livestock species whose manure is treated in anaerobic digesters by the proposed project activity.

Manure management systems are listed as follow:

- Uncovered anaerobic lagoon;
- Liquid/Slurry, Pit storage;
- Solid storage;
- Dry lot;
- Daily spread;
- Anaerobic Digestion – Biogas;
- Burned for fuel;
- Pasture Range and Paddock.

Step 2: List the alternatives identified in Step 1 that are in compliance with local regulations. Alternatives that are not in compliance with local regulations are excluded that from further consideration.

Uncovered anaerobic lagoon – Current animal waste manure management

The Regulation on Livestock Farms[18] implemented in 2006 in Turkey was vaguely requested the livestock farms to have a lagoon to collect the manure generated at the farms. While the regulation did not prescribe any technical specificity for such lagoons, it was stating that the lagoons' interior walls which stayed underground shall be of concrete foundation -in order to prevent the manure from leaking into ground and underground water sources. Thus, it is justifiable to state that there is currently no legal regulation for the livestock farms to define anaerobic lagoon design. However, the common practice for the livestock farm owners is to

[18] https://www.resmigazete.gov.tr/eskiler/2006/08/20060809-4.htm

have uncovered anaerobic lagoons/ponds at their farms in Turkey. Although it varies based on the scale of the farm, the overall depth of such lagoons at the farms around the project site is 2 metres. In terms of the residence time of the manure at the lagoons, it is possible to say that since the uncovered lagoons are also fed by rain waters, the lagoons are reaching their full capacities faster than usual in rainy seasons. Nevertheless, the minimum retention time of manure waste in the uncovered anaerobic lagoons is greater than one and half and/or two months. As stated earlier, since there is no legal regulation to mandate the livestock farm owners to implement different anaerobic lagoon design and to capture and/or utilize methane generated at these lagoons, the continuum of this common practice -without making any modification of their existing manure management systems which are based on uncovered anaerobic lagoons/ponds- is the most economic, viable and reasonable for cattle farm owners.

Both liquid and solid manure generated at cattle and poultry farms are stored in the lagoons for several months till they are evacuated – usually to agricultural fields. This system is compliant with environmental and legal regulations in Turkey and therefore applicable as a baseline and/or alternative scenario for the proposed project activity.

Liquid/Slurry – Excluded due to regulatory requirements

In accordance with Chapter 10, Volume 4, Table 10.18 of the Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Liquid/Slurry manure management system is defined as “Manure is stored as excreted or with some minimal addition of water or bedding material in tanks or ponds outside the animal housing. Manure is removed and spread on fields once or more in a calendar year” (2019:10.80). This kind of manure management system is not allowed due to the regulation that requires that manure shall be kept only on concrete made floor.

Pit storage under animal confinements - Excluded due to regulatory requirements

In accordance with Chapter 10, Volume 4, Table 10.18 of the Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, pit storage under animal confinements form of manure management is defined as “Collection and storage of manure usually with little or no added water typically below a slatted floor in an enclosed animal confinement facility, usually for periods less than one year. Manure may be pumped out of the storage to a secondary storage tank multiple times in one year, or stored and applied directly to fields." (2019:10.80).

This form of manure management was used to be applied in animal farms. However, in line with the legal regulations made on livestock farms, this form of manure management system is not allowed anymore. Those who had an installed system of this kind had given legal notice to reform their systems accordingly.

Solid storage – Excluded due to regulatory requirements

In accordance with Chapter 10, Volume 4, Table 10.18 of the Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, solid storage is defined as "The storage of manure, typically for a period of several months, in unconfined piles or stacks. Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation." (2019:10.80).

This manure management system is not in line with current regulations, one of which mentioned above, as The Regulation on Livestock Farms[19].

Dry lot - Excluded due to regulatory requirements

In accordance with Chapter 10, Volume 4, Table 10.18 of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, dry lot is defined as "A paved or unpaved open confinement area without any significant vegetative cover. Dry lots do not require the addition of bedding to control moisture. Manure may be removed periodically and spread on fields." (2019:10.80).

[19] https://www.resmigazete.gov.tr/eskiler/2006/08/20060809-4.htm

Since animal farms in Turkey are mandated to function in confined conditions, store the manure for several months and then spread it in agricultural fields, this alternative is not in compliance with regulatory requirements.

Anaerobic digestion (biogas) – The proposed project activity

In accordance with Chapter 10, Volume 4, Table 10.18 of the Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, anaerobic digester is defined as animal manure with and without straw are collected and anaerobically digested in a containment vessel and/or in covered lagoon. Co-digestion with other waste or energy crops may occur. Digesters are designed, constructed and operated according to industrial technology standard for waste stabilization by the microbial reduction of complex organic compounds to CO_2 and CH_4. Digesters can also be used for waste stabilization by the microbial reduction of complex organic compounds to CO_2 and CH_4. Biogas is captured and used as a fuel. Digestate is stored either in open storage, in covered storage with no leakage control, or in gas tight storage with gas recovery or flaring. After anaerobic digestion, digestate is stored either openly, covered, or gas tightly (ibid.).

This is the proposed project activity not being registered as a VERRA/VCS project activity. Due to barriers such as – technological barriers, lack of skilled labour to operate the facility and prevailing practice, as well as the investment barrier, this system is not applicable for the baseline scenario.

Burned for fuel - Excluded due to regulatory requirements

In accordance with Chapter 10, Volume 4, Table 10.18 of the Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, burned for fuel is defined as “The dung and urine are excreted on fields. The sun dried dung cakes are burned for fuel” (2019:10.80-81).

This manure management system is not in line with current regulations, which is only in confined condition and therefore cannot be considered as an alternative scenario.

Pasture Range and Paddock - Excluded due to regulatory requirements

In accordance with Chapter 10, Volume 4, Table 10.18 of the Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, pasture range and paddock is defined as "The manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed." (2019:10.80).

Since animal farms in Turkey are mandated to function in confined conditions, store the manure for several months and then spread it in agricultural fields, this alternative is not in compliance with regulatory requirements.

All the plausible scenarios stated above are in compliance with all mandatory applicable laws and regulatory requirements.

Step 3: Eliminate and rank the alternatives identified in Step 2 taking into account barrier tests specified in the "Guidelines on the demonstration of additionality of small-scale project activities".

Uncovered anaerobic lagoon – Current animal waste manure management

This has been the system that the livestock farm owners are utilizing at present. Since this system is so widely used and is the common practice in the region, there are no barriers to analyze that would prevent the use of this system or its use continuation. As noted earlier, since there is no legal regulation to mandate the livestock farm owners to implement different anaerobic lagoon design and to capture and/or utilize methane generated at these lagoons, the continuum of this common practice -without making any modification of their existing manure management systems which are based on uncovered anaerobic lagoons/ponds- is the most economic, viable and reasonable for cattle farm owners.

Anaerobic digestion (biogas) – The proposed project activity – Eliminated due to technological and investment barriers

This alternative face both investment and technological barriers. Investment barriers relate to the increased levels of manure management complexity and significant capital outlay that are necessary for the installation and operation of anaerobic digester systems. Technological barriers relate to the fact that there are no local providers of this technology and PP would need to rely in international providers for installation and maintenance, which also represents increased investment in time and effort when it comes to implementing a technology that is not locally available. Due the technological and investment barriers for local livestock farm owners, this alternative has to be implemented as a CDM Project Activity.

Step 4: If only one alternative remains that is not the proposed project activity undertaken without being registered as a CDM project activity and also corresponds to one of the baseline scenarios provided in the methodology, then the project activity is eligible under the methodology. If more than one alternative remains that correspond to a baseline scenario provided in the methodology, choose the alternative with the lowest emissions as the baseline.

Only one alternative remains that fulfils the requirements. The proposed project activity, as a Greenfield facility, shall, hence, be considered as eligible under methodology AMS-III.D., version 21.0, with the baseline scenario being the continuum of uncovered anaerobic lagoons as manure management system.

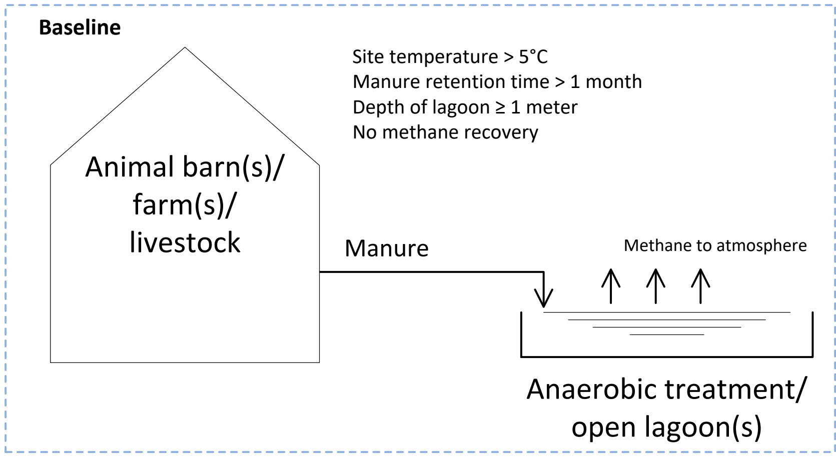


Figure 1: Baseline Scenario

As per AMS III.D, baseline emissions of the uncovered lagoon are calculated using option (a), based on the amount of the waste or raw material that would decay anaerobically in the absence of the project activity with the most recent IPCC tier 2 approach. See section 4 for detailed information regarding calculation method, formula and parameters.

Second Component of the Proposed Project Activity as per AMS-I.D., version 18.0

The second component of the proposed project activity includes feeding electricity so generated from the renewable power plant to the national electricity grid network in Turkey. And, hence the renewable power plant can be considered as the installation of new grid-connected renewable power plant that feed the electricity for a grid system, which is fed by both fossil fuel fired generating plants (using fossil fuels such as coal, natural gas, diesel etc.) and non-fossil fuel based generating plants (such as hydro, nuclear, solar, biomass and wind).

The paragraph 19 of AMS-I.D., version 18.0, defines the baseline scenario for greenfield power plant, like in the case of the proposed project activity, as “the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid”.

The baseline methodology selected approach from paragraph 48 of the CDM modalities and procedures[20] called "existing actual or historical emissions, as applicable" have been applied in the context of the project activity. The approach selected in the baseline methodology checks the additionality of the project activity and determines the baseline emission factor for selected baseline scenario.

The project will generate electricity using biogas recovered from the animal manure. Hence the biogas-based power generated from the project site will be replacing the electricity generated from the fossil fuel power stations feeding into the national grid. Since the source of the power has reduced GHG emissions, the power generated will save the anthropogenic GHG emissions that would have been generated by the fossil fuel based thermal power stations comprising coal, diesel, furnace oil and gas. The estimation of GHG reductions by the second component of the project activity is limited to CO_2 only.

The methodology lays down certain steps by which the baseline is determined. The baseline methodology identifies the project as being additional and not the baseline scenario. The proposed project activity will impact the operating margin, build margin and thus the combined margin. The methodology is designed to have the grid combined margin as the baseline scenario. For grid connected electricity generation projects it is important to ascertain whether the proposed project activity has some impact on the national grid's electricity generating pattern. It has been established in the CDM modalities and procedures that the use of the combined margin which takes into account the operating and build margins can be used to determine the effect of the power project to the grid.

As per AMS I.D., version 18., the baseline emission of the power generation is the MWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO2e/MWh) calculated in a transparent and conservative manner. The emission coefficient is calculated according to option (a) selected from the methodology AMS-I.D., version 18.0, as: (a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor

[20] https://cdm.unfccc.int/Reference/COPMOP/08a01_abbr.pdf

for an electricity system'. The detailed calculation formulae and data source used are also provided in section 4.

3.5 Additionality

Section 3.13.1. of VCS Standard, v4.0, clearly mandates that "Additionality shall be demonstrated and assessed in accordance with the requirements set out in the methodology applied to the project".

The paragraph 15 of the approved methodology of AMS-III.D., version 21.0, applied to the proposed project activity, states that "Project activities may demonstrate the additionality by showing that there is no regulation in the host country, applicable to the project site, that requires the collection and destruction of methane from livestock manure. If so, it is not required to apply the 'Guidelines on the demonstration of additionality of small-scale project activities'".

As noted above, there is no legal regulation in Turkey that requires the collection and destruction of methane from livestock manure. Thus, it is not required to apply the 'Guidelines on the demonstration of additionality of small-scale project activities'. Accordingly, Type III component of the proposed project activity, as methane recovery from animal manure, shall be considered as deemed additional.

Moreover, the paragraph 16 of AMS-III.D., version 21.0. clarifies that "This additionality condition also applies to Greenfield project activities. Furthermore, for project activities applying this methodology in combination with a Type I methodology, that has an energy component whose installed capacity is less than 5 MW, this procedure for additionality demonstration also applies to that component".

Within the boundaries of the Type III component of the proposed project activity, the project captures and utilizes biogas from animal manure in anaerobic digesters to generate electricity with biogas engines/units with the total installed capacity 1.5 MW, lower than 5 MW. Hence, as per the paragraph 16 of AMS-III.D., version 21.0, it is not required to apply the 'Guidelines on the demonstration of additionality of small-scale project activities' to the Type I component of the proposed project activity which is grid-connected renewable electricity generation. Accordingly, Type I component of the proposed project activity, as grid-connected renewable electricity generation, shall also be considered as deemed additional.

Therefore, the proposed project activity, as per the approved methodology of AMS-III.D., version 21.0, is automatically defined as additional, without further documents of barriers as per "Guidelines on the demonstration of additionality of small- scale project activities".

3.6 Methodology Deviations

No methodology deviation is applied in the project.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Calculation of Baseline Emissions as per AMS-III.D.

As per the paragraph 17 of AMS-III.D., version 21.0., the baseline scenario is the situation where, in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. To calculate the baseline emissions, the project proponents propose to utilise the Option 17 (a) presented in the AMS-III.D., version 21.0., Paragraph 17. This is because of the fact that the project prone is aware of the existing dairy manure management systems i.e, anaerobic lagoon and the IPCC guidelines are utilised for determining the manure characteristics. Hence, the baseline emissions are calculated using the Option Para 17 (a) as follows: As per AMS III.D., version 21.0., baseline emissions are determined as follows:

Equation (1)

$$BE_y = GWP_{CH_4} \times D_{CH_4} \times UF_b \times \sum_{j,LT}(MCF_j \times B_{0,LT} \times N_{LT} \times VS_{LT,y} \times MS\%_{Bl,j})$$

Where:

BE_y	= Baseline emissions in year y (tCO_2e)
GWP_{CH_4}	= Global Warming Potential (GWP) of CH_4 applicable to the crediting period of CH_4 (t CO_2e/t CH_4)
$D_{CH_4,n}$	= CH_4 density (0.00067 t/m^3 at room temperature (20^0C) and 1 atm pressure)
LT	= Index for all types of livestock
j	= Index for animal manure management system
MCF_j	= Annual methane conversion factor (MCF) for the baseline animal manure management system *j*
$B_{0,LT}$	= Maximum methane producing potential of the volatile solid generated for animal type *LT* (m^3 CH_4/kg-dm)
$N_{LT,y}$	= Annual average number of animals of type *LT* in year y (numbers)
$VS_{Lt,y}$	= Volatile solids production/excretion per animal of livestock *LT* in year *y* (on a dry matter weight basis, kg-dm/animal/year)
$MS\%_{Bl,j}$	= Fraction of manure handled in baseline animal manure management system *j*
UF_b	= Model correction factor to account for model uncertainties (0.94)

Estimation of $VS_{LT,y}$, $B_{0,LT}$ and MCF_j:

As per the paragraph 18(c) of AMS-III.D., version 21.0., the project participants choose to determine $VS_{LT,y}$ in the following way:

Scaling default IPCC values $VS_{default}$ to adjust for a site-specific average animal weight as shown in Equation (2) below:

Equation (2)

$$VS_{LT,y} = \left(\frac{W_{site}}{W_{default}}\right) \times VS_{default} \times nd_y$$

Where:

$VS_{LT,y}$	= Adjusted volatile solid excretion per year on a dry-matter basis for a defined livestock population at the project site in kg-dm/animal/yr
W_{site}	= Average animal weight of a defined population at the project site in kg
$W_{default}$	= Default average animal weight of a defined population in kg from where the data on $VS_{default}$ is sourced (IPCC 2006, Table 10A-4 to 10A-9, Chapter 10, Volume 4 or US-EPA, whichever is lower)
$VS_{default}$	= Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population (kg-dm/animal/day)
nd_y	= Number of days the central treatment plant was operational in year y

In line with the requirements of AMS-III.D., version 21.0., the project participants choose to determine Maximum Methane Production Potential ($B_{0,LT}$) in the way that default values are used and they are obtained from 2019 IPCC Refinement, Table 10.16, (p. 10.72, Other Regions, High Productivity Systems -specific to the country where the proposed project activity is implemented).

The values for Methane conversion factors (MCF_j) are obtained from 2019 IPCC Refinement, Table 10.17, (p. 10.74), depending on the annual average temperature where the anaerobic manure treatment facility in the baseline existed. As noted in AMS-III.D., version 21.0., future revisions to the IPCC Guidelines for National Greenhouse Gas Inventories are taken into account. Note that a conservativeness factor should be applied by multiplying MCF values (estimated as per above) with a value of 0.94, to account for the 20% uncertainty in the MCF values as reported by IPCC 2006.

Determination of Annual Average number of animals (N_{LT}):

Equation (3)

$$\boldsymbol{N_{LT} = N_{da} \times \left(\frac{N_p}{365}\right)}$$

Where:

N_{LT}	= Annual average number of animals of type LT for the year y, expressed in numbers
N_{da}	= Numbers of days animal is alive in the farm in the year y, expressed in numbers
N_p	= Number of animals produced annually of type LT for the year y, expressed in numbers

Calculation of Baseline Emissions as per AMS-I.D.

As per the paragraph 22 of AMS-I.D, version 18., baseline emissions include only CO2 emissions from electricity generation in power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

Equation (4)

$$\boldsymbol{BE_y = EG_{PJ,y} \times EF_{grid,y}}$$

Where:

BE_y	= Baseline emissions in year y (t CO_2)
$EG_{PJ,y}$	= Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh)
$EF_{grid,y}$	= Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

Since the proposed project activity is the installation of a greenfield power plant, as per the paragraph 26 of AMS-I.D, version 18., $EG_{PJ,y}$ is calculated as follows:

Equation (5)

$$\boldsymbol{EG_{PJ,y} = EG_{PJ,facility,y}}$$

Where:

$EG_{PJ,facility,y}$	= Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh)

As per the paragraph 23 of AMS-I.D, version 18., the emission factor shall be calculated in a transparent and conservative manner. The project participants choose to calculate a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system", version 07.0.

According to the Tool, the "combined margin" emission factor is calculated through the following six steps:

Step (1): Identify the relevant electricity system;

Step (2): Choose whether to include off-grid power plant in the project electricity system (optional);

Step (3): Select a method to determine the operating margin (OM);

Step (4): Calculate the operating margin emission factor according to the selected method;

Step (5): Calculate the build margin (BM) emission factor;

Step (6): Calculate the combined margin (CM) emission factor.

Step 1: Identify the relevant electricity system

According to the applicable "Tool to calculate the emission factor for an electricity system", version 07.0, the relevant project electricity system has to be identified by the project participants. a project electricity system has to be defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity, and that can be dispatched without significant transmission constraints.

Similarly, a connected electricity system, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraint.

The transmission lines in Turkey are operated by TEİAŞ (Turkish Electricity Transmission CO), which is a state-owned company. By 2019, the transmission lines of the grid is around 70,034.1[21] km long and constitutes of 1,889 transformer stations with a total transformer capacity of 181,360 MVA[22]. Accordingly, the relevant electricity system for the proposed project activity is defined as the interconnected national grid system of Turkey, which has an installed capacity of 91,266.9 MWh[23] and gross generation about 303,897.5 GWh[24] by 2019.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

According to the applicable "Tool to calculate the emission factor for an electricity system", version 07.0, project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: *Only grid power plants are included in the calculation.*

Option II: *Both grid power plants and off-grid power plants are included in the calculation.*

[21] https://webapi.teias.gov.tr/file/3148d813-fc39-4cf6-8af3-ae2b9f4048f0?download

[22] https://webapi.teias.gov.tr/file/7d8140c6-4c3d-4bc4-afb6-0569b2e6ddc7?download

[23] https://webapi.teias.gov.tr/file/58e27c07-462c-432a-a13c-cac4641cd07a?download

[24] https://webapi.teias.gov.tr/file/88482c14-52fc-4d9f-ad9b-18f77c90a0c7?download

The project participants choose Option I and therefore only grid power plants are included in the calculation.

Step 3: Select a method to determine the operating margin (OM)

According to the applicable "Tool to calculate the emission factor for an electricity system", version 07.0, the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

a) Simple OM; or

b) Simple adjusted OM; or

c) Dispatch data analysis OM; or

d) Average OM.

The project participants have selected option (a) Simple OM method for calculation of the operating margin emission factor. The choice is applicable since low-cost/must-run resources less than 50% of total grid generation in average of five most recent years[25]. The low-cost/must-run resources include hydro, geothermal, wind, low-cost biomass, nuclear, and solar power generation.

As seen the Table below[26], the Turkish grid is heavily dominated by the thermal-based energy generation systems. In average of the five most recent years, 66.8% of Turkey's gross electricity generation has been generated by the thermal plants. The total share of renewable energy resources, including hydro, geothermal, wind and solar, add up to 33.2%, which is below the threshold for applicability of the simple OM method. Furthermore, due mainly to insufficient data available, the

[25] https://webapi.teias.gov.tr/file/34f0ddbb-c64c-4a53-82f5-4472dd579912?download

[26] https://webapi.teias.gov.tr/file/34f0ddbb-c64c-4a53-82f5-4472dd579912?download

Methods (b) and (c) are not taken into account. Hence, the Simple OM method is justified to be used in calculations.

Years	Total Thermal	Total Hydro	Geothermal, Wind and Solar
2015	68.5%	25.6%	5.8%
2016	67.7%	24.5%	7.8%
2017	71.4%	19.6%	9.1%
2018	68.8%	19.7%	11.5%
2019	57.6%	29.2%	13.1%
Average	**66.8%**	**23.7%**	**9.5%**

For the simple OM, the emissions factor can be calculated using either of the two following data vintages:

a) ***Ex ante option:*** *if the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of this PDD.*

b) ***Ex post option:*** *if the ex post option is chosen, the emission factor is determined for the year in which the project activity displaced grid electricity, requiring the emission factor to be updated annually during monitoring.*

For the proposed project activity, the ex ante option is selected. Data for calculating the three-year average is obtained from the period 2017-2019 which are the most recent data available at the time of development of the PDD[27].

Step 4: Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (t CO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated by one of the following two options:

Option A: *Based on the net electricity generation and a CO_2 emission factor of each power unit; or*

Option B: *Based on the total net electricity generation of all power plants serving and the fuel types and total fuel consumption of the project electricity system.*

Since the fuel consumption and the average efficiency data for each power plant/unit is not available Option B is used for the simple OM calculation.

Option B: Calculation based on total fuel consumption and electricity generation of the system

[27] The index "y" in the equations refers to the years 2017-2019 to calculate the emission factor ex-ante.

Under the Option B, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

Equation (6)

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y}$$

Where:

$EF_{grid,OMsimple,y}$	*= Simple operating margin CO_2 emission factor in year y (t CO_2/MWh)*
$FC_{i,y}$	*= Amount of fuel type I consumed in the project electricity system in year y (mass or volume unit)*
$EF_{CO2,i,y}$	*= CO_2 emission factor of fuel type I in year y (t CO_2/GJ)*
EG_y	*= Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year y (MWh)*
i	*= All fuel types combusted in power sources in the project electricity system in year y*
y	*= The three most recent years for which data is available at the time of submission of the PDD to the DoE for validation (ex ante option)*

For this approach (simple OM) to calculate the operating margin, the subscript m refers to the power plants/units delivering electricity to the grid, not including

Step 5: Calculate the build margin (BM) emission factor

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: *for the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of PDD submission to the DoE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DoE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period;*

Option 2: *for the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.*

For the proposed project activity, the project participants choose ***Option 1*** *in terms of availability of vintage of data.*

The sample group of power units m used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

a) Identify the set of five power units, excluding power units registered as VER project activities, that started to supply electricity to the grid most recently ($SET_{5\ units}$) and determine their annual electricity generation ($AEG_{SET-5-units}$, in MWh);

The commissioning dates and energy generation data of the recent plants excluding power units registered VER project activities consistent with the data vintage selected above (2017-2019) and their installed capacities are available in the database provided by the Directorate General of Energy Affairs of the Ministry for Energy and Natural Resources[28]. The Table below provides details in comply within reference documents.

Name of the Plant	***Type of Fuel***	***Commissioning Date***	***Estimated Generation (GWh)***
Kirazlı RES	*WPP*	*31/12/2019*	*188[29]*
RA GÜNEŞ MARDİN	*SOLAR*	*28/12/2019*	*20[30]*
YAHŞELLİ RES	*WPP*	*27/12/2019*	*72.3[31]*

28 https://enerjiapi.enerji.gov.tr//Media/Dizin/EIGM/Raporlar/Enerji_Yatirimlari/2019%20Y%C4%B1l%C4%B1%20Enerji%20Yat%C4%B1r%C4%B1mlar%C4%B1.xlsx

29 https://www.enerjiatlasi.com/ruzgar/kirazli-res.html

30 http://www.enerji-dunyasi.com/yayin/902/global-yatirim-holding-ilk-ges-yatirimini-mardin-de-devreye-aliyor_25685.html#.YCDXSc8zY-R

31 https://www.enerjiatlasi.com/ruzgar/yahselli-res.html

OĞUL ENERJİ BİYOKÜTLE	*BIOMASS*	*27/12/2019*	*65.7*[32]
GÜLPINAR RES	*WPP*	*19/12/2019*	*87.5*[33]
Total			***433,5***

b) Determine the annual electricity generation of the project electricity system, excluding power units registered as VER project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as VER project activities, that started to supply electricity to the grid most recently and that comprise 20 per cent of AEG_{total} (if 20 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\ per\ cent}$) and determine their annual electricity generation ($AEG_{SET-\geq 20\ per\ cent}$, in MWh);

For determination of plants that comprise 20% of the system's generation, net generation in year 2019 which is calculated data provided by TEİAŞ in reference documents as 303,897.5 GWh[34] has been taken into account and its 20% has been determined as about 60,779.5 GWh. Since 20% of the most recent year's generation does not fall partly on capacity of a plant, total capacity included in BM calculation is 60,779.5 GWh.

[32] http://eced.csb.gov.tr/ced/jsp/dosya/dosyaGoster.htm?tempAd=sign2693717040944515354.pdf&orjinalAd=PTD3.pdf&yuklemeTarihi=2017-12-18

[33] https://www.enerjiatlasi.com/ruzgar/gulpinar-res.html

[34] https://webapi.teias.gov.tr/file/88482c14-52fc-4d9f-ad9b-18f77c90a0c7?download

c) From $SET_{5\ units}$ and $SET_{\geq 20\ per\ cent}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In this case ignore Steps (d), (e) and (f).

$SET_{\geq 20\ per\ cent}$ is selected as (SET_{sample}) due mainly to the set of power units that comprises the larger annual electricity generation. There are no power units in SET_{sample} that started to supply electricity to the grid more than 10 years ago. Therefore, the steps (d), (e) and (f) shall be ignored.

Accordingly, without the need of any further assessment it can be concluded that the $SET_{5-units} \ll SET_{>20\%}$ and therefore the $SET_{>20\%}$ is selected as SET_{sample}[35] for the calculation of the build margin (BM).

The build margin emissions factor is the generation-weighted average factor (t CO_2/MWh) of all power units m during the most recent year y for which electricity generation data is available[36], calculated as follows:

Equation (7)

$$\boldsymbol{EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}}$$

[35] None of the power units in SET_{sample} started to supply electricity to the grid earlier than 10 years ago.

[36] The most recent year for which power generation data available is for 2018.

Where:

$EF_{grid,BM,y}$	*= Build margin CO_2 emission factor in year y (t CO_2/MWh)*
$EG_{m,y}$	*= Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)*
$EF_{EL,m,y}$	*= CO_2 emission factor of power unit m in year y (t CO_2/MWh)*
m	*= Power units included in the build margin*
y	*= Most recent historical year for which electricity generation data is available*

As per the applicable "Tool to calculate the emission factor for an electricity system", version 07.0, the CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) should be determined as per the guidance in Step 4 for the simple OM, using Options A1, A2 or A3, using for y the most recent historical year for which electricity generation data is available, and using for m the power units included in the build margin.

Since plant-specific fuel consumption data is not available for Turkey, Option A2 has been selected for the calculation of the CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) as follows:

Equation (8)

$$\boldsymbol{EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}}}$$

Where:

$EF_{EL,m,y}$ = *CO_2 emission factor of power unit m in year y (t CO_2/MWh)*

$EF_{CO2,m,i,y}$ = *Average CO_2 emission factor of fuel type I used in power unit m in year y (t CO_2/GJ)*

$\eta_{m,y}$ = *Average net energy conversion efficiency of power unit m in year y (ratio)*

m = *All power units serving the grid in year y except low-cost/must-run power units*

y = *The most recent year for which power generation data is available at the time of submission of the PDD to the DoE for validation (ex ante option)*

3.6 = *Conversion factor (GJ/MWh)*

Step 6: Calculate the combined margin emissions factor

According to the applicable "Tool to calculate the emission factor for an electricity system", version 07.0, the calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

a) Weighted average CM; or

b) Simplified CM.

In line with the requirements of the applicable "Tool to calculate the emission factor for an electricity system", version 07.0, the option (a), weighted average CM, is chosen by the project participant.

The combined margin emissions factor is calculated as follows:

Equation (9)

$$\boldsymbol{EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}}$$

Where:

$EF_{grid,BM,y}$	*= Build margin CO_2 emission factor in year y (t CO_2/MWh)*
$EF_{grid,OM,y}$	*= Operating margin CO_2 emission factor in year y (t CO_2/MWh)*
$EF_{grid,CM,y}$	*= Combined margin CO_2 emission factor in year y (t CO_2/MWh)*
w_{OM}	*= Weighted of operating margin emissions factor (per cent)*
w_{BM}	*= Weighted of build margin emissions factor (per cent)*

As per the applicable "Tool to calculate the emission factor for an electricity system", version 07.0, the default weights for the operating margin and build margin emission factors for the proposed project activity is defined as:

$w_{OM} = 0.50$

$w_{BM} = 0.50$

for the first crediting period. And, $w_{OM} = 0.25$ *and* $w_{BM} = 0.75$ *for the second and third crediting period.*

4.2 Project Emissions

Calculation of Project Emissions as per AMS-III.D.

In accordance with AMS-III.D., version 21.0., Project activity emissions consist of:

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

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

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

(d) CO_2 emissions from incremental transportation distances;

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

Accordingly,

Equation (10)

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

Where:

PE_y	= Project emissions (tCO_2e)
$PE_{PL,y}$	= Emissions due to physical leakage of biogas in year y (tCO_2e)
$PE_{flare,y}$	= Emissions from flaring or combustion of biogas stream in the year y (tCO_2e)
$PE_{power,y}$	= Emissions from use of fossil fuel or electricity for the operation of the installed facilities in the year y (tCO_2e)
$PE_{transp,y}$	= Emissions from incremental transportation in the year y (tCO_2e), as per relevant paragraph in AMS-III.AO
$PE_{storage,y}$	= Emissions from the storage of manure (tCO_2e)

As per the paragraph 21(a/i) of AMS-III.D., version 21.0., project emissions due to physical leakage of biogas from the animal manure management systems used to produce, collect and transport the biogas to the point of flaring or gainful use are determined as:

Equation (11)

$$PE_{PL,y} = 0.10 \times GWP_{CH_4} \times \rho_{CH_4,n} \times \sum_{i,LT} B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{i,y}$$

Where:

$MS\%_{i,y}$	= Fraction of manure handled in system I in year y. (If the project activity involves sequential manure management systems, the procedure specified in paragraph 18(e) shall be used to estimate the project emissions due to physical leakage of biogas in each stage)

As per the paragraph 23 of AMS-III.D., version 21.0., project emissions from electricity and fossil fuel consumption are determined by following the methodological tool "Project and leakage emissions from anaerobic digesters", version 02.0., where $PE_{power,y}$ is the sum of $PE_{EC,y}$ and $PE_{FC,y}$ in the tool.

The paragraph 19 of the methodological tool "Project and leakage emissions from anaerobic digesters", version 02.0., determines project emissions from electricity consumption. It is there stated that this step is applicable if the anaerobic digester consumes electricity, such as for mixing, recirculation of digestate, or processing of feed material. If the electricity consumed is generated on-site using biomass residues, wind, hydro or geothermal power, then $PE_{EC,y}$ = 0.

In accordance with the technical feasibility report of the proposed project activity, a small portion of the electricity consumed as auxiliary shall be used from on-site electricity generation. This portion will be monitored accordingly and $PE_{EC,y}$ will be accounted as zero.

Nevertheless, the rest of the electricity consumed at the plant will be supplied by the Turkish national grid. Hence, as per the paragraph 19 of the methodological tool "Project and leakage emissions from anaerobic digesters", version 02.0., the project participants chose Option 1: Procedure using monitored data in the paragraph 20 of the tool which states that $PE_{\mathrm{EC,y}}$ shall be calculated using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", where the project emission source j referred to in the tool is the total electricity consumption associated with the anaerobic digestion facility.

It is, however, noted that "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" became inactive in 2015 and is recently replaced with the "Methodological tool – Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation", version 03.0. In accordance with the Tool, in the generic approach, project emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

Equation (12)

$$\boldsymbol{PE_{EC,y} = \sum_{j} EC_{PJ,j,y} \times EF_{EF,j,y} \times \left(1 + TDL_{j,y}\right)}$$

Where:

$PE_{EC,y}$ = Project emissions from electricity consumption in year y (t CO_2 / yr)

$EC_{PJ,j,y}$ = Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)

$EF_{EF,j,y}$ = Emission factor for electricity generation for source j in year y (t CO_2/MWh)

$TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source j in year y

j = Sources of electricity consumption in the project

As per the paragraph 22 of the methodological tool "Project and leakage emissions from anaerobic digesters", version 02.0., which determines project emissions from fossil fuel consumption ($PE_{FC,y}$), states that where the anaerobic digester facility uses fossil fuels, project participants shall calculate $PE_{EC,y}$ using the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion". However, since in the proposed project activity the anaerobic digester facility does not use fossil fuels, $PE_{FC,y}$ will be accounted as zero.

In accordance with the paragraph 22 of AMS-III.D., version 21.0., in the case of flaring of the recovered biogas, project emissions are estimated using the procedures described in the methodological tool "Project emissions from flaring", version 03.0. If the recovered biogas is combusted for electrical/thermal energy production or for other gainful use, the methane destruction efficiency can be considered as 100%. However, this use of the recovered biogas shall be included in the project boundary and its output shall be monitored in order to ensure that the recovered biogas is actually destroyed, even if the emission reductions from this component are not claimed.

In the proposed project activity, an enclosed flare will be installed. The flare is installed for the case of emergency and malfunction in the plant. Thus, $PE_{flare,y}$ is considered as zero. Nevertheless, the monitoring plan of the facility shall measure the quantity of captured methane fed to the flare. If such measurement is positive, the emissions from flaring the biogas shall be determined following the procedure described in the methodological tool project emissions from flaring, version 03.0.

As per the paragraph 24 of AMS-III.D., version 21.0., project emissions on account of storage of manure before being fed into the anaerobic digester shall be accounted for if both condition (a) and condition (b) below are satisfied:

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

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

Since the storage time of the manure after removal from the animal barns, including transportation, exceeds 24 hours before being fed into the anaerobic digester in the proposed project activity, $PE_{storage,\ y}$ shall be accounted as zero.

In accordance with AMS-III.D., version 21.0., $PE_{transp,y}$ is calculated as per the paragraph 14 of AMS-III.AO, version 01.0., which states project emissions due to incremental transport distances ($PE_{transp,y}$) are calculated based on the incremental distances between:

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

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

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

Equation (13)

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

Where:

Q_y	= Quantity of raw waste/manure treated and/or wastewater co-digested in the year y (tonnes)
CT_y	= Average truck capacity for transportation (tonnes/truck)
DAF_w	= Average incremental distance for raw solid waste/manure and/or wastewater transportation (km/truck)
$EF_{CO2,transport}$	= CO_2 emission factor from fuel use due to transportation ($kgCO_2/km$, IPCC default values or local values may be used)
$Q_{res.waste,y}$	= Quantity of residual waste produced in year y (tonnes)
$CT_{res.waste,y}$	= Average truck capacity for residual waste transportation (tonnes/truck)
$DAF_{res.waste}$	= Average distance for residual waste transportation (km/truck)

Calculation of Project Emissions as per AMS-I.D.

As per the paragraph 39 of AMS-I.D., version 18.0., for most renewable energy project activities, $PE_y = 0$. However, for the following categories of project activities, project emissions have to be considered following the procedure described in the most recent version of "ACM0002: Grid-connected electricity generation from renewable sources":

(a) Emissions related to the operation of geothermal power plants (e.g. non-condensable gases, electricity/fossil fuel consumption);

(b) Emissions from water reservoirs of hydro power plants.

As per the paragraph 40 of AMS-I.D., CO_2 emissions from on-site consumption of fossil fuels due to the project activity shall be calculated using the latest version of the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion". Also, the paragraph 41 of AMS-I.D. states that in case biomass is sourced from dedicated plantations, the procedures in the tool "Project emissions from cultivation of biomass" shall be used.

Since none of the exception stated in the relevant paragraphs of AMS-I.D. mentioned above is applicable to the proposed project activity, PE_y as per AMS-I.D., version 18.0., shall be accounted as zero.

4.3 Leakage

Calculation of Leakage Emissions as per AMS-III.D.

As per the paragraph 26 of AMS-III.D., version 21.0., it is determined by following the relevant procedure in the methodological tool "Project and leakage emissions from anaerobic digesters", version 02.0.

The footnote 1 of the methodological tool "Project and leakage emissions from anaerobic digesters", version 02.0., states that if the storage of digestate or the composting of digestate is occurring within the project boundary, these emissions will be considered as project emissions. Hence, since both the storage of digestate is occurring within the project boundary and no composting is applied to the proposed project activity, LE_y shall be accounted as zero.

Calculation of Leakage Emissions as per AMS-I.D.

As per the paragraph 39 of AMS-I.D., version 18.0., general guidance on leakage in biomass project activities shall be followed to quantify leakages pertaining to the use of biomass residues.

Since the methodological tool "Project and leakage emissions from biomass", version 04.0, is regarding the use of biomass residues which is not applicable to the proposed project activity, LE_y as per AMS-I.D., version 18.0., shall be accounted as zero.

4.4 Net GHG Emission Reductions and Removals

To Be Calculated (TBC)

Describe the procedure for quantification of net GHG emission reductions and removals. Include all relevant equations. For AFOLU projects, include equations for the quantification of net change in carbon stocks.

Provide the ex-ante calculation (estimate) of baseline emissions/removals, project emissions/removals, leakage emissions and net GHG emission reductions and removals in the table below.

For data and parameters monitored, use estimates. Document how each equation is applied, in a manner that enables the reader to reproduce the calculation. Provide example calculations for all key equations, to allow the reader to reproduce the calculation of estimated net GHG emission reductions or removals.

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
Year A				
Year B				
Year C				
Year…				
Total				

5 MONITORING

5.1 Data and Parameters Available at Validation

To Be Completed (TBC)

Complete the table below for all data and parameters that are determined or available at validation, and remain fixed throughout the project crediting period (copy the table as necessary for each data/parameter). Data and parameters monitored during the operation of the project are included in Section 5.2 (Data and Parameters Monitored) below.

Data / Parameter	
Data unit	*Indicate the unit of measure*
Description	*Provide a brief description of the data/parameter*
Source of data	*Indicate the source(s) of data*
Value applied	*Provide the value applied*
Justification of choice of data or description of measurement methods and procedures applied	*Justify the choice of data source, providing references where applicable. Where values are based on measurement, include a description of the measurement methods and procedures applied (e.g., what standards or protocols have been followed), indicate the responsible person/entity that undertook the measurement, the date of the measurement and the measurement results. More detailed information may be provided in an appendix.*
Purpose of Data	*Indicate one of the following:* • *Determination of baseline scenario (AFOLU projects only)* • *Calculation of baseline emissions* • *Calculation of project emissions* • *Calculation of leakage*
Comments	*Provide any additional comments*

5.2 Data and Parameters Monitored

To Be Completed (TBC)

Complete the table below for all data and parameters that will be monitored during the project crediting period (copy the table as necessary for each data/parameter). Data and parameters determined or available at validation are included in Section 5.1 (Data and Parameters Available at Validation) above.

Data / Parameter	
Data unit	*Indicate the unit of measure*
Description	*Provide a brief description of the data/parameter*
Source of data	*Indicate the source(s) of data*
Description of measurement methods and procedures to be applied	*Specify the measurement methods and procedures, any standards or protocols to be followed, and the person/entity responsible for the measurement. Include any relevant information regarding the accuracy of the measurements (e.g., accuracy associated with meter equipment or laboratory tests).*
Frequency of monitoring/recording	*Specify measurement and recording frequency*
Value applied	*Provide an estimated value for the data/parameter*
Monitoring equipment	*Identify equipment used to monitor the data/parameter including type, accuracy class, and serial number of equipment, as appropriate.*
QA/QC procedures to be applied	*Describe the quality assurance and quality control (QA/QC) procedures to be applied, including the calibration procedures where applicable.*
Purpose of data	*Indicate one of the following:* • *Calculation of baseline emissions* • *Calculation of project emissions* • *Calculation of leakage*
Calculation method	*Where relevant, provide the calculation method, including any equations, used to establish the data/parameter.*
Comments	*Provide any additional comments*

5.3 Monitoring Plan

TBR

Describe the process and schedule for obtaining, recording, compiling and analyzing the monitored data and parameters set out in Section 5.2 (Data and Parameters Monitored) above. Include details on the following:

- The methods for measuring, recording, storing, aggregating, collating and reporting data and parameters. Where relevant, include the procedures for calibrating monitoring equipment.
- The organizational structure, responsibilities and competencies of the personnel that will be carrying out monitoring activities.
- The policies for oversight and accountability of monitoring activities.
- The procedures for internal auditing and QA/QC.
- The procedures for handling non-conformances with the validated monitoring plan.
- Any sampling approaches used, including target precision levels, sample sizes, sample site locations, stratification, frequency of measurement and QA/QC procedures.

Where appropriate, include line diagrams to display the GHG data collection and management system.

APPENDIX

Use appendices for supporting information. Delete this appendix (title and instructions) where no appendix is required.